WORLD TRADE ORGANIZATION

World Trade Report 2010

Trade in natural resources

What is the World Trade Report?

The World Trade Report is an annual publication that aims to deepen understanding about trends in trade, trade policy issues and the multilateral trading system.

Using this report

The 2010 World Trade Report is split into two main parts. The first is a brief summary of the trade situation in 2009-2010. The second part focuses on the special theme of natural resources.

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Website: www.wto.org
General enquiries:
enquiries@wto.org
Tel: +41 (0)22 739 51 11

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Acknowledgements

The *World Trade Report 2010* was prepared under the general direction of the Deputy Director-General Alejandro Jara and supervised by Patrick Low, Director of the Economic Research and Statistics Division. The principal authors of the Report were Marc Bacchetta, Cosimo Beverelli, John Hancock, Alexander Keck, Gaurav Nayyar, Coleman Nee, Roberta Piermartini, Nadia Rocha, Michele Ruta, Robert Teh and Alan Yanovich. Other written contributions were provided by Marc Auboin, Mireille Cossy and James Windon. Trade statistics information was provided by the Statistics Group of the Economic Research and Statistics Division, coordinated by Hubert Escaith, Julia de Verteuil, Andreas Maurer and Jurgen Richtering.

Aishah Colautti assisted in the preparation of the graphical input and Paulette Planchette, assisted by Véronique Bernard, prepared the Bibliography. Research assistance was provided by Tushi Baul, Edoardo Campanella, Sandra Hanslin, Joelle Latina, Shrey Metha, Heiner Mikosch, Silvia Palombi and Xue Wen. Other Divisions in the WTO Secretariat provided valuable comments on drafts at various stages of preparation. The authors are particularly grateful to several individuals in the Agriculture and Commodities Division, the Appellate Body Secretariat, the Institute for Training and Technical Cooperation, the Legal Affairs Division, the Market Access Division, the Rules Division, Trade and Environment Division, the Trade in Services Division and Trade Policies Review Division.

The following individuals from outside the WTO Secretariat also made useful comments on earler drafts: Frank Asche, Ken Ash, Morvarid Bagherzadeh, Paul Collier, Graham Davis, K. Michael Finger, David Hartridge, Luis Diego Herrera, Arjen Hoekstra, Lutz Killian, Jeonghoi Kim, Jorge Miranda, Hildegunn Kyvik Nordås, Cédric Pène, Juan Robalino, Raed Safadi, Carl Christian Schmidt, Yulia Selivanova, Martin Smith, Robert Staiger, Scott Taylor, Frank Van Tongeren and Anthony Venables.

The production of the Report was managed by Paulette Planchette of the Economic Research and Statistics Division in close cooperation with Anthony Martin, Serge Marin-Pache, Heather Sapey-Pertin and Helen Swain of the Information and External Relations Division. The translators in the Languages, Documentation and Information Management Division worked hard to meet tight deadlines.

This year the WTO Secretariat launched a Webpage discussion on the topic of the World Trade Report 2010. The Webpage was managed by Michele Ruta, assisted by Edoardo Campanella and Joelle Latina, in collaboration with Anthony Martin. Around ninety individuals from academia, institutions, non-governmental organizations and the private sector contributed to this Webpage with stimulating and helpful articles and commentaries.

Disclaimer

Foreword by the WTO Director-General

The 2010 *World Trade Report* examines trade in natural resources. This is a topic of growing importance in international trade relations. Natural resources are at the root of much economic activity, they are a key component of many economies, and their share in world trade is growing. A number of features exclusive to natural resources explain why they occupy a special place in economic, political economy and policy analysis.

Natural resources tend to be concentrated in relatively few locations around the world. This makes for profitable trading opportunities among nations. At the same time, because natural resources are so crucial to many economic activities, adequate access to them is regarded as a vital national interest everywhere. Those who possess natural resources may not always wish to trade them, but rather to harness them domestically as a basis for economic development and diversification. When the underlying conditions of supply or demand for natural resources change – which has been the case in recent years for many resource products and is likely to continue to be so – competing national interests can become a source of political tension.

Another important feature of natural resources is that they are either finite in nature – like fossil fuels – or exhaustible. If they are renewable but exhaustible – like fish and forests – they can effectively be rendered finite by over-exploitation. In the case of both finite and renewable resources, current policies are inextricably linked with the prospects of future generations. The rate at which natural resources are extracted or exploited is crucial. This reality adds to the complexity of policy analysis and strengthens the need for international cooperation.

The production and consumption of natural resources also frequently create situations in which market prices do not reflect the full costs or benefits of economic activity. This generates what economists refer to as an externality, a market failure that can only be addressed by policy intervention. Such intervention could in some cases also entail institutional innovation. A feature of some natural resources is open access, which means that property rights are ill-defined. One person's harvest of such a resource affects the harvesting prospects of everyone else, and it is not difficult to see how a resource can be exhausted by the pursuit of individual self-interest in the face of a deficient market and a lack of regulation. This is a classic externality. Most externalities associated with natural resources tend to be negative, such as the environmental damage caused by burning fossil fuels. These effects often occur across borders, and cannot be addressed effectively without joint action among nations.

Natural resources sometimes dominate entire economies, posing particular policy challenges. This is more likely to be the case for smaller developing countries. The kinds of policies that the government of a nation in these conditions pursues make the difference between suffering from a so-called resource curse and building successfully for development.

We have seen over the years how natural resource prices can be much more volatile than the prices of other goods. Volatility carries economic costs because it generates uncertainty. It makes planning difficult and means that incomes fluctuate, hurting individuals, enterprises and countries. Some things can be done to counteract price volatility and there are also ways that affected parties can insulate themselves from the effects of volatility. But uncooperative government responses to price hikes often exacerbate rather than reduce volatility.

The characteristics of natural resource markets can make standard trade policy prescriptions problematic. While it is clearly true that trade in natural resource products can often yield benefits to all concerned, blind reliance on standard prescriptions for greater trade openness can be hazardous. Where markets fail and nothing is done to rectify the failures, more trade can strengthen the adverse effects of poorly functioning markets. Increased trade in an open access situation can exacerbate the problem of over-exploitation. Habitats can be destroyed if resource management is poor and trade accelerates changes in land use. Countries in which natural resources dominate the economy run greater risks of suffering from the resource curse if trade merely intensifies resource dependency.

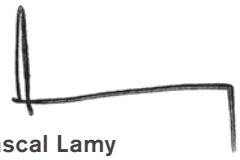
Most of these arguments are not about the desirability of trade. Rather, they are about the need to ensure that trade is accompanied by domestic policies and global rules that address the particularities of natural resource markets. Moreover, opening to trade can have specific beneficial effects in natural resource markets. Trade can support technological developments that improve resource management. It can provide opportunities for resource-dependent economies to diversify and develop new industries. By joining up markets, trade can provide a bulwark against volatility.

If the relationship between trade and natural resources is by nature complicated, it is hardly surprising that these complexities spill over into trade policy. The report devotes considerable space to an economic analysis of different policies affecting trade, how these policies relate to each other and affect economic welfare. While the use of tariffs is less prevalent in natural resource sectors than in other goods markets, domestic policies affecting production and consumption can have effects very similar to trade policies where a natural resource is predominantly exported or imported. Policies affecting exports are more common in natural resource sectors than elsewhere. Subsidies are also quite common.

Among the range of policies affecting natural resources trade, subsidies and export policies appear to be the most challenging. Subsidies can be useful instruments for addressing market failures and changing incentive structures in ways that favour superior outcomes. But they can also make matters worse. Everything depends on what subsidies governments are deploying, and whether they are responding to public welfare concerns or pressures from narrow interest groups. Governments may use export taxes and restrictions for a variety of reasons, including economic diversification and domestic price stabilization, to counter escalating tariffs in importing countries and to manage environmental externalities. But at the same time, export taxes and restrictions may also raise world prices and shift economic "rents" arising from scarcity. Beggar-thy-neighbour policies of this nature reduce economic welfare, increase trade tensions and can provoke retaliation.

As discussed in the report, the GATT/WTO rules were not written with natural resource markets as the primary focus. Many of the rules impinge on natural resources trade but some of them are open to competing interpretations as well as disputes from time to time, and they do not cover all aspects of the policy realities surrounding natural resources trade. Moreover, many other inter-governmental agreements besides the WTO contain rules relevant to natural resources trade, and this mixture is not always entirely coherent.

The report attempts to clarify, elucidate and contribute to a debate which in effect is already taking place in various guises, including through negotiating proposals in the Doha Round. I believe not only that there is room for mutually beneficial negotiating trade-offs that encompass natural resources trade, but also that a failure to address these issues could be a recipe for growing tension in international trade relations. Well-designed trade rules are key to ensuring that trade is advantageous, but they are also necessary for the attainment of objectives such as environmental protection and the proper management of natural resources in a domestic setting. My final point, which will come as a surprise to no-one, is that we would greatly enhance our chances of positive action in this area if we were to come to a prompt closure of the Doha Round.



Pascal Lamy
Director-General

Executive summary

Section A: Introduction

Natural resources represent a significant and growing share of world trade, and properly managed, can provide a variety of products that contribute greatly to the quality of human life. They also present particular challenges for policy makers.

The extraction and use of natural resources must balance the competing needs of current and future generations. The manner in which they are managed has important environmental and sustainability implications. The unequal distribution of natural resources across countries and frequent volatility in their prices are potential sources of international tension. Moreover, as world output growth resumes following the financial crisis and global recession, natural resource prices will almost certainly rise again.

A number of characteristics peculiar to natural resources influence the manner in which they are traded and the nature of the rules applied to this trade. Differing international and inter-generational interests inherent in natural resources trade make transparent, predictable, well-designed and equitable trade rules particularly valuable. Inadequate or contested rules risk stoking the fires of natural resource nationalism, where differences in power across countries and beggar-thy-neighbour motivations dominate trade policy. In a world where scarce natural resource endowments must be nurtured and managed with care, uncooperative trade policies could have a particularly damaging effect on global welfare.

The report examines these issues with particular reference to resources that are traded between countries, such as fish, forestry, fuels and mining products. Agricultural products are not included in the analysis as they are cultivated rather than extracted from the natural environment. Other non-traded resources are only briefly discussed. For instance, the report considers water, not as a traded product in itself, but rather in terms of the water content of other commodities. Natural resources such as air or biodiversity are only examined to the extent that they are affected by trade.

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Section B: Natural resources: Definitions, trade patterns and globalization

Definitions and key features of natural resources

Natural resources are "stocks of materials that exist in the natural environment that are both scarce and economically useful in production or consumption, either in their raw state or after a minimal amount of processing". Most natural resources share a number of important characteristics, including uneven distribution across countries, exhaustibility, externalities (market failures in the form of unpriced effects resulting from consumption and/or production), dominance in output and trade, and price volatility.

Uneven distribution

Supplies of some of the world's most vital natural resources are controlled by a small number of countries, which may be able to exercise power over markets as a result. Trade frictions may follow, although trade has the potential to improve efficiency and increase welfare by shifting resources from regions of relative abundance to regions of relative scarcity.

Exhaustibility

Resources are either non-renewable (e.g. fossil fuels and metallic ores) or renewable (e.g. fish, forests and water) but even renewable resources can be exhausted if they are mismanaged. This is what makes resource management so important. In some instances, trade may contribute to the exhaustion of resources by accelerating their depletion.

Externalities

The production, trade and consumption of natural resources can have negative impacts on people not involved in the markets in which the relevant economic decisions are made. Trade may exacerbate or ameliorate these externalities either by increasing the rate of consumption or by promoting more efficient use of resources.

Dominance in national economies

Resource extraction industries are sometimes responsible for an outsized share of a country's trade and/or GDP. This is especially true for fuels, and to a lesser extent for ores and other minerals. Exports from resource-rich countries tend to be highly concentrated in few products and trade can encourage over-specialization in resource extraction. Trade can also facilitate diversification by providing access to foreign markets.

Volatility

Certain natural resources, particularly fuels and mining products, can be subject to extreme price volatility. This is a source of uncertainty that adversely affects investment and production decisions. Trade can contribute to a reduction of volatility by ensuring access to diverse resource supplies.

Natural resource trade flows and related indicators

The share of natural resources in world trade has risen sharply in recent years, partly reversing the trend since World War II towards increasing trade in manufactured goods, but the picture varies by region.

The recent rise is mostly due to rising commodity prices, particularly for oil. Fuels account for more than three-quarters of natural resources trade.

Africa, the Middle East and the Commonwealth of Independent States (CIS) all had resource shares in total exports in excess of 70 per cent in 2008, while North America, Europe and Asia all had resource shares of 20 per cent or less. South and Central America was in between, at 47 per cent.

Less industrialized regions have very little intra-regional trade in natural resources, whereas more industrialized regions tend to trade resources within their own regions.

Shares of intra-regional trade in natural resource exports of the more industrialized WTO regions in 2008 were as follows: 82 per cent for Europe, 78 per cent for Asia and 62 per cent for North America. Meanwhile, resource-dominant regions of the CIS, Africa and Middle East had very low intra-regional trade shares of 12 per cent, 5 per cent and 2 per cent, respectively. Latin America was again between the extremes with an intra-regional trade share of 22 per cent.

Modes of natural resources trade

Natural resources trade differs from trade in manufactured goods in some notable respects. Being more or less homogeneous in nature, natural resources are amenable to centralized trading that facilitates exchange transactions and entails the formation of a unified price.

The emergence of organized exchanges has greatly reduced transaction costs for trade in natural resources. Although a large share of commodity trading still occurs in the developed world, some developing-country exchanges have become market leaders for certain commodity contracts.

Centralized exchanges facilitate "price discovery" – or the determination of market prices – and, by encouraging competition, these exchanges tend to lower prices to consumers. Commodity exchanges also increase liquidity and allow disruptions in supply from one producer to be compensated by alternative supplies from elsewhere. They also allow for hedging against unfavourable price movements and act as financial intermediaries as well as clearing houses, thus managing the risk associated with exchange transactions and ensuring the integrity of the marketplace.

Specific modes of trade, such as long-term intergovernmental contracts and vertical integration, have also developed in response to particular characteristics of natural resources, notably their unequal geographical distribution.

Until the early 1970s, trade in a range of commodities was conducted primarily through long-term contracts between producer and consumer countries, mostly via state or multinational companies. These arrangements responded to a number of factors, including strategic considerations, non-competitive production structures, high sunk-cost investments and security of supply. Over time, these bilateral long-term supply contracts have been complemented and even replaced by trading on organized exchanges. However, bilateral supply contracts between governments of resource-abundant countries and private investors or firms from abroad still exist.

For many energy and mining commodities, rather than arm's-length contracts, the vertical integration of various stages of the production process within one company is often the preferred mode of trade in increasingly important global production chains. This may be attributable to fluctuations in profits at different stages of the supply chain, uncertainty in access to resources, high sunk costs associated with location or site-specific investments, and consumer demands for quality and safety.

Natural resources: Globalization and the intellectual debate

The globalization of natural resources trade has been driven by a number of factors, including population growth, spreading industrialization, and the rise of developing economies. However, two trends are particularly significant – the revolution in transport technology since the mid-19th century and the gradual opening of commodity markets since the 1980s.

Technological advances in transport and information technology have dramatically changed the economics of moving low-value goods cheaply across great distances. Natural resource transport costs fell over 90 per cent between 1870 and 2000. This, in turn, has greatly expanded the volume of raw materials traded, the distances covered, and the commodities involved.

The period after the 1980s saw a steady (though not universal) shift towards an opening of global commodity markets. Tariff barriers have gradually been reduced in successive rounds of multilateral trade negotiations.

A wide-ranging intellectual debate continues about the impact of economic growth on the earth's limited natural resources.

Some have argued that continued economic and/or population growth will inevitably lead to the exhaustion of natural resources and the degradation of the environment.

Others believe that economic growth and technological progress can help to manage scarce resources and to develop alternatives.

One point of disagreement is whether markets, as presently structured, are equipped to deal with these pressures. Concerns about the viability of markets relate to spillovers or externalities that need to be managed by government policy. Climate change and other signs of environmental degradation have been pointed to as evidence of the limitations of existing markets in addressing resource depletion and environmental costs.

Views have differed over the years as to whether natural resources are a "blessing" or a "curse" for economic development. Many economists have seen natural resource endowments as key to countries' comparative advantage and critical to economic growth, while others have argued that dependency on natural resource exports can trap countries in a state of under-development.

While signs of declining prices and growing resource abundance were a cause for optimism among some economists, others drew a link between falling commodity prices on world markets and declining terms of trade (falling export prices relative to import prices) for developing countries, leading to stagnant incomes and arrested development.

In order to break free, developing countries were urged to diversify their economies and develop their manufacturing industry – including through the use of selective protection and import substitution. Excessive reliance on import substitution in some countries gave way to an emphasis on export-led growth, and also to the belief that open markets were the surest guarantor of growth and development.

The debate has matured in recent years, recognizing the multi-faceted and inherent complexity of the development process. This perspective acknowledges both the advantages of market openness and the responsibility of governments in fostering development.

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Section C: Trade theory and natural resources

Trade and resource distribution

Uneven geographical distribution of resource endowments across countries plays an important part in explaining the gains from natural resources trade.

In standard trade models built on the theory of comparative advantage, endowments of immobile and scarce natural resources may constitute a source of gains from trade. Trade fosters a more efficient allocation of resources, leading to an increase in global social welfare. These "static" effects need to be evaluated against the dynamic effects that trade has on the exhaustibility of natural resources.

Recent empirical literature finds support for traditional theory. However, it also suggests that only when other determinants of comparative advantage – such as infrastructure, schooling and institutional quality – are in place does the resource-abundant country reap the full benefits of exchanging its resources with countries that have relatively high endowments of capital and skilled labour, and import capital-intensive goods in return.

Trade theory and resource exhaustibility: The challenge of finite supplies

Trade in finite resources has both "static" and "dynamic" effects on social welfare. While traditional theories predict that the static effects are positive, the dynamic implications of trade are more difficult to study.

A key feature of finite resources is that current use alters consumption possibilities of future generations. This poses a problem for the efficient management of natural resources over time.

Several studies have concluded that in a world of finite resources, the predictions of the traditional theory are generally preserved under the assumption that there are no market and government failures. While this is a useful theoretical finding, it is important to bear in mind that failures such as imperfect competition, environmental effects unpriced in markets (externalities) and poor governance are pervasive in natural resource sectors.

Imperfections in some natural resource markets raise questions about the efficiency of extraction and optimal extraction rates. Imperfect competition may affect trade patterns, although the impact of trade on resource management in these circumstances remains largely unexplored in the economic literature.

Natural resource markets are often characterized by high concentration and monopoly power. On the supply side, uneven geographical distribution of natural resources, scarcity and high fixed costs of extraction limit market participation and favour the creation of cartels. On the demand side, high fixed costs of refining natural resources and high transport costs favour concentration of processing in few locations.

A finding of economic theory is that imperfectly competitive markets will lead to slower resource depletion than in the case of perfect markets. As far as trade is concerned, the notion that imperfect competition will deliver a more conservative extraction path than perfect competition continues to hold in a situation where all resources are controlled by a cartel and exported to the rest of the world. More generally, economists are less certain about the impact of trade on resource depletion under imperfect competition. This is because modelling imperfect competition in natural resource markets introduces analytical complexities, due to the fact that strategic interactions among agents have to be considered in an inter-temporal framework, making welfare analysis more difficult and results harder to generalise.

Trade patterns are likely to depart from comparative advantage if extraction is controlled by an international cartel. Imperfect competition *per se* may also be a determinant of trade. Monopolists in two markets may differentiate between domestic and foreign markets in terms of prices, thus generating two-way trade in the same type of goods – a phenomenon referred to as reciprocal dumping.

Technical change and capital accumulation can partially offset the exhaustibility of non-renewable resources. Trade can contribute to this process.

Current use of non-renewable natural resources will, by definition, reduce future consumption possibilities. However, economists point out that this simple fact does not necessarily imply that current growth rates cannot be sustained in the future.

The substitution of man-made factors of production (capital) for natural resources can offset the limitations imposed by natural resources. To the extent that it promotes the diffusion of technologies that offset the exhaustion of natural resources, international trade can help to support sustained growth.

Trade theory and resource exhaustibility: The problem of open access

Open access may reverse some of the predictions of standard trade theory.

Weakness in property rights means access to a natural resource, such as a lake stocked with fish cannot be controlled. The entry of too many fishermen, results in over-exploitation of the natural resource. Each fisherman reduces the productivity of all other fishermen. However, the individual fisherman does not take into account the negative effect of his entry on the productivity of other fishermen. In the end the result is too much effort expended to catch too few fish.

In standard trade theory, countries with identical tastes, endowments and technologies do not have any reason to trade. However, if a natural resource sector is characterized by open access, differences in the strength of each country's property rights regime can create the basis for trade despite countries being identical in all other respects. This means that the property rights regime can serve as a *de facto* basis of comparative advantage, which can also alter the pattern of trade. For instance, it is possible for the resource-scarce country to end up exporting the good to a more resource-abundant country if the former's property rights regime is sufficiently weak.

Open access may also undermine the gains from trade.

While the welfare of the resource-importing country rises with trade, it declines for the resource-exporting country. This is because free trade exacerbates the exploitation of the natural resource so that the stock is lower than in autarky. Since the size of the natural resource stock affects labour productivity, the lower stock means that the economy will be harvesting a smaller quantity of the natural resource under more open trade.

Trade pessimism may be overstated if demand for an open-access natural resource is high or if trade strengthens the property rights regime.

If the demand for a particular natural resource is high, a country with weak property rights can end up importing rather than exporting the natural resource. The combination of high demand for the resource and poorly defined property rights leads to rapid depletion of the stock even if the country does not trade at all.

The strength of the property rights regime depends on a variety of factors, including the ability of a government to monitor supplies and catch cheating, the nature of technologies for harvesting and for regulating, and the economic benefits from poaching the resource. An increase in the price of the natural resource brought about by trade affects each of these factors in different ways. It may lead to increased monitoring effort or higher penalties for poaching, both of which would strengthen the property rights regime. The possible effects of trade-induced technological change are ambiguous, depending on the nature of the change.

Environmental externalities and trade

The extraction and use of exhaustible resources in production and consumption activities can have negative effects on the environment.

Adverse environmental effects of resource extraction and use, such as carbon dioxide emissions, acidification of the sea or deforestation, may not be taken into

account by the market. The resulting negative externality leads to resource extraction in excess of the socially optimum rate.

In the case of polluting resources that are finite, such as fossil fuels, a general conclusion of the theoretical literature is that postponing resource extraction is optimal for the environment. The impact of trade on pollution externalities resulting from finite resource extraction is ambiguous.

Prices of non-renewable resources may be expected to rise over time as stocks are depleted. This will implicitly take care of part of the environmental damage generated by the extraction of such resources. In addition, the market may react to the increase in prices by developing alternative energy technologies to deal with the climate change problem. Where monopolistic power exists in the extraction industry, the resource will be extracted at a slower rate than it would be under more competitive market conditions.

In the presence of market failures such as different levels of information among actors in the market about the total amount of available resources and poorly defined property rights, trade may accelerate resource consumption beyond the social optimum and exacerbate the environmental externalities associated with the extraction and use of finite resources. By contrast, the impact of technological innovation induced by trade on environmental damage will be negative or positive depending on whether the technology reduces the costs of extraction or the emissions generated by the extraction and consumption activity. For resources such as coal, oil and natural gas, trade might help to mitigate some of the environmental externalities deriving from their use by facilitating substitution from more to less polluting energy sources.

The preservation of biodiversity is an important concern in the context of renewable resource use. In certain contexts opening to trade can have an adverse impact on biodiversity via the destruction of natural habitat. The effect of trade on species in the context of an open access problem depends on the biological relationship between species.

Habitat destruction, in forestland or grassland, for example, is a direct result of the expansion of economic activities, such as timber or grain production respectively. The welfare gains from trade would need to be discounted by this consideration to the extent that trade has contributed to such an outcome. If the species of each country are specific to that country, trade specialization will have a negative impact on global biodiversity. If, however, the same species live in all countries prior to opening up to trade, it is still possible that trade allows for an overall increase in biodiversity.

The impact of trade on various species of plants and animals depends on whether their relationship to other species is symbiotic – or positive. For example, in a world without trade where two species of fish are harvested, the problem of common access to a natural resource will be mitigated if the relationship between the species is positive (that is, if the stocks of the two species are mutually beneficial). The problem will be worsened if the relationship is negative. With trade between two countries, leading to specialization in the harvesting of one species, the result will be under-harvesting (or over-harvesting) if the relationship between the species is negative (or positive). As the number of countries exploiting and trading each species rises, whether there is over- or under-harvesting will not only depend on the type of biological externality across species. It will also be determined by a series of factors such as the total number of countries trading, the price effects and consumer preferences among countries.

The natural resource curse

The dominance of a natural resource in an economy may harm economic performance. This phenomenon is often referred to as the resource curse hypothesis. Transmission channels for the resource curse include the "Dutch disease", adverse effects on other determinants of growth, and civil conflict.

The Dutch disease occurs when an increase in revenues from natural resources de-industrializes a nation's economy by raising the real exchange rate, making the manufacturing sector less competitive. This type of de-industrialization can be direct or indirect. It is direct when production shifts from manufacturing to the natural resources sector, and indirect when additional spending caused by the increase in natural resource revenues results in a further appreciation of the real exchange rate. If the manufacturing sector has benefited from positive externalities through learning by doing or other factors, the contraction in manufacturing output induced by the Dutch disease is likely to reduce the growth rate of the economy, with permanent effects on income levels.

Resource dominance may have an indirect effect on economic growth through the institutional framework. It can either hamper growth in the presence of weak institutions, such as badly defined property rights, poorly functioning legal systems, and weak rule of law, or it can itself contribute to institutional worsening.

Primary commodities can help emerging rebel groups to fund their operations, so natural resources increase the probability of civil wars. In addition, resource extraction can create grievances among the local population on account of such factors as insufficiently compensated land expropriation or environmental degradation. Countries marked by an uneven distribution of natural resources within their territory and ethnic divisions are particularly prone to civil conflict. Evidence shows that "point-source" natural resources – that is, resources such as oil and minerals that naturally occur in dense concentrations – are more likely to engender the onset of civil conflict. The amount of commodities that can be looted and smuggled, like gemstones, tends to be correlated with the duration of civil conflict.

Trade may intensify or dilute natural resource dominance in an economy.

All else being equal, opening up to trade will increase the price of a natural resource and engender greater resource dominance. However, trade may also offer opportunities for diversification of the production base and therefore reduce dominance. The latter effect will depend largely on whether governments pursue relevant supporting policies for diversification.

Empirical literature on the natural resource curse has so far failed to reach unified conclusions.

Earlier literature identified a negative relation between growth and resource dependency, even after taking into account a large number of other possible determinants of slow growth, such as terms of trade changes, investment activity and institutional quality. Subsequent work pointed to institutional quality as a crucial determinant of whether natural resource abundance is a curse or a blessing, arguing that resource abundance indirectly affects economic growth through its adverse impact on institutions.

More recent empirical contributions have criticized the finding that natural resource abundance is a curse, arguing that natural resource dominance can have zero or even positive effects on growth if abundance is correctly measured, additional variables that correlate with resource abundance are taken into account, and depletion of the resource over the sample period is factored into the assessment.

Natural resources and price volatility

Historically, natural resources have been characterized by periods of high price volatility. In the most recent commodity boom and bust – one of the largest and most long-lasting in history, covering a broad range of commodities – the dramatic acceleration of price increases from 2006 onwards for certain commodities created the suspicion that prices were influenced by speculative activity.

The possible role of non-traditional investors, such as index funds, hedge funds and others not connected to the commodity business, in bringing about price volatility has been a matter of concern. The increasing market share of financial traders in the oil futures market between 2004 and 2008 (from 33 to 50 per cent), for instance, and the declining participation of traditional traders, such as oil producers, refiners and wholesalers (down to 15 per cent from 31 per cent), is seen by some as being indicative of "herding" effects that may have resulted in a speculative bubble.

However, it is doubtful that "speculators" have played a major role in explaining recent commodity price volatility. Speculative trading may raise prices in spot markets, where physical delivery of a product is immediately arranged, only if it induces participants to hold commodities outside the market and build up inventories. Inventory data on a range of commodities over the time period in question suggest that stocks have stayed flat or even declined, thus defying any notion of possible "hoarding".

Some evidence suggests that commodity investment by non-traditional traders has delayed or moderated price volatility, rather than initiating or adding to it. High price volatility has been present in certain commodity markets with little participation of non-traditional investors. As in previous cycles, it appears that a particular mix of fundamental economic factors is responsible for the observed large swings in commodity prices.

Market forces that appear to have contributed to price volatility include buoyant economic growth in emerging economies, limits to production capacity in the short run and the relative prices of resource substitutes.

Relative to the 1980s and 1990s, the period from 2002 to 2007 saw large annual increases in the global consumption of major commodities, in particular due to rapid economic growth, industrialization and urbanization in several emerging economies. In mid-2008, however, this trend changed with a contraction of world demand during the recession.

In the short run, there are limits to increasing supply capacity. Capacity constraints became apparent during the commodity price boom as a result of limited investments during the 1980s and 1990s, when prices were low. On the other hand, high commodity prices prior to the recent economic downturn are likely to have stimulated investment in production capacity, thereby alleviating supply-side constraints in the future.

Linkages across different commodity markets have also played a role in recent price fluctuations. For instance, higher oil prices affected other commodity prices, as in the case of substitution from oil to coal for power generation.

Volatility in the price of natural resources has long been considered a problem for countries that are heavily reliant on commodity exports.

One reason for this is that risk-averse consumers spend income on hedging against the risk of large swings in resource prices. Another is that when exporters borrow against high export earnings to fund additional imports and consumption, they may confront worrisome debt burdens when natural resource prices fall.

Empirical evidence confirms that volatility hampers economic growth. When countries suffer from the resource curse, this is aggravated by price volatility. Even in countries where resource abundance has a positive effect on growth, this effect can be overturned by the negative influence of volatility.

Volatility in the price of natural resources is also a concern for countries that are heavily reliant on

imports of these products. This has especially been the case for oil, due to its prominence as an input into production in virtually every sector.

Fluctuations in oil prices affect oil-importing economies through three channels – supply, demand and monetary policy. A rise in oil prices increases the production costs of goods that use oil as an intermediate input. Consumption and investment expenditures on goods and services decline in response to unanticipated energy price increases. Inflationary pressures from rising oil prices may lead to contractionary monetary policy. The empirical literature suggests that changes in demand constitute the strongest influence on changes in oil prices. What is true for oil in this context can apply to any natural resource, but probably to a lesser degree.

See page 72.

Section D: Trade policy and natural resources

Information on trade and other policy instruments applied in the natural resource sectors

Standard trade policy instruments are applied to natural resources just as they are to other goods. These include export taxes, tariffs, quantitative restrictions, other non-tariff measures and subsidies, all of which are discussed in the report. However, the motivations and effects of policy interventions may differ in certain ways on account of the particular characteristics of natural resource markets.

Although only partially comparable across countries, information on export taxes and quantitative restrictions recorded in WTO Trade Policy Reviews (TPRs) suggests that these measures are applied with relative frequency to natural resources.

On the basis of selective and often highly aggregated information covering different years, it appears that while natural resources represent approximately 24 per cent of all sectors, about one-third of all export taxes recorded in TPRs cover natural resource sectors. Export taxes occur with greater frequency in fishing and forestry than in fuels and mining.

Evidence on quantitative export restrictions suggests that, where these are present, it is often for the declared purpose of conserving exhaustible natural resources. Information on other forms of export restrictions notified to the WTO also mainly relates to natural resources.

Tariffs are generally low in the natural resources sector, although tariff escalation is present. Certain non-tariff measures are also applied.

The incidence of tariffs in the natural resources sector is generally lower than for overall merchandise trade. The only exception to this is fisheries, where for developing countries tariffs are higher than for all merchandise imports. Fuels and mining products attract the lowest rates. Bound rates on natural resources are often higher than applied rates, with the amount of "water" between the two being greater for developing countries.

Tariff escalation appears to be present in some natural resource goods, such as forestry and mining, but not in others, such as fuels. However, if one focuses on developed country markets only, the extent of tariff escalation appears greater and applies to fuels as well.

The most common types of non-tariff measures applied to the natural resource sectors are: (i) technical regulations (product characteristic requirements, labelling requirements, testing, inspection and quarantine requirements, etc.); (ii) non-automatic

licensing (licence combined with or replaced by special import authorization, prior authorization for sensitive product categories, etc.); and (iii) import prohibitions. The frequency of non-tariff measures is greater in fisheries than in either forestry or fuels.

Domestic and trade policies in natural resources are often substitutable in terms of their economic effects

Because of the geographical concentration of natural resources, measures affecting domestic production or consumption have a considerable impact on exports or imports. For example, a country that imports all its oil and charges a consumption tax on it achieves the same effect on trade as if it levied a tariff. The legal distinction between these two interventions is important, however, since the WTO and other international agreements typically cover tariffs, but not consumption taxes.

The incidence of measures other than tariffs and other trade (non-tariff) measures vary significantly among countries and categories of natural resource products.

In the case of fuels, for example, domestic taxes tend to be higher and several orders of magnitude greater than tariffs on fuels. Subsidies to fisheries are large in absolute terms and as a share of total production.

Trade policy, resource distribution and exhaustibility

For exhaustible and finite natural resources, the effects of trade policy depend not only on the level of interventions but also on the evolution of a policy over time. Only a few studies have looked at the dynamic effects of trade policy on natural resources.

The available literature on this dimension of trade policy has focused exclusively on import tariffs and consumption taxes. A major result from these studies is that if a government can pre-commit to a constant tariff, the price and extraction path of a natural resource will remain unaffected. Trade policy may also face time consistency problems. An initial policy stance, for example, may come under pressure as market dynamics unfold. Policy consistency over time is therefore a challenge for governments.

The quest for scarcity premiums (economic rents) is one explanation for using trade measures in non-renewable resource sectors.

Tariffs cannot move production from one location to another if natural resources are location-specific and immobile, making rent-shifting – whereby resource-importing countries seek to extract rents from resource-exporting countries – a motive for using such measures. More generally, the availability of large rents in scarce natural resources provides a strong incentive for rent-seeking behaviour.

While import tariffs shift rents from the exporting to the importing country, export taxes shift rents from the extracting company to the government, and export quotas shift rent from the future to the present.

Even if the immediate effect of a tariff is to increase the domestic price in the importing country, rigidity in supply means that the burden of the tariff will eventually fall on the exporter. The export price will fall to the point where the tariff-inclusive price in the importing country is equal to the price prevailing before the introduction of the tariff.

When all resources extracted are exported, an export tax on a non-renewable resource constitutes a transfer of resources rents from the producer to the government. In these circumstances, there is only one export price at which all available resources will be demanded and the producer will bear the full burden of the tax. There will be no effect on export prices (terms-of-trade effects).

A quota on natural resources will increase prices, but this will result in higher extraction rates and lower prices in the future. If all production is exported, an export (or production) quota shifts rents from the future to the present.

There may be a terms-of-trade argument in the case of a large supplier for taxing exports of exhaustible natural resources, thereby increasing the price of exports relative to the price of imports. However, certain qualifications apply to this argument.

When resources are also consumed domestically, an export tax is equivalent to a subsidy on domestic consumption – or dual pricing – in terms of price and quantity effects. Therefore, overall welfare considerations in relation to the effect of an export tax on the resource-producing sector should be taken into account.

When a country is large enough to increase world prices by taxing its natural resource exports, thus inducing terms-of-trade gains at the expense of importing countries, overall world welfare will be reduced. This is why terms-of-trade motivations for trade measures are referred to as beggar-thy-neighbour policies.

In the long run, higher export prices resulting from taxes may provide an incentive for the development of substitute products, new resource-saving technologies, or the exploitation of new resources. Importing countries may also retaliate by imposing taxes on imports of other products. Short-run national terms-of-trade gains need to be measured against the long-term costs of higher demand uncertainty.

Export taxes and other trade policies may also be justified to address a variety of other policy objectives, including problems related to natural resources volatility and dominance in a domestic economy setting. However, the use of trade measures in a number of these circumstances is not without hazards.

Export taxes on a natural resource reduce the domestic price of the product in question. This can help to soften the impact of rapidly rising world prices in the domestic market, thus protecting local consumers. Many natural resource economists would argue that this is a second-best way of addressing income instability problems, to be used only where the first-best option of developing efficient stock exchanges and financial markets is not attainable.

Export taxes have also been used to avoid de-industrialization (the so-called Dutch disease) and to promote infant industries or diversification. Since natural resources are used as inputs in many higher-value added industries, export taxes can work as an indirect subsidy to manufacturing by reducing the price of resource inputs. The justification for such second-best measures rests on some form of market imperfection, including in this instance a learning-by-doing argument.

Subsidies can have rent-shifting and beggar-thy-neighbour effects, but they may also be used to address legitimate policy objectives.

Economic theory generally supports the use of subsidies in case of market failures. A well known case is that of "green" subsidies. For instance, when deciding how much to invest in the development of a technology that reduces extraction emissions, a firm will compare the private benefits of producing the new technology with its private costs. Since a firm will not fully take into account the environmental benefits to society, it will under-invest. This market failure could justify government intervention in the form of subsidies.

Another interesting example is that of exploration subsidies. A key feature of non-renewable natural resources is that their supply is uncertain. Companies invest in exploration to discover new deposits. Also in this case the market may fail and governments may need to intervene. Examples of these market failures include spillover of geological information and the hold-up problem arising because of the sunk costs of exploration.

Trade policy and exhaustibility: The problem of open access

The first-best solution to the problem of open access is to strengthen the property rights regime. If this option is unavailable or very costly, a government may consider measures that directly affect production or trade.

A production tax on a natural resource can also serve as a first-best policy instrument if it is set at a level that results in the internalization of the effects that producers have on each other's productivity. A similar argument could also be made for a production quota on the harvest of the natural resource.

Although export taxes will not correct the absence of property rights, they can limit the over-exploitation of the natural resource base. However, the use of an export tax has a beggar-thy-neighbour effect because the increase in welfare of the exporting country comes at the expense of the welfare of its trading partner. The importing country will suffer a terms-of-trade decline.

By lowering the domestic price of a natural resource, an export tax could also encourage an unsustainable level of domestic consumption of a resource. Such an outcome could be avoided through measures that ensure a sustainable level of resource extraction.

Subsidies to natural resource industries, such as fisheries, will worsen the exploitation of stocks that already suffer from open access. However, the impact on harvest and trade is ambiguous. If the effort required to increase the harvest is too great because of the prevailing degree of over-exploitation, the subsidy may actually reduce production.

Natural resource externalities and environmental policy

Recognition of the link between environmental externalities and resource depletion is key to an efficient implementation of environmental policy.

The economic literature argues that an *ad valorem* tax that varies over time delays depletion and slows down adverse environmental effects of resource exploitation. When environmental damage increases over time, the optimal level of a time-varying tax will depend on the interaction among different factors, such as the natural rate of decay, the initial stock of accumulated environmental damage, and the extent to which consumers disregard the future impact of today's actions (the discount rate).

The extraction and use of resources, such as fossil fuels, has a negative effect not only on the country using or extracting such resources, but also on the global environment. In such a situation, an agreement among nations to increase taxes uniformly beyond a nationally determined optimum tax level is necessary to provide an efficient allocation of the resource over time.

In order for an environmental policy to be effective, it should be implemented rapidly after it has been announced. This is to avoid an acceleration of resource extraction and aggravation of the associated environmental damage prior to implementation of the policy.

When biodiversity loss is a consequence of a decrease in the total stock of a resource, the effect of a tariff on the harvested good depends on the principal causes of a decrease in the total stock of the resource, and hence on habitat destruction.

Habitat destruction can be a direct result of over-harvesting or it may arise as a result of the expansion of substitute economic activities that compromises habitat conversion. In the first case, a trade policy such as a

tariff would be optimal because it would decrease the rate of resource extraction and reduce habitat loss. However, in the second case the effect of a tariff is ambiguous because it affects habitat conservation both through reducing resource extraction and expanding other economic activities.

If habitat is affected adversely by the conversion of resources to other uses, environmental standards and eco-label schemes could efficiently address the problem.

While mandatory environmental standards set quality conditions to be adhered to by each producer, an eco-label is a certification scheme that provides information to consumers, helping them to identify environment-friendly products. An eco-label can only achieve its objective if consumers hold preferences for environmental amenities. In that circumstance, eco-label schemes may be able to achieve similar environmental goals to those of environmental standards. Moreover, in situations where governments cannot impose an environmental standard on foreign firms, an eco-label scheme is the most efficient policy to implement.

The political economy of trade policy in natural resource sectors

The socially optimal rate of resource extraction may be hard to obtain when trade and conservation policies are influenced by special interest groups. The effect of trade opening on resource extraction in this context is ambiguous.

A number of studies point to the possibility that the rate of resource utilization may be greater than the socially optimal rate because of poor governance or lobbying activities. This is particularly true in countries where institutional checks and balances on government activity are weak.

Trade openness affects both incentives to lobby the government and the quality of institutions in which policy-makers operate. While the effect on lobbying is ambiguous, recent studies highlight a positive effect of trade on institutional quality and hence on efficient resource utilization.

In the presence of lobbying activities, international transfers are the most appropriate policy to address negative cross-border effects associated with the excessive extraction of resources.

By inducing the exporting government to increase resource stocks, international transfers such as debt-for-nature swaps are the first-best policy to improve management of a natural resource whose depletion creates negative cross-border effects ignored by the market (externalities). A trade sanction may have exactly the opposite effect as it hurts the politically organized resource sector.

National resource abundance and regional integration

A two-way relationship exists between natural resources and regional integration. Regional integration affects resource-rich and resource-scarce countries differently. These effects, in turn, shape the incentives for these countries to engage in regional integration.

The integration of two resource-abundant countries with low tariffs and non-tariff barriers on natural resources, and similar production structures with limited manufacturing activity, is likely to lead to limited trade creation and potentially large trade diversion effects. On the other hand, regional integration may enable a resource-abundant country to diversify its production and export structure by relaxing the constraints it faces in developing a manufacturing sector.

Regional integration may assuage concerns about over-exploitation of natural resources and other potential negative consequences of international trade on the environment as provisions on natural resource management are sometimes included in regional and bilateral free trade agreements.

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Section E: Natural resources, international cooperation and trade regulation

Trade in natural resources and WTO rules

The WTO does not have an agreement specifically regulating trade in natural resources, but a number of WTO rules covering goods and services are relevant. These have been analysed in terms of the five characteristics of natural resource markets that were identified in this report.

Uneven global distribution

Article II of the General Agreement on Tariffs and Trade (GATT) constrains WTO members from applying tariffs at rates higher than those "bound" in their schedules of concessions. The General Agreement on Trade in Services (GATS) also establishes schedules of specific commitments on the terms on which markets may be accessed. Article I and Article III of the GATT lay out rules on non-discrimination, as does Article II of the GATS. Article XI provides that no prohibitions or restrictions other than duties, taxes or other charges may be imposed on the importation of any product or on the exportation or sale for export of any product. Where such restrictions are exceptionally permitted as a matter of public policy, Article XIII requires that measures are applied in a non-discriminatory fashion. Article XVII seeks to ensure that state trading enterprises conduct their activities in a non-discriminatory manner on the basis of commercial considerations. Article V of the GATT sets out rules that apply to goods that are in transit.

Exhaustibility

The Agreement on Subsidies and Countervailing Measures prohibits export subsidies and sets out disciplines on subsidies that cause adverse effects to other WTO members. Some natural resources that are agricultural products, such as certain raw materials and forestry products, are subject to the Agreement on Agriculture, which also includes rules on subsidies. WTO members are currently negotiating specific rules on fisheries subsidies as part of the Doha Round of trade negotiations.

Some of the public policy exceptions in Article XX of the GATT are particularly relevant to the issue of exhaustibility. Sub-paragraph (g) allows measures relating to the conservation of exhaustible natural resources. Sub-paragraph (j) allows WTO members to take measures that are essential to the acquisition or distribution of products in general or local short supply. However, any such measures must be consistent with the principle that all members are entitled to an equitable share of the international supply of such products.

Externalities

Eco-labels may be used to manage the un-priced negative effects of economic activity on the environment. The Agreement on Technical Barriers to Trade defines technical regulations as documents that lay down product characteristics or their related processes and production methods. Similar language is used in the definition of voluntary standards. The second sentence of both definitions refers to labelling requirements "as they apply to a product, process or production method".

The Agreement on Sanitary and Phytosanitary Measures recognizes that WTO members have the right to adopt sanitary and phytosanitary measures to protect human, animal or plant life or health. Article XX(b) also permits the adoption of measures that are necessary to protect human, animal or plant life or health. Article XX(d) permits the adoption of measures that are necessary to secure compliance with laws or regulations which are not inconsistent with the provisions of the GATT. The rules in the Import Licensing Agreement may be relevant where licences are used, for example, to control imports of forestry products made from legally harvested timber.

The Agreement on Government Procurement may impose conditions on the purchases of central and sub-central government entities as a means of minimizing externalities, such as the negative environmental consequences of certain practices.

Article XI(2)(a) provides an exception to the ban of export restrictions by allowing WTO members to impose them temporarily "to prevent or relieve critical shortages of foodstuffs or other products essential to the exporting contracting party". The Agreement on Agriculture also contains provisions on export restrictions.

Dominance

Dual pricing mechanisms – establishing a different domestic price from the export price – have been used by some governments as a means of diversifying the domestic production structure. Such mechanisms include export taxes and restrictions, state monopolies, and maximum domestic prices on natural resources. Some have suggested that dual pricing practices constitute an actionable subsidy, but no agreement or authoritative legal interpretation exists on this point.

Article XX(i) permits measures inconsistent with WTO agreements if these measures involve restrictions on exports of domestic materials where such restrictions are necessary to ensure essential quantities of such materials to a domestic processing industry.

Volatility

Price stabilization is one of the principal objectives of international commodity agreements. Article XX(h) of the GATT provides a specific exception for measures taken under such agreements. This provision may be of limited relevance today, at least for the natural resource sectors covered by this report.

Rules of international law relevant to natural resources

The WTO is part of a much broader framework of international cooperation and many aspects of natural resources are regulated by other rules of international law outside of the WTO.

The WTO does not regulate ownership of natural resources. There is a vast corpus of customary and treaty law regarding sovereignty over territories, land masses, bodies of water and the seabed. This corpus of law is relevant in terms of the allocation of property rights over natural resources as between states. In the 1960s and 1970s, several international instruments were adopted in which developing countries sought to reassert state sovereignty over natural resources in relation to foreign investors.

International commodity agreements established mechanisms to stabilize the prices of natural resources and were also seen as tools to correct the declining terms of trade of developing country exporters. The only international commodity agreement related to products covered by this report that remains operational today is the International Tropical Timber Agreement, and its objectives have been broadened. The International Tin Agreement and the International Natural Rubber Agreement were terminated. Agreements between producer countries are more relevant today. OPEC is the most prominent of such agreements.

Some trade agreements include obligations that go beyond the obligations in the WTO relevant to natural resources. For example, certain bilateral and regional agreements prohibit new export taxes or abolish them completely. The Energy Charter Treaty's disciplines on transit go beyond those found in Article V of the GATT.

A large number of international agreements establish mechanisms for cooperation between states to deal with international externalities. Many of these relate to environmental protection. Corruption is another issue on which states have cooperated.

Bilateral investment treaties seek to resolve what is known as the hold-up problem – a situation where the contractual agreement between two parties is affected by concerns that one party will gain undue bargaining power once investment by the other party has been committed – and play an important role particularly in relation to minerals and energy resources.

The relationship between the WTO agreements and general international law has been the subject of much discussion in recent years and the debate is not firmly settled.

WTO agreements offer avenues for WTO members to reconcile their WTO obligations with those under other international agreements. At a broader level, the UN International Law Commission has identified several principles that may be of assistance when seeking to understand the relationship between different international norms.

One of the issues that has received the most attention is the relationship between the WTO and multilateral environmental agreements.

The 1994 WTO Decision on Trade and Environment states that "there should not be, nor need be, any policy contradiction between upholding and safeguarding an open, non-discriminatory and equitable multilateral trading system on the one hand, and acting for the protection of the environment".

A similar call for coherence between environmental measures and the multilateral trading system is reflected in the Rio Declaration on Environment and Development. To date, no trade measure taken under a multilateral environmental agreement has been found to be incompatible with WTO obligations by a dispute settlement panel or the Appellate Body.

Regulating natural resources trade: Challenges and policy implications

A number of challenges for international cooperation are highlighted here. The list is not exhaustive, nor is there any implication in the selection of these issues that they should necessarily be negotiated in the WTO, or even that they all fall within the scope of agreed WTO competence.

Export policy

The first challenge relates to export policy in the form of export taxes and restrictions. A key economic rationale of WTO rules is to stimulate cooperation among trading partners in areas where they can harm each other by acting unilaterally. A large country can improve its terms of trade at the expense of its trading partners by imposing export restrictions and shifting economic rents. The reduction in supply will push up the world price and drive a wedge between this price and the domestic price. As in the tariff case, two large countries restricting their exports to each other could both end up worse-off. Commitments on export taxes could be exchanged either amongst exporters using such measures or for concessions on import tariffs, as export taxes are often associated with tariff escalation in the importing country. Broader trade-offs would of course also be possible.

Two points should be made here. Firstly, the issues surrounding export policy are not unique to natural resources. They have more general application. Secondly, whether or not export taxes change world prices, governments may resort to them other than for terms-of-trade and rent-shifting reasons. Export taxes may be intended to raise revenue, stabilize income, diversify the domestic and export structure of the economy, address escalating tariffs of trading partners along production chains, and meet environmental

objectives. The theoretical analysis in the report of the case for export taxes (and sometimes quantitative restrictions) also points out some of the potential limitations of these policy choices.

Sustainable exploitation of natural resources

While existing WTO rules offer flexibility to accommodate the sustainable exploitation of natural resources, there may be a case for expanding this flexibility in certain areas. For instance, certain subsidies can be an important domestic policy tool for governments to manage a natural resource or to address the environmental impact associated with its use. Provisions under Article 8 of the Agreement on Subsidies and Countervailing Measures that deemed environmental subsidies non-actionable – that is, not subject to challenge in the WTO or to countervailing measures – expired at the end of 1999, and WTO members did not agree to extend them. It is unclear whether the general exceptions in Article XX may be invoked to justify environmental/conservation subsidies.

Different policies with similar outcomes

Another challenge arises where certain domestic and trade measures are subject to different disciplines, even though they have the same economic impact. Where countries importing a natural resource do not produce it, and countries exporting it use very little of it, trade measures and domestic measures can be close substitutes. With natural resources, a production quota, for example, is often equivalent to an export quota and a dual pricing scheme often has an effect similar to that of an export tax. This, in turn, has an effect equivalent to that of a consumption subsidy. In these cases, regulating only one of the equivalent measures is often insufficient to achieve undistorted trade in natural resources.

Managing short-run exigencies with long-run costs

Because natural resources are either finite or exhaustible, current policies and their future consequences bear a particularly important relationship. International rules such as those negotiated at the WTO can provide an anchor to help governments ignore short-run incentives and pursue sustainable policies. One example of a measure that may be beneficial in the short run, possibly for political economy reasons but which does not serve the long-run interest of the country, is subsidies for the exploitation of a resource with an open access problem. The WTO negotiations on fishing subsidies address exactly this sort of problem. The recent G20 mandate to review consumption subsidies on fossil fuels, which have a negative environmental impact, has a similar purpose.

Transit and trade in natural resources

Although trade in most of the natural resources covered by this report moves relatively unimpeded, a number of issues have arisen in relation to the transit across jurisdictions of traded natural resources. This issue has risen in particular with energy products. The freedom of transit obligation in GATT Article V plays an important role in facilitating the flow of goods across the world. However, alternative views regarding the scope of Article V in the case of transport via fixed infrastructures, such as pipelines, creates regulatory uncertainty. This uncertainty carries economic costs.

Improving legal clarity and coherence among international agreements

One issue here relates to the blurred nature of the border between the GATT and the GATS with respect to activities surrounding the exploitation and processing of natural resources. This reduces the predictability of multilateral rules. A second, and perhaps more important, issue concerns the relationship between the WTO and other international agreements. Many aspects of natural resources are regulated by international rules outside the WTO and a number of challenges can only be effectively confronted through better global governance. Many discussions on international issues facing natural resources have to proceed on several multilateral fronts, and coherence is important.

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Section F: Conclusions

The analysis in this report argues strongly for cooperation. The importance of natural resources to virtually every aspect of human activity, and the particular characteristics of these products, make it vital that governments work together to find common ground and appropriate trade-offs. Such cooperation should aim to ensure sound resource management, equity and mutual gain.

The trade aspects of cooperation have been a particular focus of the report, and the case has been made for seeking accommodation through effective multilateral trade rules. Well-designed rules on trade are not only about securing the standard gains from trade; they are also a key component of cooperation in domains such as environmental protection and domestic policies to manage scarce resources.

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I The trade situation in 2009-10

The economic and financial crisis that shook the world economy in the closing months of 2008 produced a global recession in 2009 that resulted in the largest decline in world trade in more than 70 years. The rate of trade growth had already slowed from 6.4 per cent in 2007 to 2.1 per cent in 2008, but the 12.2 per cent contraction in 2009 was without precedent in recent history. The WTO has projected a modest recovery in 2010 which should reverse some of the impact of the trade collapse.

Contents

A. Introduction

Trade and output growth resumed in the second half of 2009 following record declines earlier in the year. The recovery through the first quarter of 2010 was insufficient to attain pre-crisis levels. The WTO has projected a further recovery in 2010 from the depressed levels of 2009, which should reverse some but not all of the impact of the trade collapse. One positive development in 2009 was the absence of any major increase in trade barriers imposed by WTO members in response to the crisis, despite high unemployment in many countries. The WTO system of trade regulation played a significant role in helping to prevent another descent into protectionism that so exacerbated economic conditions in the 1930s.

The dramatic decline in world trade in 2009 (see Figure 1) was even greater in US dollar terms (-22.6 per cent) than in volume terms (-12.2 per cent), thanks in large part to falling prices for oil and other primary products.[1] World output as measured by gross domestic product (GDP) also fell by 2.3 per cent in 2009, the first such decline since the end of the Second World War. Taken together, these developments amounted to the most severe global economic slowdown since the Great Depression.

1. Explaining the size of the trade collapse

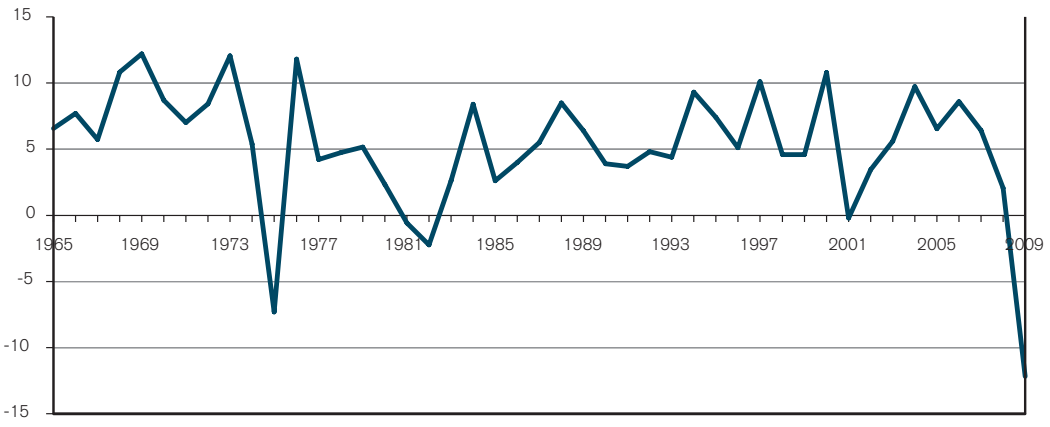
World trade volumes fell on three other occasions since 1965 (-0.2 per cent in 2001, -2.0 per cent in 1982, and -7.0 per cent in 1975), but none of these episodes approached the magnitude of last year's plunge. The slump in trade in 2009 was larger than most econometric models would have predicted given the size of the drop in GDP, and it was also larger than the decline predicted by the WTO in the early stages of the crisis.

Economists have suggested a number of explanations for the trade collapse, including the imposition of some protectionist measures and reduced access to credit to finance trade transactions. However, the consensus that has emerged centres on a sharp contraction in global demand as the primary cause.[2] The weakness in demand had its roots in the sub-prime mortgage crisis in the United States, which became apparent in 2007 and intensified towards the end of 2008. What began as a crisis in the US financial sector spread to the real economy, to other developed economies, and to the rest of the world in short order. The impact of the crisis on trade was further magnified by the product composition of the fall in demand, by the fact that the decline was synchronized across countries and regions, and by the growth of global supply chains in recent decades.

Sharp falls in wealth linked to the recession caused households to reduce their spending on consumer durables such as automobiles (trade in automotive products was down 32 per cent in 2009), and also made firms reconsider expenditures on investment goods such as industrial machinery (down 29 per cent in 2009 – see Table 1). Purchases of these items could be postponed easily in response to heightened economic uncertainty, and they may also have been more sensitive to credit conditions than other types of goods. The reduction in demand for these products then fed through to markets that supply inputs for their production, particularly iron and steel (down 47 per cent in 2009). Shrinking demand for iron and steel was also linked to the slump in building construction in countries where property markets had been booming before the crisis. Consumer durables and capital goods make up a relatively small fraction of global GDP but a relatively large part of world trade. As a result, falling demand for these products may have had a greater impact on world trade than on world GDP.

The magnitude of the trade contraction of 2009 may also have been inflated somewhat compared with earlier declines in the 1970s and '80s due to the spread of global supply chains in the intervening years. With today's more extensive supply chains, goods frequently cross national borders several times during the production process

Figure 1: **Volume of world merchandise exports, 1965-2009** (Annual percentage change)



Source: WTO International Trade Statistics.

Table 1: **World trade in manufactured goods by product, 2008Q1-2009Q4**
(Year-to-year percentage change in current dollars)

	2008Q1	2008Q2	2008Q3	2008Q4	2009Q1	2009Q2	2009Q3	2009Q4	2009
Manufactures	**16**	**18**	**13**	**-11**	**-28**	**-30**	**-22**	**0**	**-21**
Iron and steel	15	27	43	4	-39	-56	-55	-31	-47
Chemicals	19	24	20	-7	-24	-25	-17	8	-15
Office and telecom equipment	10	13	7	-14	-29	-22	-15	8	-15
Automotive products	15	16	3	-26	-47	-46	-29	6	-32
Industrial machinery	21	22	15	-8	-29	-36	-32	-15	-29
Textiles	11	9	3	-13	-27	-27	-17	0	-19
Clothing	11	11	8	-2	-11	-15	-12	-6	-11

Source: WTO Secretariat estimates.

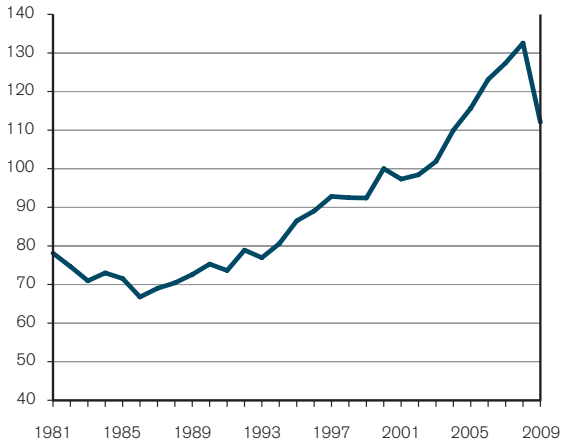
before arriving at their final destination. Merchandise trade statistics record the value of goods every time they cross national boundaries, so when these data are added together to arrive at a figure for total world trade, the number will be larger when supply chains are more extensive due to a certain amount of double counting. Consequently, a given fall in demand in 2009 would probably produce a bigger measured decline in trade than an equivalent fall in demand in 1982 or 1975.

The extent of this double counting is difficult to gauge due to a lack of readily available data, but it is reflected in the fact that trade has been growing faster than production since the 1980s. As a result, the ratio of world exports to GDP has increased steadily since 1985, and jumped by nearly one-third between 2000 and 2008, before dropping in 2009 as world trade fell faster than world GDP (see Figure 2).

A final factor that reinforced the trade slump was its synchronized nature. Exports and imports of all countries fell at the same time, leaving no region untouched (see Figure 3). It is intuitively clear that the fall in world trade would have been smaller if contraction in some regions had been balanced by expansion in others, but this was not the case in 2009.

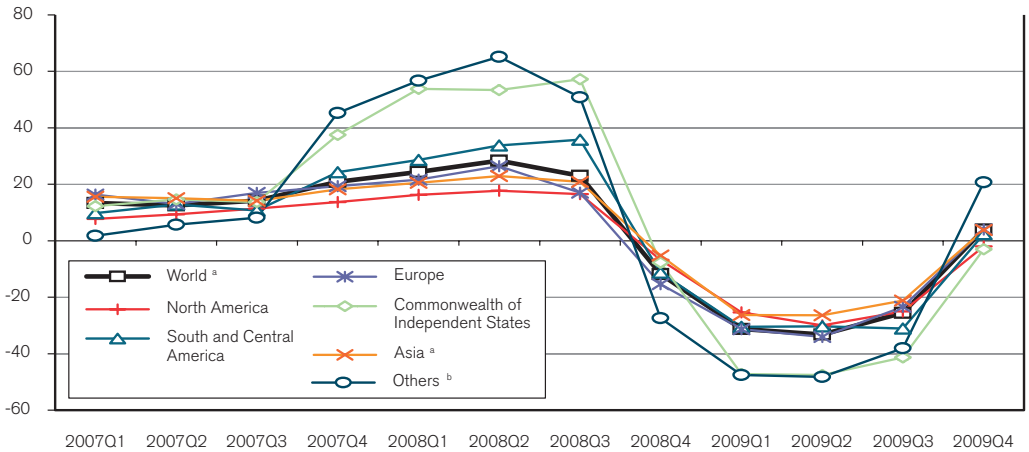
The synchronized nature of the decline is closely related to the spread of international supply chains and information technology, which allows producers in one region to respond almost instantly to market conditions in another part of the world. This usually contributes to global and national welfare by encouraging the most efficient use of scarce resources, but in the case of the trade collapse it may have acted as a transmission mechanism.

Figure 2: **Ratio of world exports of goods and commercial services to GDP, 1981-2009**
(Index 2000=100)



Source: IMF for world GDP, WTO Secretariat for world trade in goods and commercial services.

Figure 3: **World merchandise exports by region, 2007Q1-2009Q4**
(Year-to-year percentage change in current US dollars)



a Includes significant re-exports.
b Includes Africa and Middle East.
Source: IMF, International Financial Statistics; Eurostat, Comext Database; National statistics; Global Trade Atlas.

B. Overview of output and price developments in 2009-10

1. Economic growth

World GDP growth turned sharply negative in 2009 for the first time since the 1930s, dropping to -2.3 per cent from 1.6 per cent in 2008. Both years were well below the 2000-08 average of 3.0 per cent. Although the contraction in output started in the developed economies in the fourth quarter of 2008, it accelerated in the first half of 2009 and eventually affected all countries and regions to varying degrees. However, many developing countries only experienced slower GDP growth rather than absolute declines in output.

Figure 4 shows the quarterly evolution of GDP, as well as exports and imports of goods and services for the industrialized economies of the Organisation for Economic Cooperation and Development (OECD). Positive quarter-on-quarter GDP growth resumed in the second quarter of 2009 in OECD countries, but year-on-year changes remained negative throughout the year. An interesting feature of Figure 4 is that trade and output began their declines and started their recoveries at the same time. This provides some support for the notion that the trade decline was mostly related to falling demand rather than other factors.

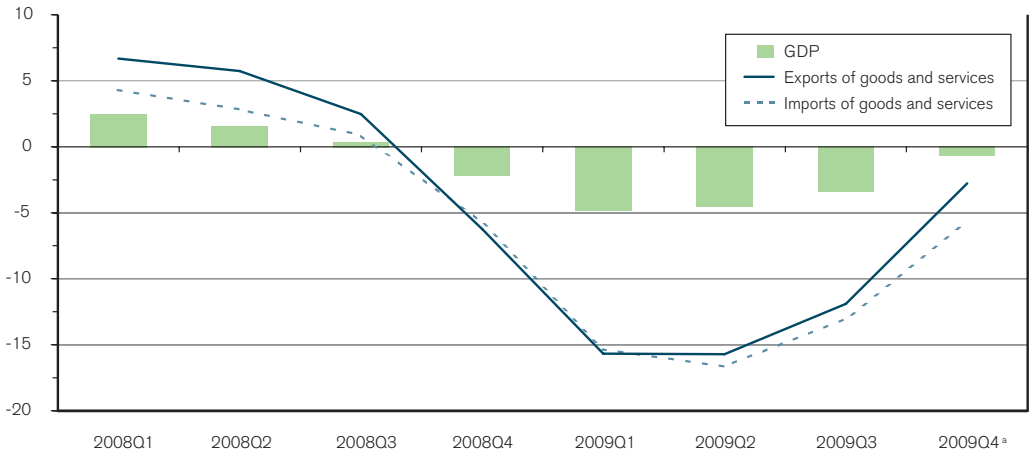
Output of developed economies fell 3.5 per cent in 2009 after growing just 0.5 per cent in 2008. Among the leading developed economies, Japan suffered the largest decline in its GDP (-5.0 per cent) followed by the European Union (-4.2 per cent)[3] and the United States (-2.4 per cent). On the other hand, developing economies still managed to increase their collective output by 2.6 per cent in 2009, although this was down sharply from the 5.6 per cent growth of the previous year. The continued positive GDP growth of developing economies can be partly credited to the strong performances of China and India, whose output increased by 8.5 per cent and 5.4 per cent, respectively, in 2009. Oil-exporting countries saw their collective GDP fall to 2.0 per cent in 2009, down from 5.1 per cent in 2008, while least-developed countries (LDCs) grew 3.7 per cent, down from 6.7 per cent in 2008.

North America's GDP growth fell to -2.7 per cent in 2009, while South and Central America's rate dropped to -0.8 per cent. The decline in Europe's output was even larger (-4.0 per cent), and that of the Commonwealth of Independent States (CIS) larger still (-7.0 per cent). On the other hand, Africa managed to increase its production of goods and services by 1.6 per cent, as did the Middle East, which recorded GDP growth of 1.0 per cent. Asia's GDP growth was almost flat at 0.1 per cent, as the sharp decline of Japan cancelled out the expansions of China and India.

2. Prices and exchange rates

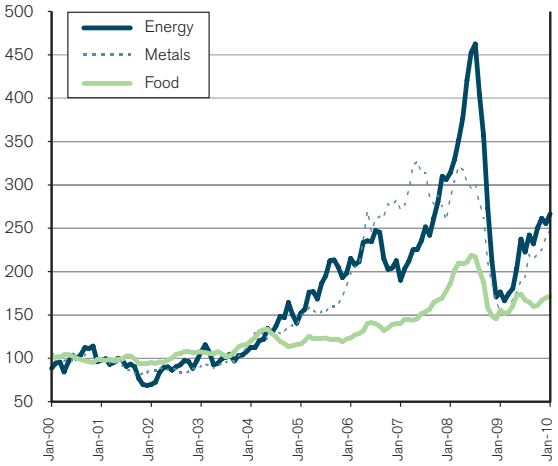
After plunging in the early stages of the economic crisis, prices for primary products stabilized and staged a significant recovery in the second half of 2009. This is illustrated by Figure 5, which shows indices of world primary product prices from the International Monetary Fund (IMF). Between July 2008 and February 2009, energy prices fell by 64 per cent and metals prices dropped by 50 per cent, but between February 2009 and January 2010 prices for energy and metals rose 60 per cent and 65 per cent, respectively. Average commodity prices for 2009 were down for energy (-37 per cent), metals (-29 per cent), agricultural raw materials (-17 per cent) and food (-15 per cent). The only primary product category registering an increase in prices last year was beverages (1.7 per cent), which includes coffee and tea (see Figure 6).

Figure 4: **Real GDP and trade growth of OECD countries, 2008-09** (year-to-year percentage change)



[a] Estimated based on available data.
Source: OECD Quarterly National Accounts.

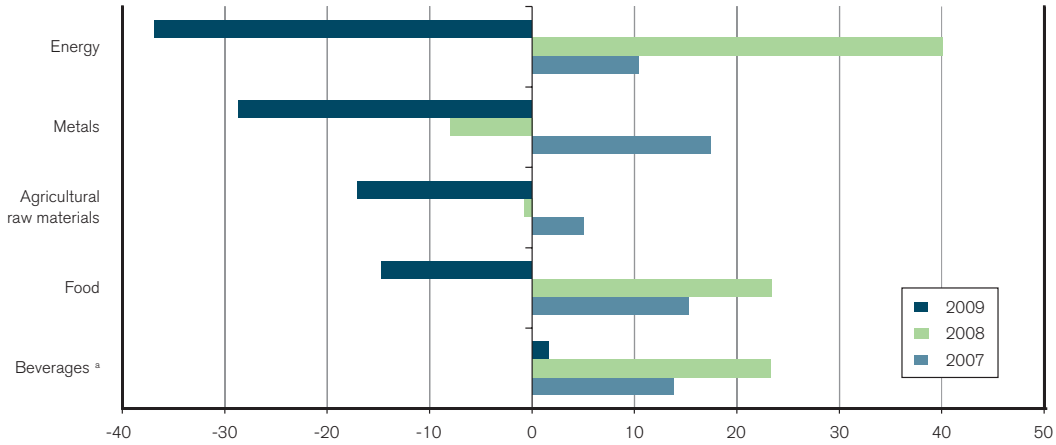
Figure 5: **Export prices of selected primary products, January 2000-January 2010** (Index, January 2000=100)



Source: IMF International Financial Statistics.

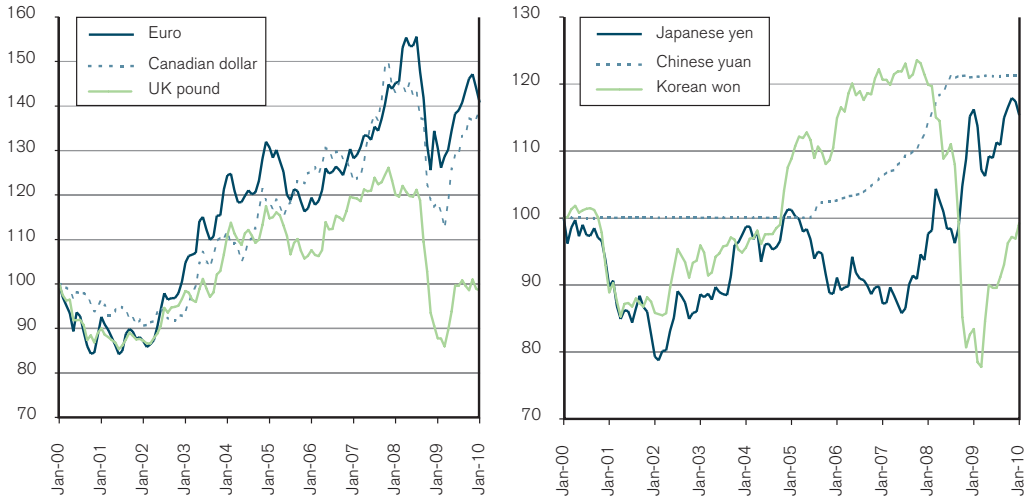
Major currencies have undergone significant fluctuations against the US dollar since the beginning of the economic crisis, with the exception of the Chinese yuan, which has been effectively pegged to the dollar since July 2008. For example, after falling nearly 20 per cent in value against the dollar between July and November 2008, the euro then appreciated 17 per cent between February and November 2009. Many other currencies followed a similar pattern, depreciating against the dollar as the crisis worsened and appreciating as conditions eased, probably due to the dollar's role as a safe haven currency in times of economic uncertainty. An exception to this rule is the Japanese yen, which appreciated against the dollar as a result of the unwinding of the so called yen "carry trade" in which large amounts of yen were borrowed in Japan and invested in assets denominated in other currencies in order to obtain a higher rate of return. The liquidation of these positions increased capital inflows into Japan and put upward pressure on the country's currency (see Figure 7).

Figure 6: **Export prices of selected primary products, 2007-09** (Annual percentage change)



Source: IMF International Financial Statistics.

Figure 7: **Dollar exchange rates of selected currencies, January 2000-January 2010** (Index, January 2000=100)



Source: IMF International Financial Statistics.

C. Merchandise trade, volume (real) terms, 2009

World merchandise trade in volume terms (i.e. excluding the influence of prices and exchange rates) fell by 12.2 per cent in 2009 (see Table 2). This was well below the 2.1 per cent increase for 2008, and significantly lower than the 10 year average increase of 4.1 per cent. The drop in trade was also larger than the 2.3 per cent decline in GDP for 2009, which is not surprising since world trade generally grows faster than GDP when output is accelerating and declines more when output slows (see Figure 8).

All countries and regions in Table 2 saw the volume of their exports decline last year. North America and Europe fell more than the world average (14.4 per cent each) while the smallest declines were recorded by oil-exporting regions such as the Middle East (-4.9 per cent), Africa (-5.6 per cent) and South and Central America (-5.7 per cent). The declines for Asia (-11.1 per cent) and the CIS (-9.5 per cent) were somewhat larger, but still less than the world average.

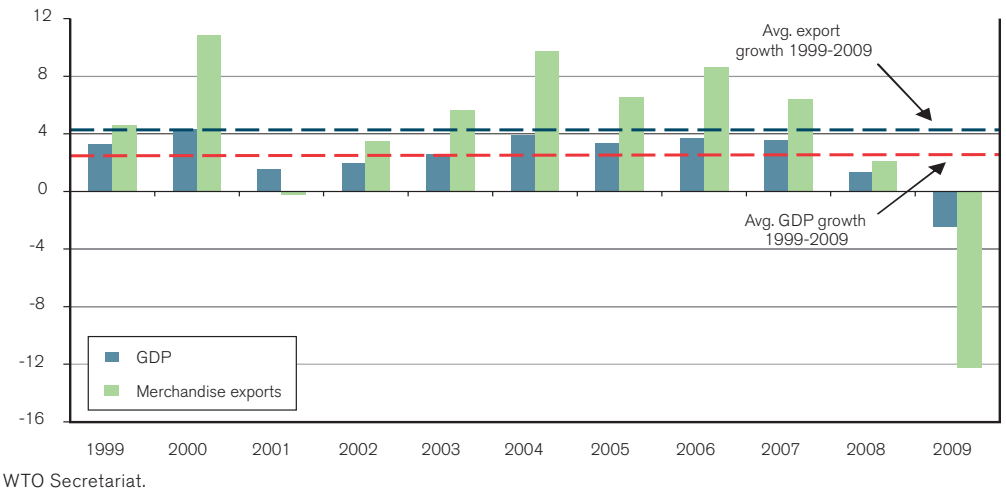
The United States (-13.9 per cent), European Union (-14.8 per cent) and Japan (-24.9 per cent) all saw their exports fall by more than the world average, but China's drop was smaller (-10.5 per cent). Collectively, the newly industrialized countries (NICs) experienced a relatively small decline in exports (-5.9 per cent) despite their vulnerability during the crisis due to the export orientation of their economies. The reduction in India's exports was also comparatively small (-6.2 per cent).

Table 2: **GDP and merchandise trade by region, 2007-09** (Annual percentage change)

	GDP			Exports			Imports		
	2007	2008	2009	2007	2008	2009	2007	2008	2009
World	3.8	1.6	-2.3	6.4	2.1	-12.2	6.1	2.2	-12.9
North America	2.2	0.5	-2.7	4.8	2.1	-14.4	2.0	-2.4	-16.3
United States	2.1	0.4	-2.4	6.7	5.8	-13.9	1.1	-3.7	-16.5
South and Central America [a]	6.4	5.0	-0.8	3.3	0.8	-5.7	17.6	13.3	-16.3
Europe	2.9	0.8	-4.0	4.2	0.0	-14.4	4.4	-0.6	-14.5
European Union (27)	2.8	0.7	-4.2	4.0	-0.1	-14.8	4.1	-0.8	-14.5
Commonwealth of Independent States (CIS)	8.3	5.3	-7.1	7.5	2.2	-9.5	19.9	16.3	-20.2
Africa	5.8	4.7	1.6	4.8	0.7	-5.6	13.8	14.1	-5.6
Middle East	5.5	5.4	1.0	4.5	2.3	-4.9	14.6	14.6	-10.6
Asia	6.0	2.7	0.1	11.7	5.5	-11.1	8.2	4.7	-7.9
China	13.0	9.0	8.5	19.8	8.6	-10.5	13.8	3.8	2.8
Japan	2.3	-1.2	-5.0	9.4	2.3	-24.9	1.3	-1.3	-12.8
India	9.4	7.3	5.4	14.4	14.4	-6.2	18.7	17.3	-4.4
Newly industrialized economies (4) [b]	5.6	1.6	-0.8	9.0	4.9	-5.9	5.3	3.5	-11.4

[a] Includes the Caribbean.
[b] Hong Kong, China; Republic of Korea; Singapore and Chinese Taipei.
Source: WTO Secretariat.

Figure 8: **Growth in the volume of world merchandise trade and GDP, 1999-2009** (Annual percentage change)

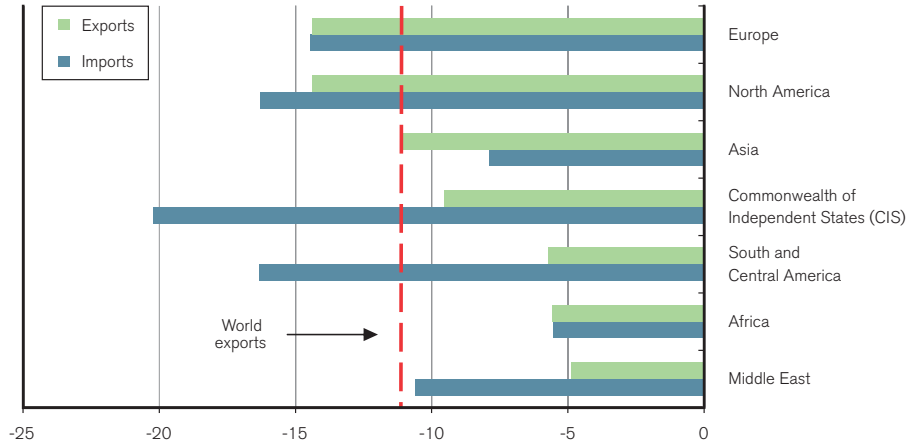


Source: WTO Secretariat.

The situation was reversed on the import side, where the regions with the largest declines in 2009 included major exporters of oil and other natural resources – the CIS (-20 per cent) and South and Central America (-16.5 per cent – see Figure 9). This can be partly explained by falling export revenues as a result of lower oil prices in 2009. North America, Europe and the Middle East all saw their imports drop sharply (-16 per cent, -14.5 per cent and -10.6 per cent, respectively), but Africa and Asia only suffered single-digit declines (-5.6 per cent and -7.9 per cent respectively).

The declines in imports for the United States and the European Union (-16.5 per cent and -14.5 per cent, respectively) were greater than the world average, while Japan's drop was nearly equal to the world rate (-12.8 per cent). India recorded a relatively small drop in its imports (-4.4 per cent) while the volume of China's purchases from other countries actually increased (2.8 per cent). This increase can be partly explained by China's stockpiling of minerals and other natural resources while prices for these commodities were temporarily depressed.

Figure 9: **Real merchandise trade growth by region, 2009** (Annual percentage change)



Source: WTO Secretariat.

D. Merchandise and services trade, value (nominal) terms, 2009

1. Merchandise trade

The US dollar value of world merchandise trade fell 23 per cent in 2009 to US$ 12.1 trillion, down from US$ 16.1 trillion in 2008 (see Appendix Table 1). Some of this decline was due to changes in trade volumes, while much of the rest can be explained by falling commodity prices in 2009, particularly for oil. After rising to record levels in 2008, world crude oil prices plunged 37 per cent in 2009, from US$ 95 per barrel to US$ 60 per barrel on average. As a result, nominal trade developments for particular countries and regions may differ substantially from developments in volume terms, particularly for oil exporters on the export side and oil importers on the import side.

North America's merchandise exports fell 21 per cent in 2009, from US$ 2.0 trillion to US$ 1.6 trillion, while imports dropped 25 per cent from US$ 2.9 trillion to US$ 2.2 trillion. The percentage declines on both the export and import sides were roughly in line with the overall drop in world trade, as were those for South and Central America. Exports of the latter fell 24 per cent to US$ 461 billion while the region's imports dropped 25 per cent to US$ 444 billion. The story for Europe was similar, with exports falling 23 per cent to US$ 5.0 trillion and imports shrinking by 24 per cent to US$ 5.1 trillion.

Oil-producing regions recorded declines in exports that were much larger than the overall decline in world trade, including the CIS, which saw its exports fall more than any other region (-36 per cent to US$ 452 billion). The CIS also had the largest percentage decline on the import side, as purchases from the rest of the world fell 33 per cent to US$ 332 billion. Africa's exports dropped by 32 per cent to US$ 379 billion, but the decline in the continent's imports was smaller than any other region's (-16 per cent to US$ 400 billion). Results for the Middle East were similar to those for Africa, with exports falling 33 per cent to US$ 691 billion and imports dropping 18 per cent to US$ 493 billion.

Asia's exports were down 18 per cent in 2009, from US$ 4.7 trillion to US$ 3.6 trillion, the smallest nominal decline of any region. Asia's imports also fell less than the world average, 21 per cent to US$ 3.4 trillion. This relatively strong performance rested on China's ability to minimize the impact of the economic crisis on its trade flows. The country's exports fell 16 per cent to US$ 1.2 trillion last year, while its imports declined by just 11 per cent to US$ 1.0 trillion.

As many observers had predicted, China overtook Germany as the world's leading exporter in 2009 with a 9.6 per cent share in world trade (see Appendix Table 3). The other top exporters were Germany (9.0 per cent), the United States (8.5 per cent), Japan (4.7 per cent), and the Netherlands (4.0 per cent). Among major economies, the country that advanced the most in world export rankings was the Republic of Korea, which moved from 12th to 9th place. The country that fell furthest was the Russian Federation, which dropped from 9th to 13th position.

The United States remained the leading merchandise importer with a 12.7 per cent share in world trade. China (8.0 per cent) took over second place from Germany (7.4 per cent), which fell to third place. France (4.4 per cent) and Japan (4.4 per cent) exchanged places, with France taking over the fourth position and Japan dropping to fifth. Appendix Table 4 shows rankings in world trade excluding EU intra-trade, which places the European Union atop the rankings on both the export and import sides.

2. Commercial services trade

World commercial services exports fell 13 per cent in 2009, from US$ 3.8 trillion to US$ 3.3 trillion (see Table 3). Although smaller than the 23 per cent drop in merchandise trade, it was the largest decline ever recorded for services in a data series going back to 1980. It was also the first time since 1983 that trade in commercial services declined year on year.

Transport recorded the largest drop among services categories, followed by travel and other commercial services (see Table 4). The drop in transport services is unsurprising since this category is closely linked to trade in goods, which fell by a similar amount. One might have expected a larger decline in other commercial services, since this category includes financial services that were at the centre of the recent crisis. However, these trade flows are often based on long-term contractual relationships with suppliers, possibly making them less sensitive to short-term fluctuations in the business cycle.

Table 3: **World exports of merchandise and commercial services, 2005-09** (Billion dollars and percentage)

	Value	Annual percentage change			
	2009	2005-09	2007	2008	2009
Merchandise	12147	4	16	15	-23
Commercial services	3312	7	20	12	-13

Source: WTO Secretariat.

Table 4: **World exports of commercial services by major category, 2009** (Billion dollars and percentage)

	Value	Annual percentage change			
	2009	2005-09	2007	2008	2009
Commercial services	**3312**	**7**	**20**	**12**	**-13**
Transport	704	5	20	16	-21
Travel	854	6	15	11	-11
Other commercial services	1754	10	23	12	-10

Source: WTO Secretariat

All countries and regions in Appendix Table 2 recorded negative growth in commercial services trade in 2009 with two exceptions (China's imports were unchanged from 2008, while Morocco was the only country to report a rise in imports of services).

Regional declines in exports were led by the CIS (-18 per cent to US$ 69 billion), followed by Europe (-14 per cent, US$ 1.6 trillion), Asia (-13 per cent, US$ 751 billion), Middle East (-12 per cent, US$ 96 billion), Africa (-11 per cent, US$ 78 billion), North America (-10 per cent, US$ 542 billion) and South and Central America (-8 per cent, US$ 100 billion). On the import side, the CIS again had the biggest decline (-21 per cent, US$ 91 billion), followed by the Middle East (-13 per cent, US$ 162 billion), Europe (-13 per cent, US$ 1.5 trillion), Africa (-11 per cent, US$ 117 billion), Asia (-11 per cent, US$ 776 billion), North America (-10 per cent, US$ 430 billion) and South and Central America (-8 per cent, US$ 111 billion).

The United States was the largest exporter of commercial services in 2009 with a 14.2 per cent share of world trade, followed by the United Kingdom (7.2 per cent), Germany (6.5 per cent), France (4.2 per cent) and China (3.9 per cent). The United States also retained top spot on the import side (10.6 per cent of world trade), with Germany (8.2 per cent), the United Kingdom (5.1 per cent), China (5.1 per cent) and Japan (4.7 per cent) being the other countries in the top five (see Appendix Table 5).

Appendix Table 1: **World merchandise trade by region and selected country, 2009**
(Billion dollars and percentage)

	Exports					Imports				
	Value	Annual percentage change				Value	Annual percentage change			
	2009	2005-09	2007	2008	2009	2009	2005-09	2007	2008	2009
World	12147	4	16	15	-23	12385	4	15	16	-24
North America	1602	2	11	11	-21	2177	-1	6	8	-25
United States	1057	4	12	12	-18	1604	-2	5	7	-26
Canada	316	-3	8	9	-31	330	1	9	7	-21
Mexico	230	2	9	7	-21	242	1	10	10	-24
South and Central America [a]	461	6	14	21	-24	444	10	25	30	-25
Brazil	153	7	17	23	-23	134	15	32	44	-27
Other South and Central America [a]	308	6	13	20	-24	311	9	23	25	-25
Europe	4995	3	16	11	-23	5142	3	16	12	-25
European Union (27)	4567	3	16	11	-23	4714	3	16	12	-25
Germany	1121	4	19	9	-22	931	5	16	12	-21
France	475	1	11	9	-21	551	2	14	14	-22
Netherlands	499	5	19	16	-22	446	5	18	18	-23
United Kingdom [b]	351	-2	-2	5	-24	480	-2	4	2	-24
Italy	405	2	20	8	-25	410	2	16	8	-26
Commonwealth of Independent States (CIS)	452	7	21	35	-36	332	11	35	32	-33
Russian Federation [c]	304	6	17	33	-36	192	11	36	31	-34
Africa	379	5	18	28	-32	400	12	23	27	-16
South Africa	63	5	20	16	-22	72	4	12	12	-28
Africa less South Africa	317	5	17	31	-33	328	14	27	32	-13
Oil exporters [d]	204	3	17	34	-40	129	16	29	39	-11
Non oil exporters	113	9	16	23	-17	199	13	27	28	-14
Middle East	691	6	16	33	-33	493	10	25	28	-18
Asia	3566	6	16	15	-18	3397	6	15	21	-21
China	1202	12	26	17	-16	1006	11	21	18	-11
Japan	581	-1	10	9	-26	551	2	7	23	-28
India	155	12	23	30	-20	244	14	29	40	-24
Newly industrialized economies (4) [e]	853	4	11	10	-17	834	4	11	17	-24
Memorandum items:										
Developing economies	4697	7	17	19	-22	4432	8	19	22	-20
MERCOSUR [f]	217	7	18	24	-22	186	13	31	41	-28
ASEAN [g]	814	6	12	14	-18	724	5	13	21	-23
EU (27) extra-trade	1525	4	17	13	-21	1672	3	16	17	-27
Least Developed Countries (LDCs)	125	11	25	32	-27	144	13	24	29	-11

a Includes the Caribbean. For composition of groups see the Technical Notes of WTO International Trade Statistics, 2009.
b The 2007 annual change is affected by a reduction in trade associated with fraudulent VAT declaration. For further information, refer to the special notes of the monthly *UK Trade First Release* (www.statistics.gov.uk/StatBase/Product.asp?vlnk=1119).
c Imports are valued f.o.b.
d Algeria, Angola, Cameroon, Chad, Congo, Equatorial Guinea, Gabon, Libya, Nigeria, Sudan.
e Hong Kong, China; Republic of Korea; Singapore and Taipei, Chinese.
f Common Market of the Southern Cone: Argentina, Brazil, Paraguay, Uruguay.
g Association of Southeast Asian Nations: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Viet Nam.

Source: WTO Secretariat.

Appendix Table 2: **World exports of commercial services by region and selected country, 2009**
(Billion dollars and percentage)

	Exports					Imports				
	Value	Annual percentage change				Value	Annual percentage change			
	2009	2005-09	2007	2008	2009	2009	2005-09	2007	2008	2009
World	3310	7	20	12	-13	3115	7	19	13	-12
North America	542	6	15	9	-10	430	4	9	7	-10
United States	470	7	16	10	-9	331	4	8	8	-9
South and Central America [b]	100	9	18	16	-8	111	12	22	21	-8
Brazil	26	15	26	27	-9	44	18	28	28	-1
Europe	1675	7	21	12	-14	1428	6	19	11	-13
European Union (27)	1513	7	21	11	-14	1329	6	19	11	-13
United Kingdom	240	4	20	2	-16	160	0	15	1	-19
Germany	215	8	18	11	-11	255	5	16	11	-10
France	140	4	16	10	-14	124	4	16	10	-12
Spain	122	7	20	12	-14	87	7	23	9	-17
Italy	101	3	13	7	-15	114	6	21	8	-11
Commonwealth of Independent States (CIS)	69	13	27	28	-18	91	11	30	26	-21
Russian Federation	42	14	27	30	-17	60	12	32	29	-19
Ukraine	13	10	26	27	-23	11	11	29	43	-32
Africa	78	9	19	19	-11	117	14	28	27	-11
Egypt	21	10	24	25	-15	14	9	27	25	-17
Morocco	12	13	24	12	-5	6	20	27	24	13
South Africa	11	0	13	-8	-9	14	4	16	3	-16
Middle East	96	11	16	20	-12	162	14	32	18	-13
Israel	22	6	10	14	-9	17	6	20	13	-12
Asia	751	9	22	14	-13	776	8	18	14	-11
China [a]	129	15	33	20	-12	158	17	29	22	-0
Japan	124	5	10	15	-15	146	4	11	10	-11
Hong Kong, China	86	8	16	9	-6	44	7	15	11	-6
India	86	...	25	18	...	74	...	21	26	...
Singapore	74	8	26	3	-11	74	8	16	6	-6
Korea, Republic of	56	6	28	20	-25	74	6	21	12	-19
Taipei, Chinese	31	5	7	11	-10	29	-2	8	0	-15

a Preliminary estimate.
b Includes the Caribbean. For composition of groups see Chapter IV Metadata of WTO International Trade Statistics, 2009.
Note: While provisional full year data were available in early March for 50 countries, accounting for more than two-thirds of world commercial services trade, estimates for most other countries are based on data for the first three quarters.
Source: WTO Secretariat.

Appendix Table 3: **Merchandise trade: Leading exporters and importers, 2009**
(Billion dollars and percentage)

Rank	Exporters	Value	Share	Annual per cent change	Rank	Importers	Value	Share	Annual per cent change
1	China	1202	9.6	-16	1	United States	1604	12.7	-26
2	Germany	1121	9.0	-22	2	China	1006	8.0	-11
3	United States	1057	8.5	-18	3	Germany	931	7.4	-21
4	Japan	581	4.7	-26	4	France	551	4.4	-22
5	Netherlands	499	4.0	-22	5	Japan	551	4.4	-28
6	France	475	3.8	-21	6	United Kingdom	480	3.8	-24
7	Italy	405	3.2	-25	7	Netherlands	446	3.5	-23
8	Belgium	370	3.0	-22	8	Italy	410	3.2	-26
9	Korea, Republic of	364	2.9	-14	9	Hong Kong, China	353	2.8	-10
						- retained imports [a]	91	0.7	-8
10	United Kingdom	351	2.8	-24	10	Belgium	351	2.8	-25
11	Hong Kong, China	330	2.6	-11	11	Canada	330	2.6	-21
	- domestic exports [a]	15	0.1	-9					
	- re-exports [a]	314	2.5	-11					
12	Canada	316	2.5	-31	12	Korea, Republic of	323	2.6	-26
13	Russian Federation	304	2.4	-36	13	Spain	290	2.3	-31
14	Singapore	270	2.2	-20	14	Singapore	246	1.9	-23
	- domestic exports	138	1.1	-21		- retained imports [b]	114	0.9	-28
	- re-exports	132	1.1	-19					
15	Mexico	230	1.8	-21	15	India	244	1.9	-24
16	Spain	218	1.7	-23	16	Mexico	242	1.9	-24
17	Taipei, Chinese	204	1.6	-20	17	Russian Federation [c]	192	1.5	-34
18	Saudi Arabia [a]	189	1.5	-40	18	Taipei, Chinese	175	1.4	-27
19	United Arab Emirates [a]	175	1.4	-27	19	Australia	165	1.3	-17
20	Switzerland	173	1.4	-14	20	Switzerland	156	1.2	-15
21	Malaysia	157	1.3	-21	21	Poland	147	1.2	-30
22	India	155	1.2	-20	22	Austria	144	1.1	-22
23	Australia	154	1.2	-18	23	Turkey	141	1.1	-30
24	Brazil	153	1.2	-23	24	United Arab Emirates [a]	140	1.1	-21
25	Thailand	152	1.2	-14	25	Thailand	134	1.1	-25
26	Austria	137	1.1	-24	26	Brazil	134	1.1	-27
27	Poland	134	1.1	-21	27	Malaysia	124	1.0	-21
28	Sweden	131	1.0	-29	28	Sweden	119	0.9	-29
29	Norway	121	1.0	-30	29	Czech Republic	105	0.8	-26
30	Indonesia	120	1.0	-14	30	Saudi Arabia [a]	92	0.7	-20
	Total of above [d]	10244	82.2	-		Total of above [d]	10323	81.6	-
	World [d]	12461	100.0	-23		World [d]	12647	100.0	-23

a Secretariat estimates.
b Singapore's retained imports are defined as imports less re-exports.
c Imports are valued f.o.b.
d Includes significant re-exports or imports for re-export.
Source: WTO Secretariat.

Appendix Table 4: **Merchandise trade: Leading exporters and importers excluding intra-EU(27) trade, 2009**
(Billion dollars and percentage)

Rank	Exporters	Value	Share	Annual per cent change	Rank	Importers	Value	Share	Annual per cent change
1	Extra-EU (27) exports	1525	16.2	-21	1	Extra-EU (27) imports	1672	17.4	-27
2	China	1202	12.8	-16	2	United States	1604	16.7	-26
3	United States	1057	11.2	-18	3	China	1006	10.5	-11
4	Japan	581	6.2	-26	4	Japan	551	5.7	-28
5	Korea, Republic of	364	3.9	-14	5	Hong Kong, China	353	3.7	-10
						- retained imports [a]	91	0.9	-8
6	Hong Kong, China	330	3.5	-11	6	Canada	330	3.4	-21
	- domestic exports [a]	15	0.2	-9					
	- re-exports [a]	314	3.3	-11					
7	Canada	316	3.4	-31	7	Korea, Republic of	323	3.4	-26
8	Russian Federation	304	3.2	-36	8	Singapore	246	2.6	-23
						- retained imports [b]	114	1.2	-28
9	Singapore	270	2.9	-20	9	India	244	2.5	-24
	- domestic exports	138	1.5	-21					
	- re-exports	132	1.4	-19					
10	Mexico	230	2.4	-21	10	Mexico	242	2.5	-24
11	Taipei, Chinese	204	2.2	-20	11	Russian Federation [c]	192	2.0	-34
12	Saudi Arabia [a]	189	2.0	-40	12	Taipei, Chinese	175	1.8	-27
13	United Arab Emirates [a]	175	1.9	-27	13	Australia	165	1.7	-17
14	Switzerland	173	1.8	-14	14	Switzerland	156	1.6	-15
15	Malaysia	157	1.7	-21	15	Turkey	141	1.5	-30
16	India	155	1.6	-20	16	United Arab Emirates [a]	140	1.5	-21
17	Australia	154	1.6	-18	17	Thailand	134	1.4	-25
18	Brazil	153	1.6	-23	18	Brazil	134	1.4	-27
19	Thailand	152	1.6	-14	19	Malaysia	124	1.3	-21
20	Norway	121	1.3	-30	20	Saudi Arabia [a]	92	1.0	-20
21	Indonesia	120	1.3	-14	21	Indonesia	92	1.0	-28
22	Turkey	102	1.1	-23	22	South Africa [a]	72	0.7	-28
23	Iran, Islamic Rep. of [a]	78	0.8	-31	23	Viet Nam	69	0.7	-15
24	South Africa	63	0.7	-22	24	Norway	69	0.7	-23
25	Bolivarian Rep. of Venezuela	58	0.6	-39	25	Iran, Islamic Rep. of [a]	51	0.5	-10
26	Kuwait [a]	57	0.6	-35	26	Israel [a]	49	0.5	-27
27	Viet Nam	57	0.6	-10	27	Philippines	46	0.5	-24
28	Argentina	56	0.6	-20	28	Ukraine	45	0.5	-47
29	Chile	53	0.6	-20	29	Egypt	45	0.5	-7
30	Nigeria [a]	53	0.6	-36	30	Chile	42	0.4	-32
	Total of above [d]	8504	90.3	-		Total of above [d]	8602	89.6	-
	World [d] (excl. intra-EU (27))	9419	100.0	-22		World [d] (excl. intra-EU (27))	9605	100.0	-23

a Secretariat estimates.
b Singapore's retained imports are defined as imports less re-exports.
c Imports are valued f.o.b.
d Includes significant re-exports or imports for re-export.
Source: WTO Secretariat.

Appendix Table 5: **Leading exporters and importers in world trade in commercial services, 2009**
(Billion dollars and percentage)

Rank	Exporters	Value	Share	Annual percentage change	Rank	Importers	Value	Share	Annual percentage change
1	United States	470	14.2	-9	1	United States	331	10.6	-9
2	United Kingdom	240	7.2	-16	2	Germany	255	8.2	-10
3	Germany	215	6.5	-11	3	United Kingdom	160	5.1	-19
4	France	140	4.2	-14	4	China	158	5.1	0
5	China [a]	129	3.9	-12	5	Japan	146	4.7	-11
6	Japan	124	3.8	-15	6	France	124	4.0	-12
7	Spain	122	3.7	-14	7	Italy	114	3.6	-11
8	Italy	101	3.0	-15	8	Ireland	104	3.3	-5
9	Ireland	95	2.9	-7	9	Netherlands	87	2.8	-5
10	Netherlands	92	2.8	-11	10	Spain	87	2.8	-17
11	Hong Kong, China	86	2.6	-6	11	Canada	77	2.5	-11
12	India	86	2.6	...	12	India	74	2.4	...
13	Belgium	75	2.3	-11	13	Korea, Republic of	74	2.4	-19
14	Singapore	74	2.2	-11	14	Singapore	74	2.4	-6
15	Switzerland	68	2.1	-11	15	Belgium	72	2.3	-12
16	Sweden	60	1.8	-16	16	Russian Federation	60	1.9	-19
17	Luxembourg	60	1.8	-16	17	Denmark	51	1.6	-19
18	Canada	57	1.7	-12	18	Sweden	47	1.5	-14
19	Korea, Republic of	56	1.7	-25	19	Hong Kong, China	44	1.4	-6
20	Denmark	55	1.7	-25	20	Brazil	44	1.4	-1
21	Austria	53	1.6	-13	21	Saudi Arabia [b]	43	1.4	...
22	Russian Federation	42	1.3	-17	22	Australia	41	1.3	-13
23	Australia	41	1.3	-7	23	Thailand	38	1.2	-18
24	Norway	38	1.1	-17	24	Austria	38	1.2	-12
25	Greece	38	1.1	-25	25	Norway	37	1.2	-16
26	Turkey	33	1.0	-6	26	Luxembourg	36	1.2	-13
27	Taipei, Chinese	31	0.9	-10	27	United Arab Emirates [b]	36	1.1	...
28	Thailand	31	0.9	-9	28	Switzerland	34	1.1	-6
29	Poland	29	0.9	-19	29	Taipei, Chinese	29	0.9	-15
30	Malaysia	28	0.8	-8	30	Malaysia	27	0.8	-12
	Total of above	2765	83.5	-	31	Total of above	2540	81.6	-
	World	3310	100.0	-13	32	World	3115	100.0	-12

a Preliminary estimate.
b Secretariat estimate.
Note: While provisional full year data were available in early March for 50 countries accounting for more than two-thirds of world commercial services trade, estimates for most other countries are based on data for the first three quarters.
Source: WTO Secretariat.

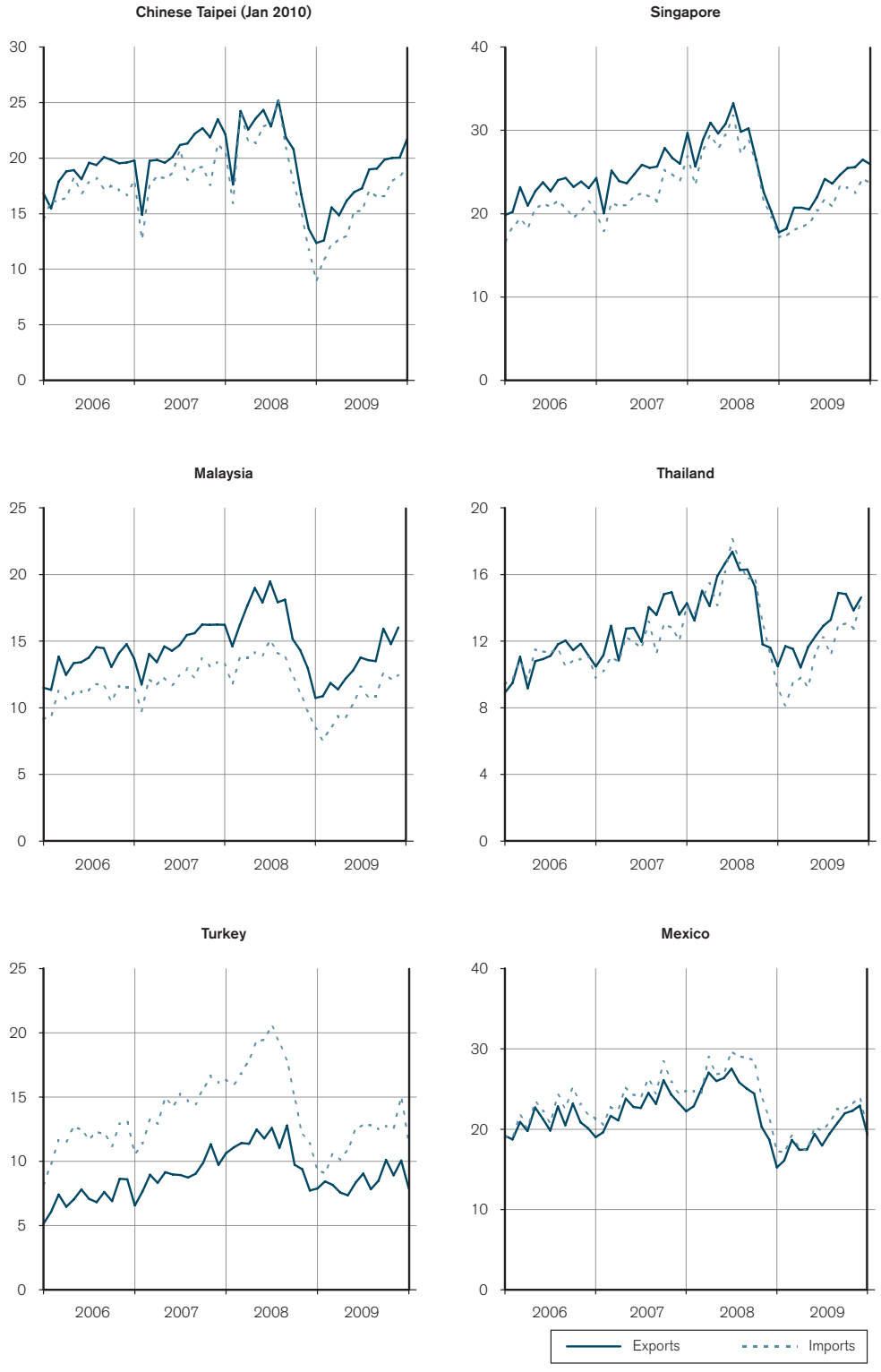
Appendix Figure 1: **Monthly merchandise exports and imports of selected economies, January 2006 - January 2010**
(Billion dollars)

Source: IMF International Financial Statisitics, Global Trade Information Services GTA database, national statistics.

Appendix Figure 1: **Monthly merchandise exports and imports of selected economies, January 2006 - January 2010** (Billion dollars) continued

Source: IMF International Financial Statisitics, Global Trade Information Services GTA database, national statistics.

Appendix Figure 1: **Monthly merchandise exports and imports of selected economies, January 2006 - January 2010** (Billion dollars) continued



Source: IMF International Financial Statisitics, Global Trade Information Services GTA database, national statistics.

Appendix Figure 1: **Monthly merchandise exports and imports of selected economies, January 2006 - January 2010** (Billion dollars) continued

Source: IMF International Financial Statisitics, Global Trade Information Services GTA database, national statistics.

Endnotes

1 Unless otherwise noted, world trade refers to world merchandise exports. Figures for world merchandise imports are similar but not identical to exports due to the inclusion of shipping and other costs in imports, and to differences in the recording of trade flows.

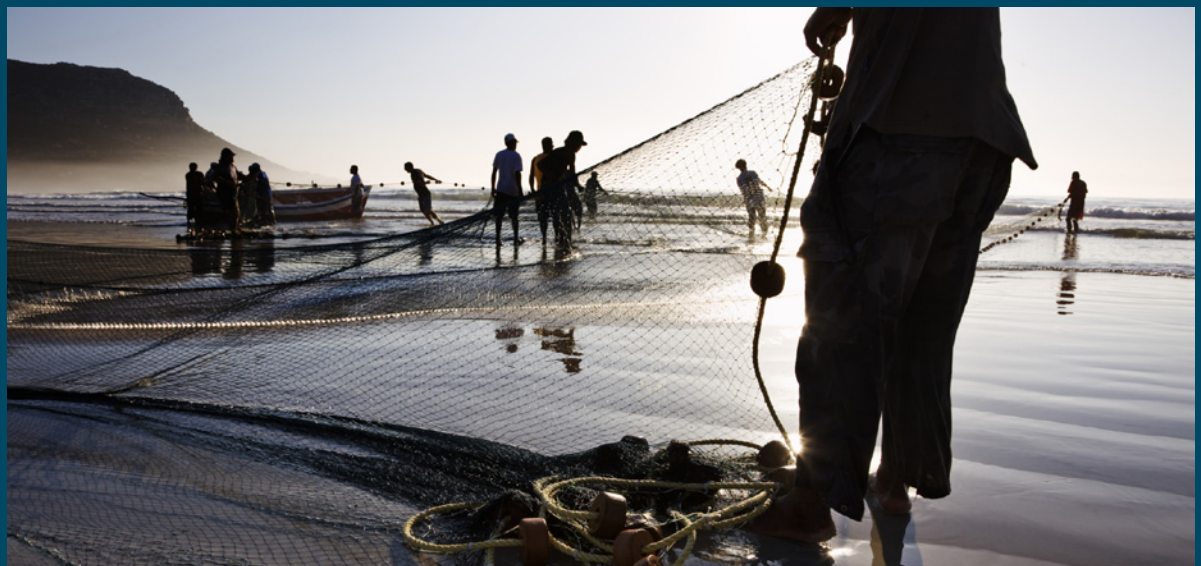
2 For a comprehensive analysis of the causes of trade contraction, see Baldwin, R. (2009), *The Great Trade Collapse: Causes, Consequences and Prospects*, London: Centre for Economic Policy Research.

3 Euro area GDP also fell by 4.0 per cent.

II Trade in natural resources

The World Trade Report 2010 focuses on trade in natural resources, such as fuels, forestry, mining and fisheries. The Report examines the characteristics of trade in natural resources, the policy choices available to governments and the role of international cooperation, particularly of the WTO, in the proper management of trade in this sector.

Contents



A. Introduction

Natural resources are fundamental for human life. Non-renewables such as oil and natural gas are transformed into the energy that is essential for the production of virtually any other good or service. Renewable resources such as forests, fisheries and aquifers are some of the world's most precious natural assets. Properly managed, they also have the potential to provide an unending stream of products that contribute greatly to the quality of human life. Natural resources represent a significant and growing share of world trade and amounted to some 24 per cent of total merchandise trade in 2008. The volume of this trade has been quite steady over the past decade, but in value terms has grown annually at 20 per cent.

Contents

1. Why a report on trade in natural resources

A number of characteristics peculiar to natural resources influence the manner in which they are traded and the nature of rules applied to this trade. The rules have long been the subject of debates that have intensified in recent years. Natural resources present particular challenges for policy-makers, in part because they are both essential to the production process and actually or potentially exhaustible. Their extraction and use must be carefully managed in order to balance the competing needs of current and future generations. The unequal distribution of natural resources across countries and frequent volatility in their prices can constitute sources of international tension. As world output growth resumes following the financial crisis and global recession, upward pressure on natural resource prices will almost certainly re-emerge.

Competing international and inter-generational interests inherent in natural resources trade make transparent, predictable and well-designed trade rules particularly valuable. Trade in natural resources will take place regardless of whether the global community has adequate rules, as the needs that motivate these exchanges persist and increase over time. However, inadequate or contested rules risk stoking the fires of natural resources nationalism, where power asymmetries across countries and beggar-thy-neighbour motivations dominate trade policy. In a world where scarce natural resource endowments must be nurtured and managed with care, uncooperative trade outcomes will fuel international tension and have a deleterious effect on global welfare.

2. Themes and structure of the *World Trade Report* 2010

The *World Trade Report* 2010 examines international trade and trade policy in natural resource sectors such as fuels, forestry, mining products and fisheries. Rather than analysing the specifics of each sector in turn, the report addresses cross-cutting themes that characterize different natural resource sectors to varying degrees. These economic characteristics include: i) the uneven geographical distribution of many natural resources; ii) their exhaustibility; iii) the environmental and other impacts associated with the extraction and/or consumption of natural resources; iv) the dominance of particular resources in some national economies; and v) market volatility. These are the five major themes of the report and they have been chosen because they often motivate policy interventions in these sectors.

The report is organized into four main sections. A brief description of each of these follows.

Natural resources: Definitions, trade patterns and globalization

Section B provides a broad overview of international trade in natural resources. It introduces the definitions and terminology used in the report and illustrates the empirical relevance of key economic features of natural resources. The section also provides a description of how commodity exchanges work, and a variety of summary statistics on the magnitude and direction of world trade flows in natural resources. The section ends with a brief overview of the history of the intellectual debate surrounding natural resources trade.

Trade theory and natural resources

Section C focuses on the economic characteristics of natural resources and their implications for international trade. It addresses the general questions of whether and under what conditions trade provides an efficient mechanism for ensuring access to natural resources. In particular, it analyses: i) the unequal distribution of natural resources and trade; ii) trade in non-renewable resources under perfect and imperfect competition; iii) trade when natural resources suffer from "open access" problems and other forms of environmental externality; iv) the economics of the so-called natural resources curse facing resource exporters; and v) the determinants and effects of resource volatility on exporting and importing countries.

Trade policy and natural resources

Section D considers the policy choices available to governments in addressing some of the predominant issues encountered in trade in natural resources. It provides a taxonomy of key trade and domestic measures such as export taxes, import tariffs, consumption taxes and information on their current use. The section analyzes the effects of these policy tools in the context of various market failures, including monopoly power in a natural resources sector, open access, and environmental externalities. Finally, the section considers how certain political economy factors enter the picture, including the influence of lobby groups in the determination of natural resources policy, and the role of regional trade cooperation in addressing economic problems that characterize natural resources.

Natural resources, international cooperation and trade regulation

Section E discusses the international regulation of trade in natural resources. It provides an overview of how natural resources fit within the legal framework of the WTO and examines how the rights and obligations of WTO members relate to particular features of trade in natural resources. The section also discusses other important international agreements that regulate trade in natural resources and their relationship to WTO disciplines. The final part of the section reviews the literature on a number of challenges that have arisen, or may be anticipated, in relation to international trade cooperation in natural resources. Issues addressed include the treatment of export taxes and restrictions, the regulation of subsidies, the facilitation of trade and the coherence of WTO rules and other international agreements.

B. Natural resources: Definitions, trade patterns and globalization

This section provides a broad overview of the role that trade in natural resources plays in the global economy. It begins with a discussion of definitions and terminology, focusing on key features that distinguish natural resources from other types of traded goods. These features include the exhaustibility of natural resources, the uneven geographical distribution of resource endowments, the presence of externalities in the spillover effects of extraction and use of natural resources, the dominance of the natural resources sector in many national economies, and the high degree of price volatility in this class of goods. A variety of statistical data related to natural resources are presented in order to illustrate the magnitude and direction of global trade flows.

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Since most natural resources trade is conducted through organized commodity exchanges, we examine the role that financial markets play in determining prices and quantities. This is followed by a historical account of trade in natural resources since the industrial revolution, touching on the recurring themes of technological change, trade liberalization and scarcity. This account also elaborates the evolution of thinking about how perceptions of natural resources have evolved over time, including their role in determining economic and political outcomes. Together, these analyses provide essential background information for the theoretical and policy-related discussions in subsequent chapters.

1. Definitions and key features of natural resources

Natural resources are difficult to define precisely, particularly in the context of international trade. Most people have an intuitive idea of what natural resources are, but "common sense" definitions cannot be relied upon since they eventually run into problems when dealing with ambiguous cases. For example, crude oil and wood are clearly natural resources, but it is less obvious how intermediate and final goods made from these products should be classified.

All goods either embody natural resources (e.g. automobiles contain iron ore) or require resources for their production (e.g. food crops require land and water to grow), so all goods could conceivably be classified as natural resources. Such an approach would be logically consistent but otherwise unenlightening. At another extreme, one could choose to focus strictly on resources in their natural state. However, even clear-cut examples of natural resources would be difficult to classify as such under this approach, since most resources require at least some processing before they can be traded or consumed. Regardless of the choice of definition, the line of demarcation between natural resources and other goods will always be somewhat arbitrary.

For the purposes of this report we define natural resources as "stocks of materials that exist in the natural environment that are both scarce and economically useful in production or consumption, either in their raw state or after a minimal amount of processing".[1] Note the qualifier "economically useful" in this definition. For example, sea water is a natural substance that covers much of the earth's surface, but it is of limited intrinsic or direct value for consumption or production. Goods must also be scarce in the economic sense to qualify as natural resources; otherwise people could consume as much as they wanted at no cost to themselves or to others.

Air would not be considered a natural resource under this definition because people can obtain it freely simply by breathing. This is not to suggest that air (especially clean air) or for that matter sea water (e.g. as a carbon sink) are without value, but it does mean that they are not commodities that can be traded in markets. In this report, the term "resources" is used interchangeably with "natural resources".

A useful definition should not only identify the nature of natural resources but also distinguish what is and what is not a natural resource. Under the above criteria, it is clear that manufactured goods such as automobiles and computers would not be considered resources, since both are subject to more than a minimal amount of processing. However, this should not be taken to imply that all primary products are covered as natural resources in the report. For example, while most agricultural goods including food are primary products, we do not classify them as natural resources for a number of reasons. To begin with, their production requires other natural resources as inputs, particularly land and water but also various types of fertilizer. More importantly, agricultural products are cultivated rather than extracted from the natural environment.

Two important exceptions in this report relate to fish and forestry products, which are normally classified under agriculture in WTO trade statistics, but which are treated here as natural resources. Both fish and forestry products can be cultivated, for example in aquaculture for fish or through forest management for wood. However, traditionally they have simply been taken from existing natural stocks, and still are for the most part. Unfortunately, it is impossible to distinguish between cultivated and non-cultivated varieties of these products in standard databases on international trade, but some effort has been made to identify these in the case of fish.

Natural resources can be thought of as natural capital assets, distinct from physical and human capital in that they are not created by human activity. Natural capital may be a potentially important input in a country's "production function" – that is, $Y = f(K, L, N)$, where *"Y"* is output, *"K"* is capital, *"L"* is labour and *"N"* is natural resources. It is important to distinguish between natural resources as factors of production and natural resources as goods that can be traded internationally. For instance, minerals, oil, and various other materials can be extracted and enter into trade. However, other resources may form the economic basis for various sectors of the domestic economy, and therefore are only involved in trade in an indirect way (Josling, 2009). For example, climate and scenery can be exported through tourism. Similarly, agricultural land, which is the archetypal "fixed, immobile" natural resource, can be exported through agricultural commodities grown on that land. Hence, at a fundamental level, natural resources are often a reason for trade rather than tradable goods in their own right.

A more precise statistical definition that identifies exactly which products are to be counted as natural resources in trade data is provided in a Statistical Appendix, but the main product groups covered in this report are fish, forestry products, fuels, ores and other minerals, and non-ferrous metals. Taken together, the product groups ores and other minerals and non-ferrous metals are referred to as mining products. Broader conceptions of natural resources will also be employed from time to time, particularly as they relate to non-

tradable resources such as scenery, bio-diversity or non-traded goods such as water or land.

As noted earlier, natural resources falling under our definition typically share a number of key features, including exhaustibility, uneven distribution across countries, negative externalities consequences in other areas, dominance within national economies and price volatility. We now examine each of these features and illustrate them with some concrete examples.

(a) Exhaustibility

In resource economics, a distinction is usually made between renewable and non-renewable resources. A renewable resource is a resource that either increases in quantity or otherwise renews itself over a short (i.e. economically relevant) period of time. Hence, if the rate of extraction takes account of limitations in the reproductive capacity of the resource, renewables can provide yields over an infinite time horizon. Of course, the timeframe must be economically relevant, since some resources may be renewable in principle but not in practice. For example, it takes hundreds of millions of years for dead trees to be transformed into coal and oil (Blundell and Armstrong, 2007), and hundreds of years for certain kinds of trees to grow to maturity (Conrad, 1999), so old growth forests would not be considered renewable resources despite the fact that they do renew themselves over time. Classic examples of renewable resources are fisheries and forests.

Non-renewable resources are defined as all resources that do *not* grow or otherwise renew themselves over time. Another way of putting this is that non-renewable resources exist in finite quantities, so every unit consumed today reduces the amount available for future consumption. The most common examples of non-renewable resources are fossil fuels and mineral deposits. The term exhaustible is sometimes used as a synonym for non-renewable, but it is worth noting that renewable resources may also be exhaustible if they are over-exploited.

In general, the sustainable management of any resource rests on a capacity to monitor the evolution of stocks and take corrective action in cases of significant degradation or decline. In the case of man-made physical assets, the cost of maintaining, renewing, expanding and improving the capital stock is an explicit part of production costs (capital depreciation is accounted for as an expense). For natural resources, however, this is not always the case. The value of natural capital is often not accounted for at the level of the individual firm or in national accounts. This implies that neither their contribution to growth nor the extent and impact of their degradation are fully measured and recognized by policy makers.

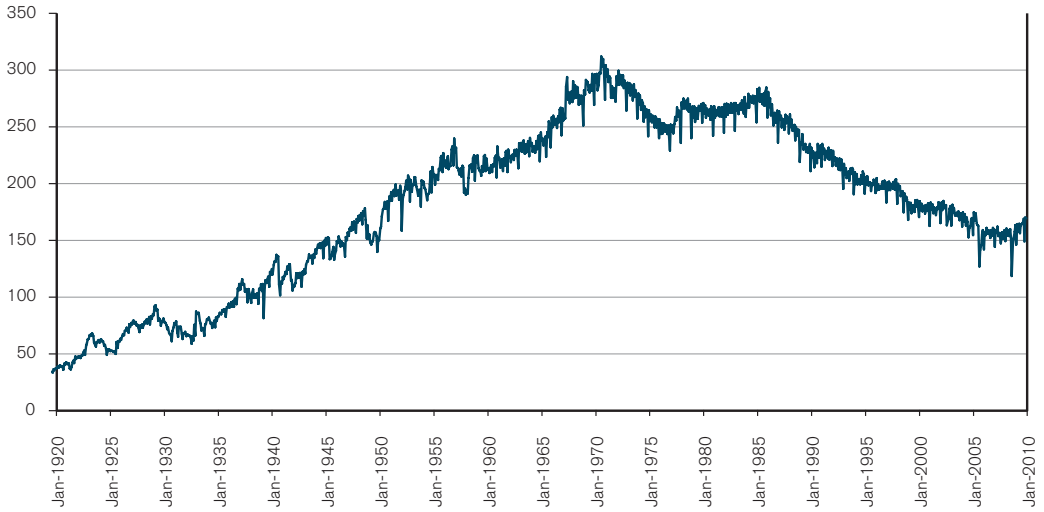
Another type of cost that is related to exhaustibility but not explicitly accounted for in natural resources use is the effect of rent-seeking behaviour. The scarcity of natural resources generates economic rents (i.e. the premium that the resource owner receives above opportunity cost, or the cost of the next best alternative use of the relevant assets). Policies, including trade measures, that alter the supply and demand and hence the price of resources alter the distribution of rents across time and countries, sometimes lead to international tension.

Technological change can effectively increase the supply of resources by contributing to new discoveries and allowing extraction of stocks that could not be reached before. According to the BP World Energy Review (2009), proven world oil reserves[2] rose from 998 billion barrels in 1988 to 1,069 billion barrels in 1998 and 1,258 billion barrels in 2008, thanks largely to new discoveries and advances in extraction technology. Changes in technology can also influence the rate of depletion of a resource by either increasing its rate of use (e.g. electrical energy for increased use of electronics, computers, etc.) or decreasing it (e.g. improvements in the efficiency of automobiles). Technological developments like these would change the rate at which a resource was used up, but it would not alter the fact of its exhaustibility.

Many petroleum experts believe that world oil production has or soon will reach its maximum point, known as "peak oil" (Hackett, 2006) . Once oil production peaks, it is believed that future supplies will become more and more difficult to obtain, causing the flow of oil to decline inexorably according to a logistic distribution known as the Hubbert curve. This bell-shaped curve is named after M. King Hubbert, who accurately predicted in the 1950s that United States oil production would peak around 1970 and decline thereafter (see Figure 1). More pessimistic peak oil theorists predict enormous economic disruptions in the near future as a result of rapidly dwindling supplies, while more optimistic observers put the date of world peak oil production many years, if not decades, in the future. Peak oil theory has been less successful at predicting maximum oil production in countries other than the United States or at the world level, but few would dispute the notion that oil production will begin to decline at some point in the future if current rates of consumption continue.

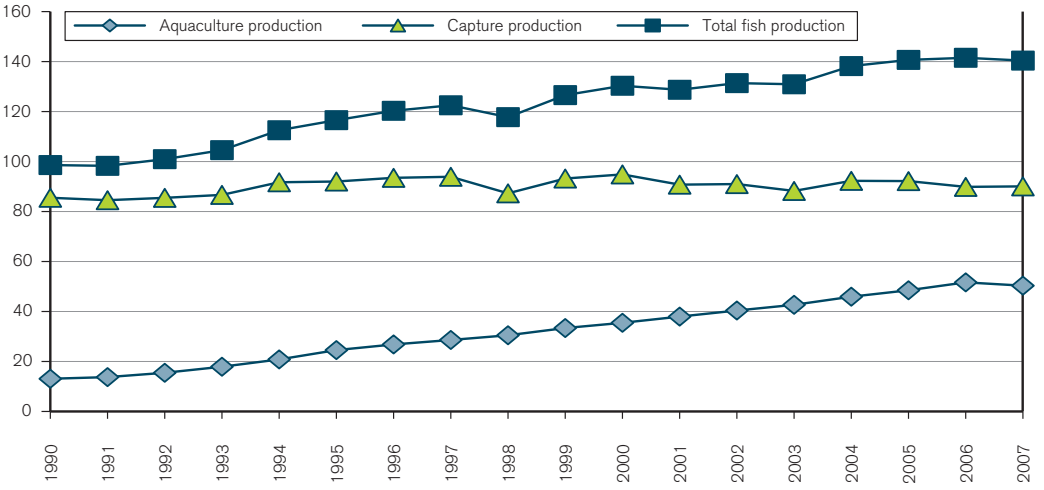
Another example of a renewable resource that may be in decline is fish. According to statistics from the United Nations Food and Agriculture Organization (FAO), total world fisheries production rose from 98 million tonnes in 1990 to 140 million tonnes in 2007, an increase of 42 per cent. During the same period, total world exports of fish jumped 60 per cent from 33 million tonnes to 53 million tonnes. The share of trade in world fish production also advanced from 34 per cent in 1990 to 38 per cent in 2007. Despite rising production and trade, annual catches from oceans and fresh water fisheries have been mostly flat during this period, at around 90 million tonnes, with nearly all growth in recent years accounted for by aquaculture, otherwise known as "fish farming" (see Figure 2). This could indicate that the world's oceans and fresh water fisheries have reached peak production and are in danger of over-exploitation in the face of growing demand.

Figure 1: **Monthly United States oil production, Jan. 1920-Jan. 2010** (Million barrels)



Source: United States Department of Energy, Energy Information Adminstration.

Figure 2: **World fisheries production, 1990-2007** (Million tonnes)



Source: United Nations Food and Agriculture Organization, AQUASTAT database.

(b) Uneven distribution across countries

Many natural resources are concentrated in a small number of countries, while others have limited domestic supplies. For example, Appendix Table 1 shows that nearly 90 per cent of the world's proved oil reserves are located in just 15 countries (out of slightly more than 200 in the world today), and 99 per cent of oil reserves are found in 40 countries.[3] International trade can help to alleviate these kinds of disparities in natural endowments by allowing resources to move from areas of excess supply to areas of excess demand, which may also serve to promote the most efficient use of these products. However, since natural resources are indispensable inputs for production and are also necessary for maintaining a high quality of human life, the unequal distribution of resources can cause friction among nations.

The nature of the friction associated with natural resources may be different from that observed in the case of other types of goods. In most trade disputes involving agricultural or manufactured goods, a country seeks to restrict imports. Many reasons may be given for this, including fiscal needs, support for an infant or a "strategic" industry, public considerations (health, environment, safety etc.), or as a response to trade practices that the importing country perceives to be unfair. Conversely, most importing countries are eager to obtain natural resources from foreign suppliers. But exporting countries may be reluctant to allow their resources to flow freely to other nations, also for a variety of reasons. These include fiscal needs, the desire for economic diversification through additional processing of raw materials, ensuring adequate domestic supplies, and protecting the environment.

The uneven geographical distribution of traded natural resources is further illustrated by Maps 1 to 5 in the

Appendix, which show net exporters and net importers by product, based on merchandise trade data from the UN Comtrade database. The distribution of fuels and non-ferrous metals is particularly noteworthy, since all of the world's largest industrial economies are net importers of these goods. With few exceptions, European countries are net importers of all types of natural resources, as are Japan and the Republic of Korea. The United States is a net exporter of forestry products and mineral ores, but a net importer of all other tradable resources. India and China are only net exporters of fish, while they are net importers of the other resource products dealt with in this report. Russia is a net exporter, except of fish. Among major developed economies, only Canada is a net exporter of all types of natural resources discussed here.

Water is mostly non-traded but it is also very unevenly distributed across countries. According to the United Nations, humanity is facing a drastic problem of water scarcity (United Nations, 2009). The vast majority of the earth's water resources are salt water, with only 2.5 per cent being fresh water. Approximately 70 per cent of the fresh water available is frozen in the icecaps of Antarctica and Greenland, leaving just 0.7 per cent of total world water resources for consumption, and of this 0.7 per cent, roughly 87 per cent is allocated to agricultural purposes. The world's limited reserves of clean, fresh water for human consumption are shrinking fast, posing a serious threat to public health, political stability and the environment.

Among the main factors aggravating water scarcity are population growth, increasing urbanization, and high levels of per capita consumption. Climate change is also expected to contribute to greater water scarcity in the future, as rising temperatures lead to droughts, desertification and increasing demand for water. The problem of water scarcity is more acute in some countries than in others, which is illustrated by Map 6 in the Appendix. It shows that per capita water supplies are many times greater in countries like Canada, Russia and Brazil than they are in the Middle East and large parts of Africa. For example, Canada's supply of 87,000 m^3 per person per year is roughly nine times greater than the 9,800 m^3 available to citizens of the United States every year. However, the US supply is nearly 14 times greater than that of Egypt, at 700 m^3 per person per year. Moreover, Egypt's water supply is roughly seven times greater than that of Saudi Arabia, with resources of just 95 m^3 per person per year (UN Food and Agriculture Organization, AQUASTAT database).

International trade could conceivably help to alleviate local problems of water scarcity by moving resources to where they are most needed. However, countries are unable or unwilling to do so, as large-scale shipments are essentially non-existent. Reasons for this lack of trade are largely technical, since water is bulky and is therefore difficult to transport. Water scarcity or abundance also tends to be shared by most countries within a given region, so water would have to be transported long distances to make a difference to the problem of scarcity.

Although water itself may not be tradable, international trade can have an indirect and beneficial effect on domestic supplies of water. Exports of water-intensive products (e.g. agricultural goods) from regions of water abundance to regions where water is scarce can generate savings in importing countries by freeing up resources for other uses. For example, from 1997 to 2001, Japan's imports of water-intensive goods saved the country 94 billion m^3 of water that would have been required if Japan had produced the goods domestically (Hoekstra, 2008b).

(c) Externalities

An externality occurs when the actions of one economic agent affect other agents indirectly, in either a positive or negative way (Nicholson, 2001). Another way of expressing this is that the outcomes of certain activities may impose external costs on, or provide external benefits to, consumers or firms not involved in the relevant production or consumption decision. These "externalities" can be negative or positive. An example of a negative externality would be when a production process results in pollution that adversely affects the health of people who live nearby, or that damages the natural environment in a way that reduces the well-being of individuals indirectly. A positive externality might occur when homeowners make improvements to their properties that raise the market value of neighbouring houses as well.

From a perspective of social well-being, externalities cause goods to be over-produced or under-produced, depending on whether the externality is positive or negative. This is because the market price of the good in question does not reflect its true cost or benefit to society. A good whose production and use imposes external costs on other agents would tend to be over-produced because these additional costs are not included in the buyer's calculations. On the other hand, goods that provide external benefits tend to be under-produced because their market price is too low. The solution to the problem of externalities, whether positive or negative, is to internalize all costs and benefits into the price of the good, but this is difficult to achieve in practice without the intervention of an external agent such as a government.

Natural resource economics is mostly concerned with negative externalities arising from the extraction and consumption of resources, but positive externalities in this area are not inconceivable. For example, over-fishing of one species of fish may benefit another competing species and improve the welfare of other fishing enterprises. Another example would be when a mining company builds a road that enables nearby farmers to ship their goods to market. Since this kind of unintended consequence is rare, the remaining discussion will focus exclusively on negative externalities. Externalities will be discussed in greater detail in Section C, but the following examples illustrate the problem in the context of natural resources.

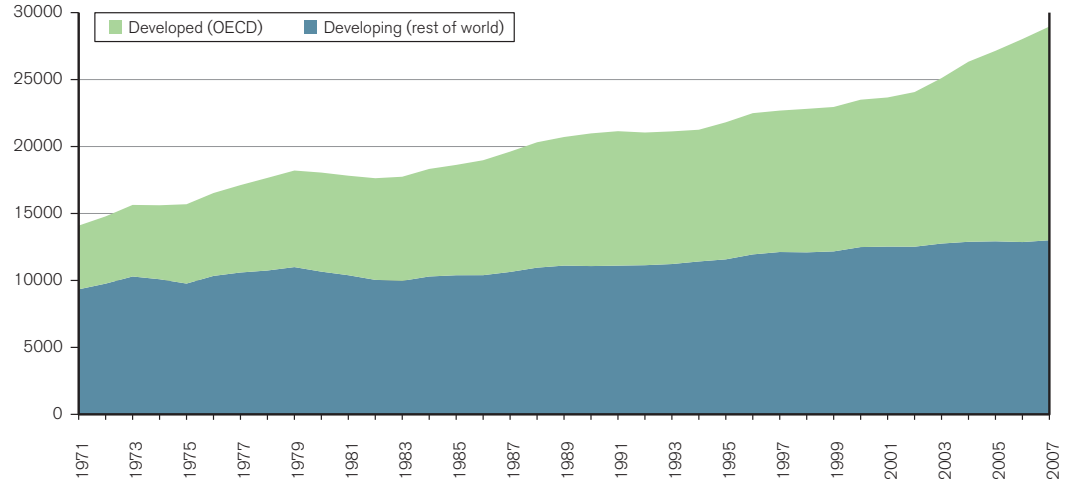
The burning of fossil fuels produces a variety of pollutants that directly harm human health, while also emitting large quantities of greenhouse gases (mainly CO_2) that contribute to global warming. Since global warming affects everyone on the planet, including people who consume little fuel, the consumption of fuels results in large externalities.

According to statistics from the International Energy Agency, annual world CO_2 emissions from fuel combustion more than doubled between 1971 and 2007, rising from 14.1 billion tonnes to 28.9 billion tonnes (International Energy Agency (IEA), 2009a). During this period the share of developing countries in world emissions increased from 34 per cent to 55 per cent (see Figure 3). This increase can be attributed to population growth, rising GDP, and increasing per capita CO_2 emissions in a number of developing countries. Global CO_2 emissions per person grew by around 17 per cent between 1971 and 2007, with sharper increases towards the end of the period on account of rapid growth in some emerging economies (see Figure 4). Per capita CO_2 emissions of most developed economies rose through the 1970s, but have since either stabilized or declined slightly.

The above figures are not adjusted for levels of economic activity. The influence of this factor is observable in terms of the carbon intensity of world output, or the CO_2/GDP ratio (see Figure 4). The ratio declined 33 per cent at the global level between 1971 and 2007. To the extent that globalization raises consumption of fossil fuels through higher incomes and industrialization, it can be seen as having a negative impact on the environment, but the increased efficiency of production and the spread of technology associated with globalization may create some countervailing benefits.

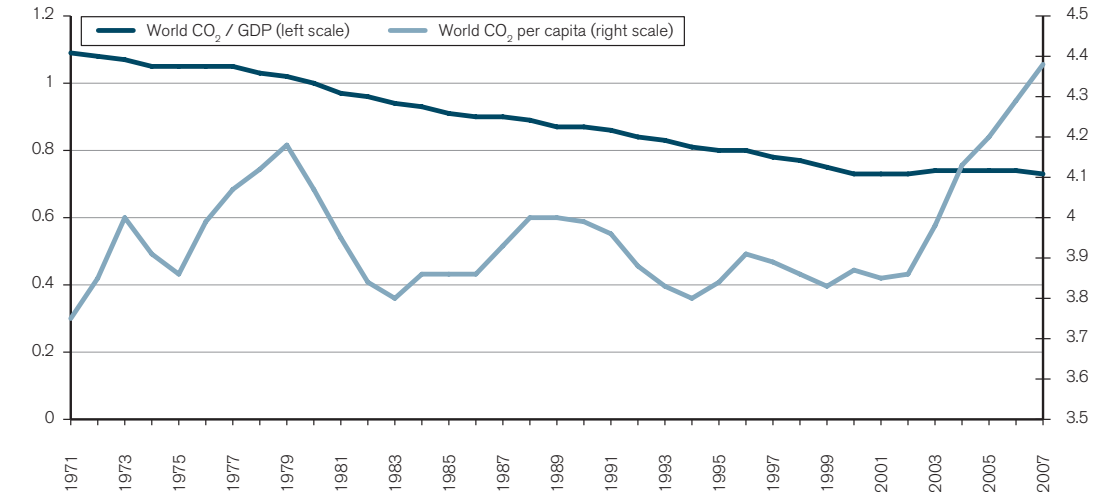
Another example of a negative externality is Hardin's well known "tragedy of the commons" (Hardin, 1968) in which lack of ownership rights over a common pool

Figure 3: **Total world CO_2 emissions by level of development, 1971-2007** (Million tonnes of CO_2)



Source: International Energy Agency.

Figure 4: **World CO_2 / GDP and CO_2 per capita, 1971-2007**
(kg of CO_2 per 2000 US dollars and tonnes of CO_2 per capita)



Source: International Energy Agency.

resource leads to depletion of that resource. The tragedy of the commons was first used to explain overgrazing on public land, but the concept can also be applied to other common pool resources such as forests. Table 1 shows the countries with the largest declines in forest land between 1990 and 2005, based on data from the World Bank's World Development Indicators database. Countries in South America and Africa experienced the biggest declines during this period, while other regions recorded smaller drops, or in some cases small increases. Europe saw its forest area rise more than any other region, but there is considerable uncertainty surrounding increases in other areas, particularly in Russia. It should be noted that forests differ significantly in the number of plant species they contain and the number of animal species that inhabit them, so that a given decline in forested land may have a greater impact on biodiversity in some regions than in others. As of 2005, 11 per cent of the world's forests were designated for the protection of biodiversity (FAO Global Forest Resources Assessment, 2005).

(d) Dominance of natural resources

Another important feature of natural resources is the dominant position of this sector in many national economies. Many of these countries tend to rely on a narrow range of export products. Table 2 shows export concentration indices from the 2008 UNCTAD Statistical Handbook, along with shares of natural resources in total merchandise exports for selected economies. Concentration indices are based on the number of products in the Standard International Trade Classification (SITC) at the 3-digit level that exceed 0.3 per cent of a given countries exports, expressed as a value between 0 and 1, with values closer to 1 indicating greater concentration. It is clear that with very few exceptions, countries with the highest export concentration scores also have high shares of natural resources in total exports.

Appendix Tables 8 and 10 show leading traders of fuels and mining products in 2008 and also illustrate the importance of these products for exporting and importing countries alike. For example, the share of fuels in Saudi Arabia's total merchandise exports was some 90 per cent in 2008, while the equivalent share for Iran was 82 per cent. Export shares for Kuwait, the Bolivarian Republic of Venezuela, Algeria, Nigeria and Angola were all in excess of 90 per cent. Although not as high as the shares for exports, fuels made up a significant part of imports for the leading developed economies in 2008, including the United States (23 per cent) and Japan (35 per cent).

Shares of mining products in total exports are much smaller than the equivalent shares for fuels, but mining products still dominate exports in many countries, including Zambia (80 per cent), Chile (60 per cent), Niger (58 per cent), Jamaica (56 per cent) and Peru (43 per cent).

The dominance of natural resources in exports conforms with predictions from trade theory that countries will specialize in the production of goods where they have a comparative advantage, and export them in exchange for other goods. However, the fact that many countries are both exporters and importers of natural resources is harder to explain. The Grubel-Lloyd (GL) index provides a useful measure of this kind of "intra-industry" trade. For a given country, the share of intra-industry trade in sector i is defined as follows:

$$GL_i = 1 - (|export_i - import_i| / (export_i + import_i))$$

If a country only exports or imports good i, then the GL index for that sector would be equal to 0, whereas if a country imports just as much as it exports it would have a GL score of 1 for that sector.

Table 1: **Countries with the largest declines in forested land, 1990-2005**
(1000 sq. km and percentage of land area)

	1000 sq. km		% of land area
Brazil	-423	Honduras	-24
Indonesia	-281	Solomon Islands	-21
Sudan	-88	Korea, Rep of	-17
Myanmar	-70	Indonesia	-15
Congo, Dem. Rep.	-69	Cambodia	-14
Zambia	-67	Zimbabwe	-12
Tanzania	-62	Nicaragua	-12
Nigeria	-61	Philippines	-11
Mexico	-48	Timor-Leste	-11
Zimbabwe	-47	Myanmar	-11
Bolivarian Rep. of Venezuela	-43	Ecuador	-11
Australia	-42	Liberia	-9
Bolivia	-41	Zambia	-9
Philippines	-34	Benin	-9
Cameroon	-33	Ghana	-8

Source: World Bank World Development Indicators.

Table 2: **Export concentration and share of natural resources in merchandise exports, 2006**
(Indices and percentage)

	UNCTAD Concentration Index (0-1)	Share of natural resources in total exports (per cent)
World	0.08	24
Angola	0.96	100
Iraq	0.95	100
Bolivarian Rep. of Venezuela	0.91	96
Sudan	0.87	95
Congo	0.87	..
São Tomé and Príncipe	0.87	47
Nigeria	0.86	92
Yemen	0.85	91
Libyan Arab Jamahiriya	0.84	97
Gabon	0.84	95
Bahrain	0.79	90
Iran	0.78	86
Tajikistan	0.77	67
Solomon Islands	0.77	81
Maldives	0.77	99
Saudi Arabia	0.76	88
Guinea-Bissau	0.75	1
Oman	0.75	79
Mali	0.75	75
Mauritania	0.74	87

Source: UNCTAD Handbook of Statistics 2008 and WTO Secretariat estimates.

Table 3 shows GL indices for natural resources in major economies at the 3-digit SITC level. Figures closer to 1 indicate more trade in similar products, whereas smaller figures indicate less intra-industry trade. Some products have relatively high scores, including fuels and non-ferrous metals. This could be explained by the fact that these products may be differentiated at lower levels of aggregation, but it is also possible that large diverse economies contain some regions that export natural resources and others that import them. Canada provided an example of this when, in 2006, the province of Ontario imported electricity from the United States while the province of Quebec exported the same product. This conjecture is supported by Table 4, which shows average GL indices for natural resources and manufactured goods for a larger group of countries. The average GL scores for manufactured goods are consistently higher than the scores for resources, but smaller countries also tend to have lower average GL values in both manufactured goods and natural resources.

(e) Volatility

The final characteristic of natural resources examined here is their occasional extreme price volatility. This is especially true for fuels, which have experienced sharp price rises from time to time since the 1970s, only to collapse at a later date. Prices for minerals and metals have also fluctuated dramatically in recent years, although their importance for the world economy is perhaps lessened by their smaller share in world trade. Price volatility for forestry products and fish is much less than for other types of natural resources. According to the International Monetary Fund's International Financial Statistics, fuel prices jumped 234 per cent during 2003-08, while mining products rose 178 per cent. During the same period, prices of fish and forestry products advanced at the relatively modest rates of 38 per cent and 26 per cent, respectively.

Figure 5 shows the evolution of prices for West Texas Intermediate (WTI) crude oil from 1970 to 2009. The first big price increase occurred in 1973, when members of the Organization of Petroleum Exporting Countries (OPEC) proclaimed an embargo against the United States and other countries that supported Israel in the Arab-Israeli war. Prices again rose sharply in 1979-80 following the Iranian revolution and the outbreak of the Iran-Iraq war. This was followed by a steep slide between 1982 and 1986, during which oil prices fell roughly 75 per cent in real terms. A prolonged period of weakness ended in 2003, when prices began their climb to the record levels of mid-2008. This was followed by yet another collapse brought on by the global recession.

The most noteworthy features of this chart are the sustained deviations of oil prices from their long-run average. Between 1979 and 1986 prices were consistently above their average level during the period 1970-2009. Then, with the exception of a brief spike that coincided with Iraq's invasion of Kuwait, oil prices stayed below average from 1986 until 2005. Since 2005 prices have remained above average except for a brief period in February 2009.

A number of possible explanations for these large swings in oil prices have been put forward, including geopolitical uncertainty, shocks to the flow of oil, changes in demand and speculation. There is no consensus in the relevant literature on which of these forces is most important, but recent research suggests that changes in supply are relatively unimportant, while changes in demand associated with global business cycles have significant effects (Kilian, 2009).

Table 3: **Grubel-Lloyd (GL) indices for selected economies, 2008** (Index, 0-1)

United States		**European Union (27)**	
Stone, sand and gravel	0.93	Briquettes, lignite, peat	0.96
Other crude materials	0.92	Petroleum products	0.93
Iron ore, concentrates	0.91	Wood, simply worked	0.89
Natural abrasives	0.83	Non-ferrous waste, scrap	0.86
Fuel wood, wood charcoal	0.78	Silver, Platinum, etc.	0.86
Petroleum products	0.73	Electric current	0.84
Pulp and waste paper	0.69	Nickel	0.84
Residual petroleum products	0.68	Natural abrasives	0.82
Nickel ore, concentrates, etc.	0.67	Stone, sand and gravel	0.78
Fish (fresh, chilled, frozen)	0.67	Residual petroleum products	0.77
Ores, concentrates of base metals	0.65	Copper	0.73
Aluminium	0.64	Ferrous waste, scrap	0.72
Nickel	0.64	Pulp and waste paper	0.68
Petroleum gases	0.62	Coal gas, water gas, etc.	0.65
Silver, platinum, etc.	0.60	Lead	0.63
Japan		**China**	
Lead	0.95	Petroleum gasses	0.91
Aluminium ore, concentrates, etc.	0.85	Crustaceans, molluscs, etc.	0.85
Petroleum products	0.84	Fish (fresh, chilled, frozen)	0.85
Residual petroleum products	0.84	Coal, not agglomerated	0.81
Pulp and waste paper	0.71	Residual petroleum products	0.80
Non-ferrous waste, scrap	0.68	Fuel wood, wood charcoal	0.78
Precious metal ores, concentrates	0.66	Silver, platinum, etc.	0.74
Nickel	0.62	Wood, simply worked	0.73
Zinc	0.61	Other crude minerals	0.68
Petroleum gases	0.54	Natural gas	0.66
Natural abrasives	0.53	Petroleum products	0.63
Coke, semi-coke	0.51	Lead	0.62
Aluminium	0.42	Aluminium	0.61
Copper	0.42	Natural abrasives	0.46
Silver, platinum, etc.	0.40	Liquified propane, butane	0.42

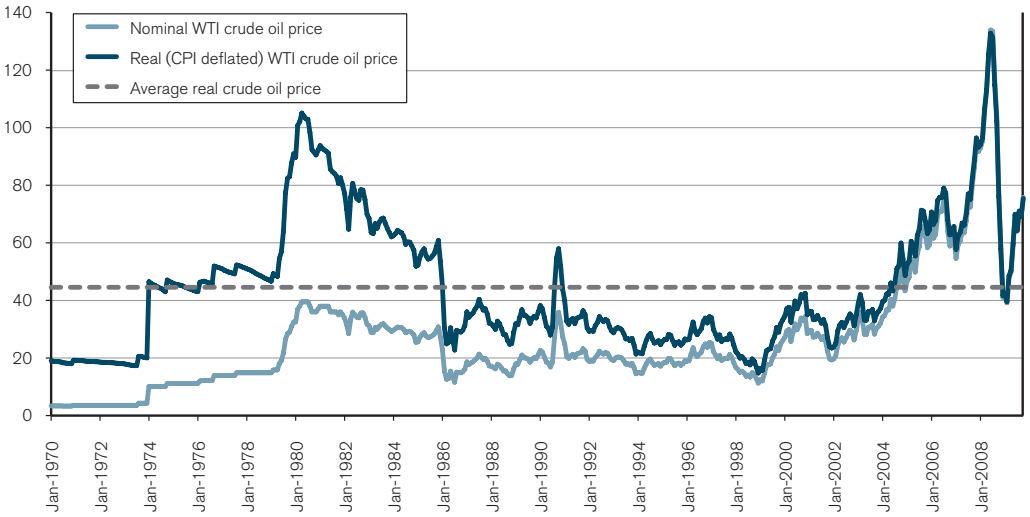
Source: UN Comtrade database.

Table 4: **Average GL indices for manufactured goods and natural resources, 2008** (Index 0-1)

	Natural resources	Manufactured goods
Australia	0.28	0.33
Bahamas	0.06	0.13
Brazil	0.29	0.52
Canada	0.49	0.59
China	0.34	0.47
European Union (27) extra-trade	0.47	0.68
Iceland	0.09	0.14
India	0.27	0.53
Japan	0.29	0.49
Russian Federation	0.25	0.32
South Africa	0.33	0.46
Sri Lanka	0.16	0.20
United States	0.49	0.68

Source: WTO Secretariat estimates.

Figure 5: **Nominal and real crude oil prices, Jan. 1970-Oct. 2009** (Current dollars per barrel and 2008 dollars per barrel)



Note: West Texas Intermediate crude oil prices are deflated by US CPI for all urban consumers to obtain real prices.
Source: Federal Reserve Bank of St. Louis.

2. Natural resource trade flows and related indicators

Having defined natural resources in general terms as the sum of forestry products, fish, fuels and mining products, we now present a variety of descriptive statistics on international trade in these products. Merchandise trade data are first shown at the world level, but are then progressively broken down by product and region to give a more detailed picture of global trade flows. Tables on trade of individual countries by product are provided in a statistical appendix, which also contains illustrative maps showing a variety of resource-related indicators.

Two definitions of natural resources are used in the merchandise trade statistics, with one slightly broader than the other. Tables showing country and product shares in world natural resources trade use the narrower definition that only includes forestry products, while tables on trade by geographic region use the slightly broader definition that includes all agricultural raw materials. This is solely for reasons of data availability, and the difference is minimal at the world or regional level.

Some grey areas in product coverage should be noted. In addition to raw fossil fuels such as coal, crude oil and natural gas, the fuels product group also encompasses refined petroleum products and electricity. It may seem odd at first to count electricity (see Box 1) and refined fuels as resources, since their production requires substantial capital inputs, and the final output is produced by human activity rather than simply extracted from the natural environment. However, fossil fuels are rarely consumed in their raw form, so we may still consider refining and electricity generation to represent the minimum amount of processing necessary to allow these goods to be traded.

Nominal trade flows are expressed in current US dollars and are strongly influenced by changes in exchange rates and commodity prices. This is especially true of fuels, which represent the largest component of natural resources trade in dollar terms, making up some 77 per cent of world natural resources trade and 18 per cent of total merchandise trade in 2008.

(a) World trade in natural resources

The dollar value of world exports of natural resources increased more than sixfold between 1998 and 2008, rising from US$ 613 billion to US$ 3.7 trillion, thanks in large part to steadily rising prices for primary commodities (see Figure 6). Higher oil prices in particular helped push the share of fuels in world natural resource exports to 77 per cent in 2008 (US$ 2.9 trillion), up from 57 per cent in 1998 (US$ 429 billion). Although prices for metals have also risen sharply in recent years, they have not kept pace with fuels, and as a result the 2008 shares of ores and other minerals and non-ferrous metals in natural resources trade fell to 8.2 per cent (US$ 308 billion) and 9.6 per cent (US$ 360 billion), respectively. Shares for these products were also below their respective long-run averages of 8.3 per cent and 13.3 per cent.

The value of global fish exports rose from US$ 53 billion in 1998 to US$ 98 billion in 2008, while exports of forestry products increased from US$ 52 billion to US$ 106 billion. Despite the growing dollar value of fish and forestry exports, shares of these products in world natural resources trade fell from 8.6 per cent to 2.6 per cent and from 8.5 per cent to 2.9 per cent, respectively, due to the even faster growth of fuels and mining products.

Higher commodity prices also boosted the share of natural resources in world merchandise trade from 11.5 per cent in 1998 to 23.8 per cent in 2008 (see Figure 7). Meanwhile, the share of fuels in world trade jumped

Box 1: **Is electricity a natural resource?**

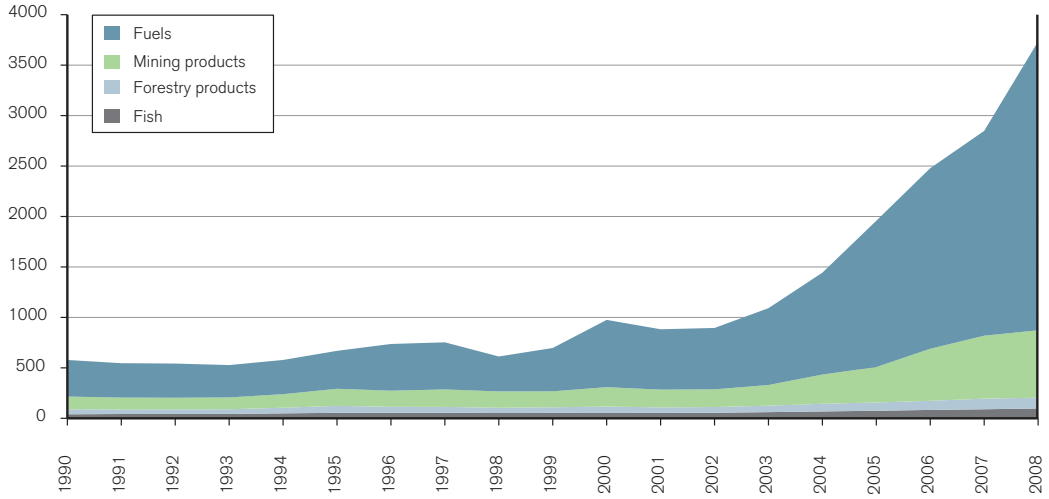
Electricity is generated from natural resources such as coal, gas, water, and uranium, but should it also be considered a natural resource? Since its production requires other natural resources as inputs, it is perhaps more natural to view electricity as a manufactured good. However, electricity arguably should be counted as a natural resource since some processing must be applied to most resources before they can be traded or consumed. In this respect, electricity can simply be seen as transformed coal, natural gas, etc. Electricity also allows energy resources that are normally untradable (e.g. flowing water in rivers used for hydroelectric generation) to be traded across national borders.

Electricity has a number of unusual properties that distinguish it from other goods. First, it is intangible and can only be stored in very small quantities. (An exception is pumped-storage of hydro energy, where water is pumped uphill into a reservoir during low demand periods and released later during high demand periods in order to generate additional electricity to balance supply and demand more efficiently.) Also, it must be produced at the same time that it is consumed, making it more like a service than a good. Electricity is classified as a fuel in international trade statistics, but it is not recorded systematically by all countries. As a result, merchandise trade statistics on electricity may be incomplete or inaccurate.

Generation facilities can be classified as base-load capacity or peak-load capacity depending on the type of fuel used. Base-load capacity has low marginal cost but usually has very large fixed costs. Examples include hydroelectric and nuclear power plants. Peak capacity has high marginal cost but is usually much more flexible in terms of scheduling output. Natural gas is often used for peak-load generation. Patterns of international trade in electricity depend to some extent on the type of generating capacity that a country possesses. Some countries export large quantities of nuclear energy (e.g. France) or hydroelectric power (Canada), resulting in large volumes of trade but lower cost per unit. Other countries may engage in international trade only during times of peak demand (e.g. to meet air-conditioning demands on hot summer days) in order to maintain the stability of their electricity grids. In such cases, the volume of electricity trade could be quite small but the dollar value might be large.

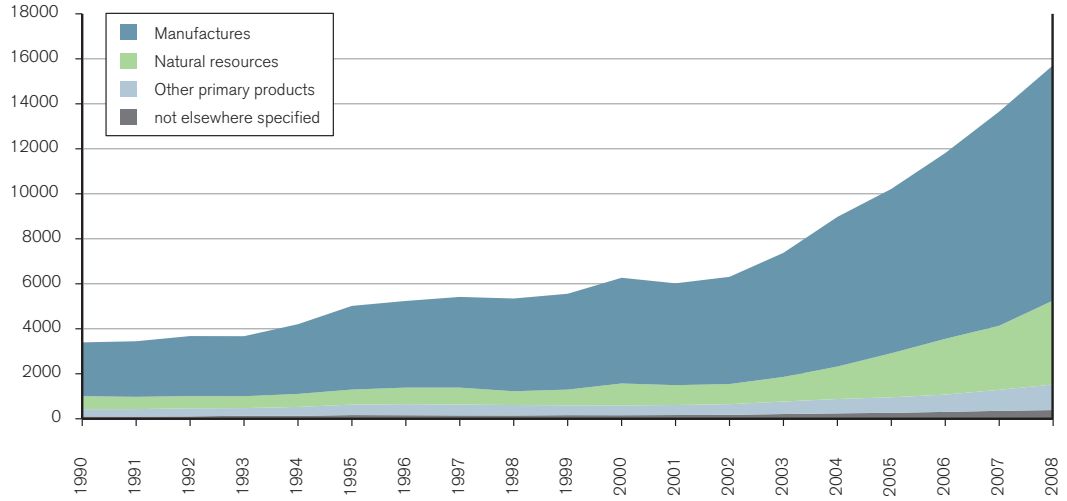
International trade in electricity is limited by physical constraints, including geographic proximity and infrastructure requirements. Only neighbouring countries trade electricity. Furthermore, power systems across countries must be interconnected. Importantly, international trade in electricity can result in better use of complementary resources (e.g. using flexible hydro generation to export peak power and importing thermal power during off-peak hours), the balancing of annual demand variations and of current versus future needs, and the pooling of reserve capacity.

Figure 6: **World natural resources exports by product, 1990-2008** (Billion dollars)



Source: WTO Secretariat estimates.

Figure 7: **World merchandise exports by product, 1990-2008** (Billion dollars)



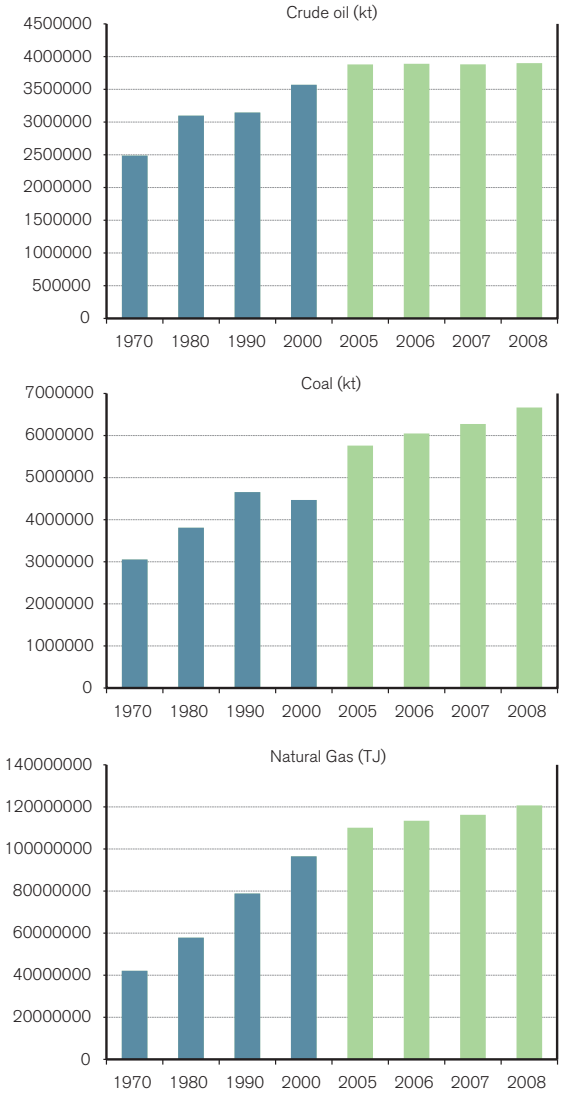
Source: WTO Secretariat estimates.

from 6.5 per cent to 18.2 per cent. Total merchandise exports increased from US$ 5.3 trillion to US$ 15.7 trillion during the same period, implying an average annual growth rate of 12 per cent, while natural resource exports grew 20 per cent per year on average over this period. Exports of manufactured goods increased from US$ 4.1 trillion in 1998 to US$ 10.5 trillion in 2008, an average growth rate of 10 per cent per year, or about half the rate of increase of natural resources. Despite the rapid growth of natural resources trade, manufactured goods still made up the bulk of world merchandise exports in 2008, at 66.5 per cent.

The growing share of oil in world trade is mostly the result of higher prices rather than increased quantities. This is illustrated by Figure 8, which shows world production of fossil fuels including crude oil since 1970. Output of oil has been remarkably steady in recent years, but this has coincided with rising demand on the part of major developing countries such as China and India, which has put upward pressure on prices. Constant oil production also fails to keep up with demand due to normal population growth. It should be noted that the relationship between world oil trade and production is not one-to-one, but given the uneven distribution of these resources across countries, it is reasonable to link the two. The share of world oil production that is exported has in fact been remarkably steady over time, rising from 50 per cent in 1970 to 55 per cent in 2000, and remaining unchanged since then. Coal and natural gas production has continued to expand in recent years, mostly to meet growing demand for electricity generation (International Energy Agency (IEA), 2009b).

For a longer-term perspective on natural resources trade, we must resort to estimation, since breakdowns of merchandise trade statistics by product are not readily available for the years before World War II. Using historical data from the United Nations and the General Agreement on Tariffs and Trade (GATT), it is possible to construct a data series going back to 1900

Figure 8: **World production of fossil fuels by product, 1970-2008** (kt and TJ)



Source: International Energy Agency.

that shows the split between manufactured goods, natural resources and other primary products, with a more detailed breakdown of natural resources available beginning in 1955 (see Figure 9). These data show that manufactured goods only made up about 40 per cent of world merchandise exports at the beginning of the last century, with the remaining 60 per cent being primary products, including natural resources and agricultural products. However, between 1955 and 2000 the share of manufactured goods in world trade increased steadily from 45 per cent to 75 per cent, largely at the expense of agricultural products. The share of natural resources also tended to fall after 1955, but the decline was less pronounced than for agricultural goods and was punctuated by increases coinciding with oil price rises.

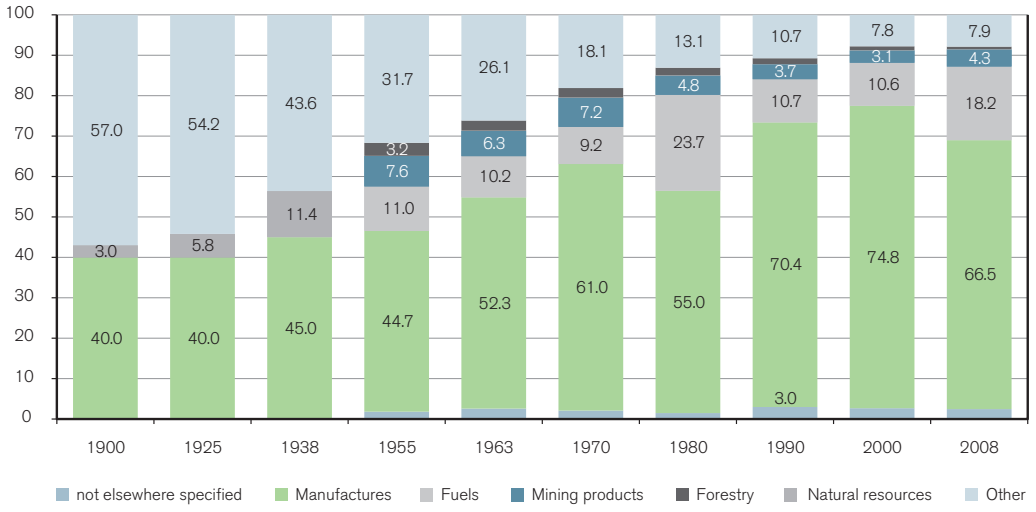
Between 1955 and 2004 the share of natural resources in world trade fell from 22 per cent to 14 per cent, but rose to 30 per cent in 1980 and to 24 per cent in 2008 due to higher prices for oil and other commodities. The rising share of natural resources between 1900 and 1955 is probably explained by trade in fuels, which was negligible at the beginning of the century but which expanded as use of the automobile became more widespread.

The pre-war shares for natural resources in Figure 9 are very rough estimates and therefore should be interpreted with caution. The definition of manufactured goods also differs slightly in the earlier period since it includes non-ferrous metals, which means that the rise of manufactured goods depicted in Figure 9 may be slightly understated. Whether the share of manufactured goods will continue to rise is difficult to say, but this chart suggests a large part of international trade in natural resources may be in the form of manufactured goods.

(b) Natural resources trade by region

Due to the uneven distribution of natural resource deposits across countries, the pattern of exports is quite different from one region to another. For some regions (e.g. the Middle East, Africa, the Commonwealth of Independent States), resources represent a significant proportion of merchandise exports, while others (Asia, Europe and North America) have more diverse export profiles (see Table 5). South and Central America is an intermediate case, with resources making up a significant, but not dominant share of merchandise exports. In 2008, the Middle East had the largest share of resources in merchandise exports, at 74 per cent, with total shipments of resources valued at US$ 759 billion.

Figure 9: **Shares of product groups in world merchandise trade since 1900** (Percentage)



Source: UN Statistical Yearbook (1969), GATT Studies in International Trade No. 7 and WTO Secretariat estimates.

Table 5: **Natural resources exports by region, 2008**[a] (Billion dollars and percentage)

	Value	Share in total merchandise exports
World	3855.4	25
Middle East	758.7	74
Africa	406.0	73
Commonwealth of Independent States (CIS)	489.7	70
South and Central America	281.3	47
North America	397.8	20
Asia	630.4	14
Europe	891.5	14

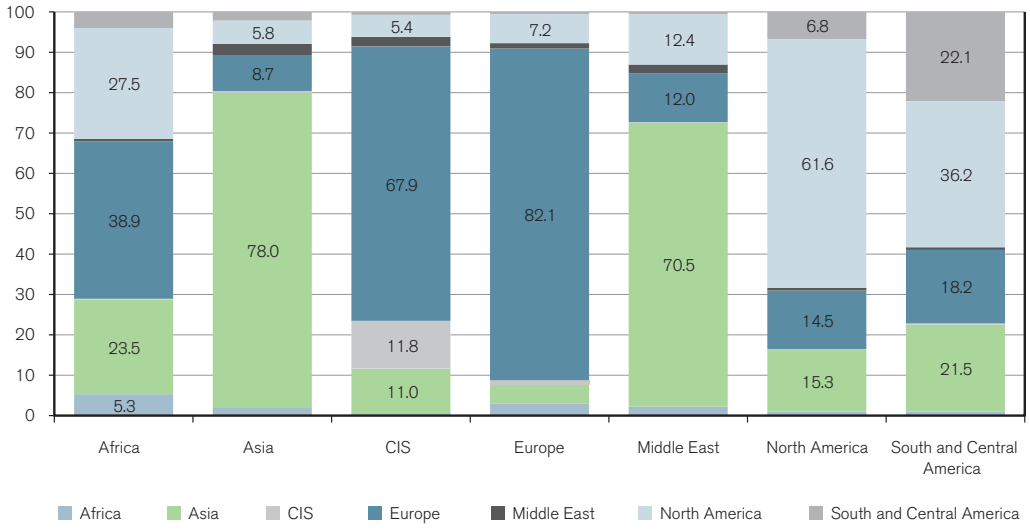
[a] This table uses the broad definition of natural resources to include all agricultural raw materials rather than just forestry products. As a result, the world total is slightly larger than the US$ 3734.2 shown in Appendix Table 1.
Source: WTO Secretariat estimates.

The total value of Africa's exports of natural resources was just under US$ 406 billion, representing 73 per cent of the continent's exports. Resource exports from CIS countries were worth US$ 490 billion, equal to 70 per cent of total merchandise exports. Europe had the smallest share of resources in total exports at 14 per cent, although the value of this trade was greater than any other region at nearly US$ 892 billion. Asia's share of resources in exports was relatively low, at just over 14 per cent, but the total value of resource exports was the second largest of any region at nearly US$ 630 billion. South and Central America exported natural resources worth US$ 281 billion, or nearly half of the region's total exports. In general, more industrialized regions have smaller shares of resources in exports than less industrialized regions.

Regions that predominantly export natural resources tend to ship these goods to other regions, whereas regions that produce more manufactured goods have much higher intra-regional shares in natural resources trade (see Figure 10). For example, 82 per cent of Europe's exports of natural resources were shipped to other European countries. Similarly, 78 per cent of Asia's exports were intra-regional, as were 62 per cent of North America's exports. On the other hand, the intra-regional shares for the Middle East, Africa and the CIS were 2.3 per cent, 5.3 per cent and 11.8 per cent, respectively. The intra-regional share of South America was higher than those of other resource exporting regions at 22 per cent, but this is still well below the levels recorded by industrialized regions.

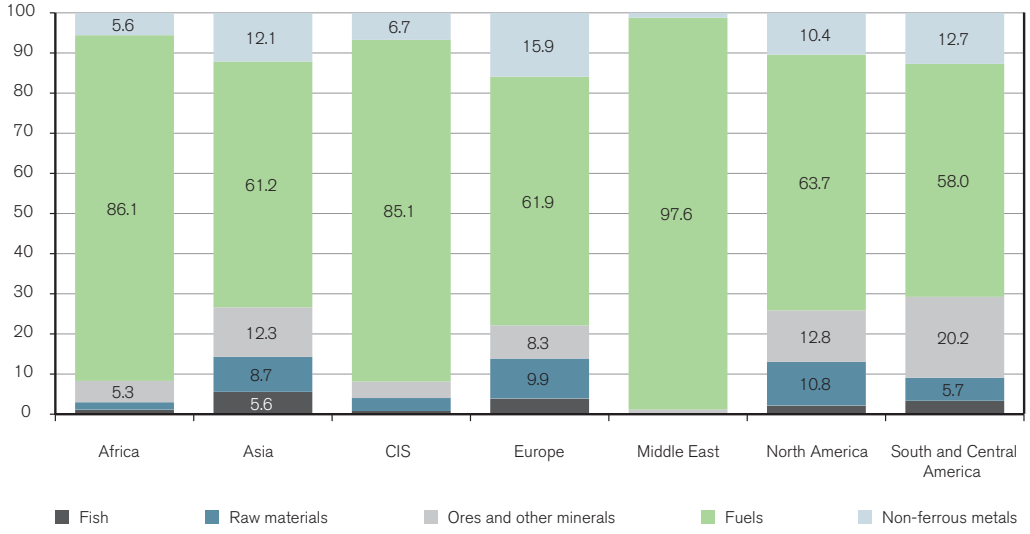
Fuels were the largest component of natural resource exports for all regions in 2008 (see Figure 11). Resource exports from the Middle East were almost entirely composed of fuels, with a 98 per cent share in resource exports. South and Central America had the smallest

Figure 10: **Natural resources exports of regions by destination, 2008** (Percentage)



Source: WTO Secretariat estimates.

Figure 11: **Natural resources exports of regions by product, 2008** (Percentage)



Source: WTO Secretariat estimates.

share of fuels in natural resource exports (58 per cent) due to significant exports of ores and other minerals (20 per cent) and non-ferrous metals (12 per cent). Shares of fuels in natural resources trade for Asia, Europe and North America were all between 61 per cent and 64 per cent. North America had the largest share of raw materials in its exports, at 10.8 per cent, followed by Europe at 9.9 per cent and Asia at 8.7 per cent.

(c) Leading exporters and importers of natural resources

Appendix Tables 2 and 3 show the top 15 exporters and importers of natural resources, both including and excluding the member states of the European Union. The largest exporter of natural resources in 2008 (including EU members) was Russia, with exports of US$ 341.2 billion or 9.1 per cent of world natural resources trade. The share of natural resources in Russia's merchandise exports rose to 72.9 per cent in 2008 as the value of resource exports jumped 34 per cent year-on-year. Russia was followed by Saudi Arabia (exports of US$ 282 billion, or 7.6 per cent of world trade), Canada (US$ 177.7 billion or 4.8 per cent), the United States (US$ 142.5 billion or 3.8 per cent), Norway (US$ 130.6 billion or 3.5 per cent) and Australia (US$ 114.3 billion or 3.1 per cent).

The leading importer of natural resources in 2008 (also including EU members) was the United States. The country's resource imports were worth US$ 583.4 billion, or 15.2 per cent of world natural resources trade. US imports of natural resources increased 27.9 per cent in 2008 while the share of natural resources in total imports rose to 27 per cent, mostly due to higher oil prices. Other leading importing countries include Japan (imports of US$ 350.2 billion or 9.1 per cent of world trade), China (US$ 330.3 billion or 8.6 per cent), Germany (US$ 231.5 billion or 6.0 per cent), Republic of Korea (US$ 182 billion or 4.7 per cent), France (US$ 148.5 billion or 3.9 per cent) and India (US$ 135.4 billion or 3.5 per cent).

If we consider the European Union as a single trader, it ranks fourth in world exports of natural resources after Russia, Saudi Arabia and Canada. The European Union exported US$ 176.6 billion worth of natural resources to the rest of the world in 2008 and imported US$ 766.6 billion, making it the largest single market for natural resources, with a share in world imports (excluding trade within the EU) of nearly 23 per cent. Tables on leading exporters and importers by product are also provided in the Appendix.

Appendix Table 12 shows imports of resources by region and supplier for some of the world's largest economies (the European Union, the United States, Japan and China.) It should be noted that the figures for the European Union include trade within the EU: in 2008, nearly 37 per cent of EU imports originated from within the trading bloc. EU imports overall totalled US$ 1.1 trillion for the year. The top five suppliers of resources to the EU were Russia (16 per cent), Norway (8 per cent), Libya (4 per cent) and the United States (2 per cent). Most of the European Union's imports of natural resources come from Europe, the Commonwealth of Independent States and Africa, which together made up almost 80 per cent of resource imports in 2008.

Total US imports of natural resources in 2008 were valued at US$ 583 billion. The country's top five suppliers of resources were Canada (24 per cent), Saudi Arabia (10 per cent), the Bolivarian Republic of Venezuela (9 per cent), Mexico (8 per cent) and the European Union (7 per cent). Japan's imports for the year came to US$ 350 billion, and its leading suppliers were Saudi Arabia (14 per cent), the United Arab Emirates (13 per cent) Australia (12 per cent), Qatar (8 per cent) and Indonesia (7 per cent). China imported US$ 331 billion worth of natural resources from other countries in 2008. Top suppliers include Australia (10 per cent), Saudi Arabia (8 per cent), Angola (7 per cent), Russia (6 per cent) and Brazil (6 per cent).

3. Modes of natural resources trade

Many natural resources are fairly homogeneous and may be classified as "commodities". Unlike the many varieties of manufactured products – automobiles, for example – they are suited to centralized trading and the formation of a unified price. In addition, characteristics, such as the uneven geographical distribution of natural resources around the world, and the consequent accumulation of market power, has triggered the evolution of alternative modes of trade that reduce market risks, such as disruptions in the supply of critical natural resource inputs. It is important to keep in mind these particular modes of natural resources trade when considering the consequences that some of the key features of natural resources, such as volatility, may have for trade and trade policy.

This sub-section first describes the role of centralized spot and futures markets in commodities trade, notably in the context of organized exchanges. It also provides an account of the evolution of these exchanges, describes their geographical distribution, and highlights their principal functions. These include price discovery, liquidity, management of risk, financial intermediation and clearing house guarantees. Second, we analyze alternative arrangements for trade in commodities that may be important for strategic reasons or quality control. These include bilateral long-term contracts, which are relevant for certain energy and metal commodities. We also explore the prevalence of vertical integration in some natural resource sectors.

(a) Commodity exchanges

(i) Key definitions

A commodity is typically defined as a homogeneous product which can be exchanged among consumers and producers. The term "commodities" is often used in the relevant literature to refer to agricultural goods, but it also

includes a number of other products that are classified as natural resources in this report. Examples are fuels, forestry products, minerals and metals. Given their mostly homogeneous nature and the fact that their quality can usually be easily verified, trade in commodities is facilitated by organized market places where trade is centralized (UNCTAD, 2006). A concentration of buyers and sellers in one place reduces the transactions costs that would be incurred in the search for a suitable counterparty (Thompson and Kunda, 2000).

Trades in organized commodity exchanges are carried out either electronically or verbally in a trading pit between buyers and sellers who are anonymous to each other (Stroupe, 2006). Trades are carried out both "on the spot" and via "futures" contracts, usually on a daily basis. In "spot" markets, physical delivery to the importing nation, via tankers or pipelines, is immediately arranged (Neuhoff and von Hirschhausen, 2005). Commodity producers, marketers, trading companies, local distribution companies and consumers are the major participants in these markets.

In "futures" markets, contracts represent a commitment to buy or sell a given quantity of an underlying product on a given date in the future at a price agreed upon now (Valdez, 2007).[4] This enables market participants to "hedge" or eliminate price uncertainty. For example, a gas distributor may purchase a futures contract to set a price cap on the gas it buys in some future period. Futures contracts dating anything between a few months and several years are traded. Most often, these contracts are settled in cash and do not result in physical delivery of the underlying commodity as the existing position of a trader is negated with the polar-opposite contract and his or her account is closed (Smith, 2009). In futures trading, others in the market besides those involved in the commodity business include hedge funds, banks and commodity index funds. These "non-traditional" investors use commodity markets to diversify their total investment portfolio. Their possible contribution to increased commodity price volatility has given rise to controversy (see Section C.5).

(ii) Evolution

The evolution of modern commodity markets may be traced back to the beginning of agricultural mechanization and the industrial revolution in present-day advanced countries. At the time, trade in agricultural crops was a hit-or-miss proposition. In the United States, for example, farmers went to Chicago to sell their goods because of its central location. However, having little idea of crop demand, farmers took whatever price they could get and unsold crops went to waste in the streets. In the mid-19th century, a central grain commodities market, which allowed farmers to sell their crops directly and on the spot for cash, was created. This market, named the Chicago Board of Trade, is the oldest organized commodity exchange in the world (Nathan, 2008). It reduced transactions costs and enabled buyers and sellers to find a ready market. Subsequently, forward delivery also became an option. Over time, these forward contracts evolved as more farmers began committing their grains to future exchanges for cash. For example, if a producer no longer needed the commodity, he or she would sell it to another producer who did. This dynamic, coupled with the uncertainty of price change over time, led to the rise of futures contracts (UNCTAD, 2001).

(iii) Geographical distribution

The old exchanges are located mainly in the United States (Chicago Board of Trade, Chicago Mercantile Exchange, New York Mercantile Exchange (NYMEX)), the United Kingdom (London Metal Exchange, International Petroleum Exchange) and Japan (Tokyo Commodity Exchange). The 1980s and 1990s saw a proliferation of commodity exchanges in emerging economies such as the Dalian Commodity Exchange, the Zhengzhou Commodity Exchange, and the Shanghai Futures Exchange in China, and various exchanges in East Asia (for example, in Kuala Lumpur, now part of Bursa Malaysia Derivatives), in Latin America (for example, Bolsa de Mercadorias & Futoros in Brazil and Bolsa de Cereales in Argentina) and in Eastern Europe (UNCTAD, 2006).

The 21st century is seeing the onset of a third wave in the evolution of commodity exchanges, driven primarily by developments in information technology. Examples include the National Multi-Commodity Exchange of India, established in 2002, the Dubai Gold and Commodity Exchange (2004) and the Dubai Mercantile Exchange (2005). Africa has seen the least success in developing its commodity exchanges, with the South African Futures Exchange (SAFEX), established in 1987, being the only major commodity exchange (UNCTAD, 2006).

Despite the development of organized commodity exchanges in different parts of the world, there is still a high degree of market concentration with the bulk of commodity trading occurring in just four countries, namely the United States, the United Kingdom, Japan and China. In fact, the top 11 commodity exchanges, in terms of market turnover, are located in one or other of these four countries (Lewis, 2005). Moreover, these exchanges are dominated by certain commodity groups. For instance, in the United States, energy and agricultural futures constitute the lion's share of turnover. In the United Kingdom, commodity trading is highly skewed towards the metals sector. In Japan the focus is on energy commodities and precious metals, and in China trading is dominated by agricultural commodities (Lewis, 2005).

(iv) Key functions

Price discovery

Organized commodity exchanges form natural reference points for determining market prices – the price discovery process – because they enable market supply

and demand forces to determine spot and futures prices. Exchange trading may bring about greater volatility in commodity prices. At the same time, by enabling effective competition (Thompson and Kunda, 2000), it may also result in lower prices, relative to those negotiated by parties in a bilateral contract.

Liquidity

Organized exchanges have facilitated the creation of a common global pool into which nearly all exporters sell their commodities and out of which nearly all importers purchase commodities, on a daily basis (Stroupe, 2006). Hence, they provide more liquidity, as disruptions in supply from one producer country may be offset by alternative supplies from elsewhere. This function of organized exchanges may have implications for price volatility, a key feature of resource commodities, which is analyzed in Section C.5.

Insurance against risk

An important function of futures markets is to allow suppliers and customers to hedge their future requirements for buying and selling commodities at a future contract price. By locking in the price for future delivery, market participants can hedge against unfavourable price movements that may occur before the delivery date (Valdez, 2007). For instance, if a future price rise can cause a loss to the prospective buyer of a commodity, the purchase of a futures contract ensures that the buyer can lock in the price at the current level. In this case, the market is used as an insurance mechanism. Futures contracts may also be bought and sold for speculative reasons, or in other words for profit (or loss) by betting against future price movements.

Clearing house feature

Every organized trading exchange operates with a clearing house, which takes initial margins or deposits from both parties of a contract. Subsequently, if the contract moves into loss, extra margin is debited on a daily basis from the relevant party in order to restore the amount of the initial margin available (Valdez, 2007). Hence, clearing houses provide financial intermediation services to major players in commodity markets and, if sufficiently well-capitalized, minimize risk of contemporary default. They also manage risk associated with exchange transactions by being a central counterparty to all exchange needs – that is, the buyer to every seller and the seller to every buyer (Valdez, 2007). Furthermore, clearing houses protect the integrity of the marketplace by ensuring that trades are executed in accordance with the rules (Neuhoff and von Hirschhausen, 2005)[5] and guaranteeing that contracts are honoured (Valdez, 2007).

(b) Other trading arrangements

Besides organized exchanges, commodities are traded via spot and futures contracts in over-the-counter (OTC) markets. For certain commodities, bilateral trades are important, notably taking the form of long-term supply contracts between countries. Finally, commodities may also be traded in the context of vertically integrated supply chains.

(i) Over-the-counter (OTC) markets

OTC trade is not conducted through a common trading facility, but directly between two parties, which in the case of commodity markets include both traditional (producers and consumers) and non-traditional (index funds and hedge funds) participants. Unlike organized exchanges, OTC markets are characterized by a lack of liquidity, the absence of competition and no protection against default. In addition, they are largely unregulated (Valdez, 2007). Although OTC markets are fundamentally bilateral trading arrangements, the negotiation process is often highly automated with dealers being interconnected among themselves as well as with major customers. This enables traders to survey the market almost instantaneously (Dodd, 2002).

(ii) Long-term contracts

Until the early 1970s, trade in energy commodities such as oil and natural gas, and in metals, such as copper, aluminium and iron ore was conducted primarily through long-term contracts between producer and consumer countries, mostly via state or multinational companies (Stroupe, 2006). These long-term take-or-pay contracts (ToP) join sellers and buyers in a bilateral contract, typically for about 15 to 20 years, during which time both have strictly defined obligations. In particular, these contracts require buyers to pay for a pre-specified minimum quantity of the commodity whether or not it is actually taken. At the same time, in most cases, some form of price indexation is used to protect the buyer against price changes on a long-term basis (Masten, 1988). Hence, the buyer bears the volume risk and the seller bears the price risk. Furthermore, under this system, if one exporting state fails to honour its delivery commitments to another, then the affected consumer state has to acquire replacement supplies (Stroupe, 2006). These arrangements are generally associated with limited market liquidity and significant difficulties can result from supply disruptions. Long-term contracts with price indexation can also have implications for price volatility.

A number of factors may explain the use of long-term contracts. First, several of the sectors involved are characterized by non-competitive producer structures (Golombek et al., 1987). Second, because of their strategic nature, the value of these commodities in long-term contracts may far exceed the sale price in a more competitive market (Parsons, 1989). Third, long-term contracts in commodities trade may function as a device to avoid the risks of opportunistic behaviour when there are high sunk investments (Klein et al., 1978; Williamson, 1983). Fourth, from the perspective of an importing country, long-term contracts are likely to increase the security of supply. Fifth, from the point of view of the exporting country, long-term contracts may serve as a barrier to entry for new market participants. Finally, a

preference for long-term contracts over exchange trading may relate to the nature of transport infrastructure. For example, the existence of a pipeline[6] between two countries may favour long-term contracts, while the availability of tankers that can reach anywhere in the world may encourage trading through exchanges.

Over time, bilateral long-term supply contracts negotiated between exporting and importing states have been complemented and sometimes replaced by trading on organized exchanges. This was true for the United States, the United Kingdom and Western Europe in general.[7] It has been argued that more exchange trading at the expense of long-term contracts may lead to a paucity of long-term information about future production capabilities, and provide an incentive for suppliers to overstate future production capacity in order to ensure high demand and less investment by competitors (Neuhoff and von Hirschhausen, 2005). Box 2 provides an account of this transition in the market for crude oil.

However, bilateral long-term supply contracts for certain natural resource products (energy products, metals and minerals) still exist, involving for instance, Russia or countries in Asia and Africa (Alden, 2009; Stroupe 2006; Energy Report, 2009). The signatories to these contracts are governments of resource-abundant countries and private investors or firms from abroad. Host country governments grant licences to these firms for exploration and extraction, and specify the accompanying fiscal regime. Contracts typically take the form of an initial payment for the licence and, subsequently, a royalty or tax on corporate profits (Collier and Venables, 2009).[8] Of late, some of these bilateral long-term supply contracts have been characterized by pre-specified exchanges akin to barter arrangements. For example, the China International Fund is financing infrastructure investments worth US$ 7 billion in Guinea in exchange for access to its natural resources such as bauxite (Alden, 2009).

Even more recently, there has been an increase in large-scale acquisitions of farmland (a natural resource) in Africa, Latin America, and Central and South-East Asia via contracts between host country governments and private firms, sovereign wealth funds and state-owned enterprises from abroad. This is driven by the lack of arable land and competing uses for agricultural land in the countries making the purchases (Cotula et al., 2009).

(iii) Vertical integration

Supply chains may involve several production stages in certain natural resource sectors. For instance, in the case of energy commodities (oil and natural gas), minerals and metals, they include exploration, extraction, processing or refining, distribution and marketing. Hence, producers sell and convey their output to refiners or processing units. Subsequently, refiners sell their products to wholesale and retail marketers, who in turn sell these products to final consumers (Smith, 2009).

Each stage in the supply chain may be located in a different region of the world, on the basis of comparative advantage (WTO, 2008) (see Section C.1). Hence, firms can lower costs of production by locating different stages of the production process in a country where there is a relative abundance of inputs used relatively more intensively in that stage of production (Jones and Kierkowski, 2001). Firms can carry out this process in one of two ways: vertical integration of various stages of the production process within a single firm or arm's-length contracts between separate, independent firms. The rationale for choosing between the two is also based on comparative advantage (Coase, 1954). For vertical integration to make economic sense, internal suppliers must be more cost-efficient than external suppliers.

In addition to the more general efficiency argument, trade in natural resource commodities may take place within firms for several reasons. First, vertical integration reduces risk as profits in the different stages of the supply chain tend to fluctuate in different ways. For example, in the case of oil, when crude prices are low, refining and marketing margins are likely to be higher (Al-Moneef, 1998). This is especially relevant for resource commodities that are characterized by high

Box 2: The evolution of the market for crude oil trade from long-term contracts to exchange trading

Prior to the early 1970s, crude oil markets were characterized by bilateral long-term supply contracts (with a duration of 10 or 20 years, or more) between exporting and importing countries, usually through multinational oil companies. Eight big oil companies were the "common suppliers" and dominated crude oil trade. They sold large quantities of oil not needed for their own operations to other integrated oil companies, independent refiners and traders to balance out world markets (Mohnfeld, 1980). However, the strengthening of OPEC and the Arab-Israeli war of 1973 led to a wave of nationalization in a group of oil exporting nations. This, in turn, facilitated a targeted embargo of the United States and a dramatic increase in crude oil prices.

Following a brief period of strict price controls, the United States administration initiated a process of deregulation. Oil spot and futures markets were created, and the New York Mercantile Exchange (NYMEX) became the first central oil trading exchange. Over the years, a proliferation of many such organized exchanges have facilitated the creation of a global pool of oil, denominated in US dollars. At the same time, Russia and its producing and consuming partners continue to trade oil through bilateral long-term supply contracts. In addition, there is a trend towards the establishment of new oil exchanges in the Middle East and Asia as rivals to the New York and London exchanges. These more recently established exchanges may denominate trade in currencies other than US dollars (Stroupe, 2006).

Box 3: **Chevron – A case of vertical integration**

Chevron has extensive oil and gas exploration and production operations throughout the world.[10] It is the largest private producer of oil in Kazakhstan, the top oil and gas producer in Thailand, the largest holder of undeveloped natural gas resources in Australia, among the largest holders of deepwater acreage in Nigeria, and it holds leases in the deepwater of the Gulf of Mexico. Furthermore, Chevron works in all segments of the downstream industry — manufacturing, marketing and transportation. The company's refining resources are concentrated in North America, Western Europe, South Africa and the Asia-Pacific rim, serving customers around the world. Chevron markets refined products primarily under three brands: Chevron, Texaco and Caltex. Under transportation, Chevron Pipe Line Co. transports crude oil, natural gas, natural gas liquid, CO_2, petrochemicals and refined products in the United States through an extensive system of pipelines and storage facilities. In addition, Chevron Shipping Co. manages a worldwide fleet of vessels that transport retail products.

price volatility. Second, as opposed to arm's-length trade, vertical integration ensures access to resources or security of supply (Al-Moneef, 1998).

Third, to sell an intermediate good to a particular downstream firm, an upstream supplier may make a location or site-specific costly investment upfront, in order to minimize inventory and transportation costs. Extraction or processing plants for mining products are good examples in this context (Joskow, 2005). Fourth, a shift from spot market exchange to vertical integration may also be attributable to the fact that producers wish to control their supply chains more tightly to satisfy consumer demand for quality and safety (Ménard and Klein, 2004). In the oil and gas sector, for instance, many drilling companies are broadening their functions to include reservoir development and resource management functions.[9] Box 3 provides a brief account of Chevron, which is a vertically integrated oil and gas company with different segments located in different parts of the world.

To summarize, the above discussion has shown that the way in which natural resources are traded may differ from manufactured goods transactions on account of certain specific features. These include the homogeneity, storability, the uneven distribution of supplies and the strategic importance of many natural resources. In light of declining transport costs and the move towards more liberalized markets, a large part of natural resources trade is now conducted at a global level, often via organized commodity exchanges. At the same time, certain commodity markets continue to be characterized by widespread government intervention and market power. The reasons for this may be both economic and non-economic, ranging from industrial development considerations to geopolitical factors.

4. Natural resources: Globalization and the intellectual debate

(a) Globalization of natural resources

Over the past two centuries – and especially over recent decades – there has been a dramatic expansion of the volume and range of natural resources traded internationally. At one time only the most valuable resources were shipped to distant markets. Today vast quantities of almost every raw material imaginable are traded around the planet – fuelling the rapid spread of industrialization and development that is defining the modern economic era. Although a number of factors have contributed to the "globalization" of natural resources – including population growth, colonization, industrialization, and the rise of developing countries – the following section looks at two key developments that have underpinned this process: first, the far-reaching improvements in transport technology since the mid-19th century which have dramatically reduced the costs of commodities trade; and second, the trend towards more liberal natural resource markets, especially since the 1980s, which have opened up an increasingly global marketplace for natural resources.

(i) Shrinking distances

The rise of a world market for natural resources is a relatively recent phenomenon. For most of human history, bulk raw materials were too costly to transport over great distances, which effectively tied economic production to the location of key natural resources, such as wood, coal or iron ore. A major factor in breaking down these constraints is what Nils-Gustav Lundgren describes as three "revolutions" in transport technology (Lundgren, 1996) The first such revolution occurred roughly between the 16th and 18th centuries with a series of incremental improvements to sailing ship design and efficiency. Although high costs still made it too expensive to ship all but the most expensive commodities, such as coffee, cocoa, spices and precious metals, across the oceans, sail transport gradually linked the coastal areas of North and South America, Africa and Asia with Europe, creating for the first time the broad outlines of a "world economy".

A second transport revolution occurred in the mid-19th century when the introduction of steam power to land and sea transportation transformed the economics of moving low-value goods cheaply across great distances. As railways replaced overland transport by horses, and as metal steamships took the place of wooden sailing vessels, a wide range of primary commodities, particularly agricultural products, in North America, South America, Africa and Asia were suddenly economically accessible to the world's industrial centres. This, in turn, greatly expanded the incentive to engage in overseas trade, exploration and investment and significantly widened the scope for industrial expansion. Transatlantic transport costs fell roughly

60 per cent in the decades between the 1870s and the beginning of the 20th century, transforming agricultural trade as North American and Eastern European grain suddenly become competitive in European markets, and accelerating the process of industrial specialization (Lundgren, 1996).

A third revolution in transport technology occurred after the 1950s with the dramatic increase in the average size of merchant ships. The closure of the Suez Canal in 1956-57 (and again in 1965) played a major part in launching this process. Suddenly faced with the expense of transporting oil, coal, iron ore and other bulk commodities over much greater distances, the shipping industry decided to invest in huge, specialized bulk carriers, as well as in the harbour facilities needed to handle these new vessels. Whereas oil tankers averaged 16,000 deadweight tonnes (dwt) in the early 1950s (their design partly constrained by the need to navigate the Suez Canal), they averaged over 100,000 dwts by the 1990s – with modern "super-takers" exceeding 500,000 dwts and capable of carrying over 3 million barrels of oil. The same technological advances have transformed bulk freighters, with ships growing from an average of less than 20,000 dwts in 1960 to about 45,000 dwts in the early 1990s.

Just as the advent of steam transport dramatically reduced the cost of agricultural trade after the mid-1800s, new transport design technology has dramatically reduced the costs of shipping a vast range of low-value bulk commodities in the post-war period. Freight rates decreased by 65 per cent in the period between the 1950s and 1990s, while bulk commodity trade grew from about 500 million tonnes to 3,977 million tonnes – a 657 per cent increase.[11] Overall the cost of transporting natural resources has fallen an astonishing 90 per cent between 1870 and 1990. This, in turn, has massively expanded the volume of raw materials traded, the distances covered, and the commodities involved. Almost every conceivable bulk commodity – from iron ore and phosphate fertilizers, to crude oil and natural gas – is now routinely shipped vast distances across land and oceans. Even resource waste – such as metal scrap, mining tailings, or rejects from forestry and agriculture – is increasingly traded globally.

(ii) More open markets

A second major factor influencing global trade in natural resources has been the ebb and flow of government intervention in national and international commodity markets. While it is difficult to generalize, the extent and type of government intervention in resource markets has appeared to depend not simply on ideological views and trends, but on the relative abundance or scarcity of natural resources on world markets.

Certain interventions, such as international commodity agreements, have been devised to deal with problems of global surpluses and price volatility. Others, such as export restrictions, have been shaped by resource scarcity, the strategic competition among countries for critical raw materials and the quest for economic diversification. If the general trend towards more open markets in recent decades has been driven in part by the relative abundance and price declines of many commodities, it remains an open question whether recent commodity price increases and signs of growing scarcity, especially for strategic raw materials, will give rise to greater government involvement and intervention in resource markets in the future.

An era of relatively free trade in natural resources during the 19th century came to an end in the first half of the 20th century. With the outbreak of the First World War and the effort to cut off enemy supplies, countries became increasingly concerned with securing access to strategic sources of food, fuels and raw materials needed to feed their populations and to supply their armies. The dramatic collapse in prices for many commodities after the war but especially during the Great Depression of the 1930s also led governments around the world to intervene in markets to assist farmers and miners. This trend continued through the Second World War and the beginning of the Cold War in the late 1940s, as governments again took action to secure access to raw materials, both at home and overseas, for strategic and security reasons.

The break-up of pre-war empires, and the resulting process of decolonization in the 1950s and 1960s, precipitated a new wave of government intervention in natural resource markets, as newly independent countries in Africa and Asia sought to gain control of mineral and energy sectors which had previously been in foreign hands. Underpinning many of the interventions during this period was a pervasive faith in the ability of governments and state planning to correct perceived failures in market systems (Skidelsky, 1996).

The various interventions over this period were diverse, wide-ranging and complex. A number of countries, in both the developed and developing world, imposed export tariffs or restrictions on wheat, sugar, rubber, tin and other commodities in an effort to control international supplies and bolster prices. From the 1920s to the 1980s a number of attempts were made – with varying degrees of success – to negotiate international commodity agreements between exporting and importing countries for key commodities, such as coffee, rubber or tin, to manage international supply and trade flows. One reason why these efforts often failed was because consumers were interested in reducing price volatility, while producers wanted to increase prices. For strategic and economic reasons, a number of countries also imposed export restrictions or domestic price controls on key commodities, such as oil. Concerns about growing reliance on foreign suppliers also encouraged some countries to amass strategic stockpiles of oil, tin and other key resources.

Another mechanism for influencing global commodity markets was foreign aid – either in the form of guarantees by importing countries to buy pre-determined quantities of a given commodity, or in the form of food aid or other types of aid, whereby exporting

countries effectively shifted their commodity surpluses on to poorer developing countries (Radetzki, 2008).

However, the trend towards government intervention in natural resource markets – and indeed in economies in general – had started to recede by the 1980s for a variety of reasons. One was the ideological shift away from state planning and controls towards market mechanisms to achieve economic growth.

With the partial exception of the energy sector, commodity markets have witnessed a general trend towards greater openness. Successive rounds of multilateral trade negotiations have resulted in low average tariff levels on most trade in raw materials. International commodity agreements have also declined in number and importance, and greater emphasis has been placed on hedging on commodity exchanges to help stabilize prices. Government-controlled strategic stockpiles have also fallen out of favour. Now largely limited to petroleum, they are a small fraction of what they were several decades earlier. Ideology is not the only explanation for this change. A long-term trend towards falling international prices across many commodities, combined with declining strategic concerns in the post-Cold War era, has reinforced this general shift away from state ownership and control and towards market mechanisms to bolster investment, improve efficiency and secure greater price stability.

While the retreat of governments from active intervention in natural resource markets has been significant, it is hardly universal or even necessarily permanent. The most obvious exceptions relate to agricultural commodities where developed-country tariffs, subsidies and regulations continue to significantly distort global trade. The energy sector represents another obvious example of state intervention in international commodity markets. Not only among OPEC members, but among other energy-producing states, governments remain the dominant players in the oil and gas industry, not only owning and managing the main assets, but actively shaping global markets through controls on output and investment (Institute of International Economics, 2004). Recent efforts by some countries to strengthen their grip over domestic natural resources or to limit supplies on world markets – especially of oil and gas – may foreshadow a new wave of state involvement in natural resource markets, especially as current high prices and profits increase the incentives to do so (Radetzki, 2008).

(iii) Summary

The on-going "globalization" of natural resources trade continues to transform not only the nature of commodity markets but also the structure of the global economy (Krugman, 1991). The huge expansion in the volume and range of natural resources on world markets in recent decades has helped to open up and equalize access to raw materials, lowering prices for many resources, encouraging investment in new, geographically dispersed sources, and generally contributing to global economic expansion. Proximity of natural resources, such as coal or iron ore, is also much less significant to industrial production today than it was a century ago, gradually de-coupling industrial development from natural resource endowments, freeing up industries to establish themselves in the most cost-efficient locations around the world, and accelerating the trend towards international specialization (Radetzki, 2008; Sachs and Warner, 1995). At the same time, the expansion of natural resources trade – and its contribution to growing global consumption – may have implications for resource depletion and negative environmental spillovers.

(b) The intellectual debate: scarcity or surplus?

For over two centuries, a wide-ranging intellectual debate has taken place about the impact of economic growth on the earth's limited natural resources. Some have argued that unrestrained economic growth will lead inevitably to resource depletion and environmental degradation. Others have contended that economic growth and technological progress can help to manage scarce resources and develop alternatives. A central point of disagreement is whether markets, as presently structured, are equipped to deal with these pressures. Present-day concerns about the relationship between globalization, resource scarcity and environmental issues (such as climate change) have given a new sense of immediacy and relevance to these long-standing debates.

(i) Free-market optimism

Adam Smith was the first economist to systematize the argument for the central role of free markets in allocating resources, including natural resources, efficiently and productively. In his *Wealth of Nations,* he famously argued that the pursuit of self interest within a free marketplace was the key to economic growth and social improvement – "as if by an invisible hand".[12]

Building on the ideas of the French physiocrats, Smith rejected the prevailing mercantilist belief that a nation's wealth is fixed, so countries should try to part with as little of it – and to hoard as much of it – as possible. Instead, he argued that wealth is created by productive work, the division of labour and international trade. In particular, he shared the physiocrats' view that the productivity of land (often synonymous with natural resources in his writing) and the expansion of agricultural output were central to prosperity – thus allowing a greater proportion of the population to earn its living from manufacturing.[13] The problem was not a shortage of land, but rather a shortage of investment in land productivity. This, in turn, often reflected problems of government interference in markets and resulting disincentives to entrepreneurship.

Although his work did not focus explicitly on concerns about resource depletion or the limits of economic growth, Smith was essentially optimistic about

mankind's ability to prosper within the context of existing resource endowments – a view reinforced by his day-to-day observations about how the world around him was being transformed by dramatic advances in manufacturing, agriculture and mining (Kula, 1998). His faith in individual efforts and ingenuity, and in the power of the market's "invisible hand" to allocate resources efficiently, had a decisive impact on future thinking about resource management, and remains highly influential to this day.

(ii) Malthusian pessimism

The ideas of Thomas Malthus ran directly contrary to Smith's belief in the market's ability to help resolve the tension between growing human consumption and the earth's finite resources – and indeed against the broader Enlightenment faith in an improving and perfectable society. Malthus saw the idea of endless progress as not only naïve, but dangerous because of the inexorable pressures of population growth and the planet's limited capacity to support it. In his *Essay on the Principle of Population,* he argued that the impact of growing population on a fixed supply of land and other resources would result in starvation. Economic growth, international trade and social improvement were no solution because they would only lead to further, unsustainable population growth. This would, in turn, be checked by widespread famine, disease and death.[14] Malthus believed there was a long-term tendency for the living standards of the mass of people to be driven down to a subsistence level – a level at which the population could only reproduce itself, not expand, and the economy would attain a steady state, with a constant population size and with constant, subsistence-level living standards (Perman et al., 1996).

Malthus's pessimism about the ability of economic growth to transcend the planet's natural limitations was as influential in its day – and indeed beyond – as was Smith's optimism. For example, David Ricardo shared his belief that diminishing natural resources as a result of expanding economic activity would eventually halt both population and economic growth. Although agricultural output could be expanded by exploiting existing land more intensively or by bringing new land into cultivation, Ricardo argued that the returns to increased inputs would steadily diminish, resulting in stagnant growth and living standards (Ricardo, 1817).

Like other classical economists, John Stuart Mill believed that economic development was destined to reach an eventual equilibrium or steady state. His contribution to the debate was to question the desirability, not simply the feasibility, of limitless economic growth (Mill, 1848). Writing at a time when output per person was rising, not falling, Mill accepted that technological innovation, the discovery of new sources of raw materials, and the application of fossil fuels to production processes were playing an important role in overcoming diminishing returns from natural resource constraints. However, Mill adopted a broader conception of the role of natural resources in the economy. Foreshadowing later thinking on conservation, he argued that the quality of the natural environment not only shaped productivity, but the general living standards and conditions of present as well as future generations. According to Mill, the problem was not economic growth in the developed world – where material progress was already reaching its apogee – but its distribution and impacts (Perman et al., 1996).

Karl Marx, almost more than any previous economist, recognized the transformational power of capitalism and technology's ability to overcome resource constraints – although he shared the classical tradition's basic assumption that economic progress would reach an eventual end or steady state. He argued that the immiserization of the working class was the result not of population pressures on fixed natural resources, but rather of the theft of surplus labour and value by the capitalist class (Marx, 1867). Marx agreed that a crisis in capitalism was inevitable. However, whereas Malthus and Ricardo thought the crisis would result from diminishing returns in the face of a growing population, Marx argued that the crisis would flow from falling profits and the limited purchasing power of the impoverished masses (Kula, 1998).

(iii) Neo-classical economists: Cautiously optimistic

Not everyone shared the classical economists' pessimism about the limits of economic growth. Henry Carey, who became increasingly critical of classical political economy, believed in the possibility of steady economic progress and the potential for harmonizing diverse economic interests. In challenging the Malthus-Ricardo theory that economic expansion would lead inexorably to population growth, depleted resources and stagnating living standards, he noted that the history of agriculture and mining had been one of steadily increasing productivity over time, the result of capital accumulation and improved methods (Carey, 1840). Agricultural production had generally migrated from poorer to richer farmlands, a process aided by continuously improving agricultural and transportation technologies. A similar pattern was evident in the mining industry. Even as old mines were gradually exhausted, new and richer mines were constantly being developed, as a result of new investments, the application of new technologies and the discovery of fresh deposits.[15]

However, neo-classical economists also recognized the market's limitations in solving all of the problems associated with resource allocation and depletion – especially through their work on the exhaustion of resources and spillover effects. As early as the mid-1800s, Mill had recognized that mining was a different economic activity from farming or manufacturing, in the sense that it was a non-renewable resource that could eventually be exhausted (Perman et al., 1996). Extraction today meant a reduction in future profits; conversely, extraction tomorrow would involve a reduction in present profits. In his widely-read book *The Coal Question,* William Jevons built and expanded on this insight, drawing attention to the imminent

exhaustion of energy supplies and developing concepts of resource depletion that have recently been revisited in work on "peak oil".

It was in *The Coal Question* that Jevons first outlined the so-called "Jevons Paradox" – i.e., that improving the efficiency of resource-use leads to an increase, rather than a decrease, in the consumption of that resource because of falling prices, eventually resulting in its depletion. Harold Hotelling offered a somewhat different and more optimistic perspective on the exhaustion of resources. In his seminal article, "The Economics of Exhaustible Resources", he argued that rational speculators, anticipating future shortages of a non-renewable resource, will conserve or store that resource in expectation of rising future prices. These rising prices generated by speculators' decisions to put supplies aside will in turn reduce consumption and encourage the search for cheaper substitutes (Hotelling, 1931).

Alfred Marshall took a further step towards an economic analysis of resource depletion and environmental degradation by highlighting the problem of unintended spillovers or "externalities" – i.e., the costs or benefits conferred on others that are not taken into account by the person taking the economic action. His student, Arthur Pigou expanded Marshall's concept of externalities, and made the case for government intervention to correct for such market failures. The lack of market incentives to stop someone from creating a negative externality (such as pollution) or to encourage someone to create a positive externality (such as recycling) was why governments had a key role to play in natural resources and pollution management, typically by influencing private behaviour through taxes or subsidies (Pigou, 1929).

(iv) Neo-Malthusians: Limits to growth

Neo-Malthusian ideas were resurrected in a highly public way in 1972 with The Club of Rome's publication, *The Limits to Growth.* Attempting to model the impact of a rapidly growing population and economic expansion on finite natural resource supplies, it predicted that existing trends could not continue indefinitely, and that "exponential growth would eventually lead to economic and environmental collapse" (Meadows et al., 1972). The study also appeared to claim that the world was already on the brink of running out of key resources (oil in 1975, gold in 1981, silver and mercury in 1985 and zinc in 1991) – a conclusion to which the 1973 oil crisis seemed to lend support. Similar conclusions were reached in a US multi-agency assessment of the earth's future published in 1980 entitled *Global 2000.* This forecast that the world in 2000 would be "more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now" and that "serious stresses involving population, resources, and environment [were] clearly visible ahead".[16]

Even mainstream economists, such as John Kenneth Galbraith (1974) and Ezra Mishan (1967; and Potter and Christy, 1962) questioned the ability of the planet's resources to withstand the strains of modern society's unrelenting and single-minded pursuit of economic growth.[17] More recently, the focus of concern has expanded from dwindling supplies of natural resources to unsustainable consumption – and its adverse impact on the environment. Land, water and air pollution, species extinctions, and global warming all pointed to a future where unrestrained economic growth would outstrip the ecosystem's ability to sustain it. Malthusianism had returned to the economics mainstream (Turner, 2008).

At the same time, a number of economists were arguing for the need to study economics within the wider context of natural systems. In 1966, Kenneth Boulding published a short but influential article entitled "The Economics of the Coming Spaceship Earth" in which he compared the planet to a small spaceship where all economic activity takes place within the context of ultimately exhaustible natural resources. He urged economists to shift their thinking away from the concept of an open economy with unlimited resources to a concept of a closed economy "without unlimited resources of anything, whether for extraction or for pollution, and in which, therefore, man must find his place in a cyclical ecological system" (Boulding, 1966).

Boulding argued that economics could only be constructively understood as a sub-system of a much broader natural system, and that to try to disaggregate economic theory from the natural world in which it operated risked environmental catastrophe. He is widely regarded as one of the founders of ecological or environmental economics, and subsequent work on sustainable development and "green accounting" (variously referred to as Natural Capitalism[18] or Total Economic Value) often take as their starting point Boulding's theories.

(v) A resourceful earth

A number of modern economists have criticized the assumptions, methods and conclusions of the Club of Rome. One criticism is that commodities have seemingly become more, not less, abundant on world markets over time.

In *The Resourceful Earth,* Julian Simon, one of the most prominent sceptics of the Club of Rome's claims, pointed out that almost all commodities had experienced falling long-term prices over the previous century, which he argued was "prima facie evidence" of greater natural resources abundance, not increasing scarcity.[19] Simon was not the first to make this observation. In the early 1960s, the claims about growing resource scarcity were tested by Potter and Christy (1962), and Barnett and Morse (1963), who analysed the long-term price trends across a range of natural resources. Assuming that rising prices would prove growing resource scarcity, their finding in fact revealed that, with one or two exceptions (such as timber), prices had followed a downward trend over the past century, implying that

natural resource supplies were becoming more plentiful, and that "technology could overcome increasing shortages of natural resources *ad infinitum*". At the same time, the researchers cautioned that a steady increase in the production of natural resources did not take into account the possible adverse effects on the environment of increased consumption.

More recently, William Nordhaus (1992) has levelled similar criticisms at the latest efforts to update the Club of Rome's projections, in the 1992 publication *Beyond the Limits*. While stressing that "our estimates are crude, the models are primitive, the future is uncertain and our ignorance is vast", he suggests that "environmental and resource constraints on economic growth should be only modest over the next half century" and that "it would take either a massive slowdown in productivity growth or a massive underestimate of the constraints to growth before the resource constraints would produce a decline in global living standards" (Nordhaus, 1992).

A more fundamental criticism was that the *Limits to Growth* theory failed to take into account mankind's capacity to innovate, adapt and harness technology to expand the use of natural resources or to find substitute products. As an economic law, diminishing returns holds only for a constant state of technology and not for a world in which methods and approaches are constantly improving. In the pessimists' models, noted Robert Solow (1986), population, capital and pollution always grow exponentially, but technology rarely does. Or as Nordhaus puts it, "for the past two centuries, technology has been the clear victor in the race with depletion and diminishing returns". Resource scarcity, far from being a problem, was the motor that encouraged investment in finding new resources, development of technologies to harness new, alternative resources, and improvement in efficiency so that resource consumption was reduced. As a result, supplies expanded, production grew more efficient, and costs declined.

(vi) Summary

The world of Adam Smith and Thomas Malthus was very different from our current one, but their concerns and insights remain highly relevant. Worries about peak oil, global warming and the many other resource and environmental challenges facing us today have reignited a two-centuries-long debate about whether continued economic development will save or destroy the planet.

It would seem that neither the pessimists nor the optimists offer a complete or satisfactory answer. What Malthus and his successors failed to take into account is an unfettered economy's adaptive power, and the extent to which technology and innovation have managed to overcome seemingly insurmountable resource and environmental constraints. Certainly the classical economists' assumption that an economy's potential (the "economic pie") is essentially fixed, that the challenge is merely to allocate resources (the "pieces of the pie") more efficiently, and that, because of resource limitations, economic growth and living standards will sooner or later reach an equilibrium or plateau has so far been proved wrong. The planet's population is over seven times larger today than it was two centuries ago, and yet most people live lives that are longer, healthier and materially richer than those of all but the most privileged and wealthy in Adam Smith's day.

Despite the fact that today we use far larger quantities of minerals, metals and other raw materials than in the past – and despite repeated warnings of the imminent exhaustion of these materials – the market still provides viable supplies of most natural resources. What the pessimists also failed to see is that as income and educational levels improve, people tend to modify their behaviour, limiting the size of families, curtailing certain kinds of consumption, and investing more income in preserving natural resources and protecting the environment.

However, what Adam Smith and his successors often underestimated is the scope for market failure – and, indeed, the extent to which existing markets are undeveloped or incomplete. As recently as 1974, Robert Solow argued that because every natural resource has a potential substitute in the marketplace there can be no problem of depletion: "Exhaustion is just an event, not a catastrophe" (Solow, 1974). The problem is that the resources which are most threatened with exhaustion today, such as the atmosphere and the oceans, are precisely those without markets. Burning fossil fuels pollutes the air everyone breathes and warms the atmosphere everyone needs. Logging activity erodes soil and diminishes greenhouse-gas-absorbing forests. Over-fishing may lead to an irreparable loss of biodiversity. In each case, there are no viable markets to mediate between those causing the damage and those being harmed – especially future generations.

While most resource allocation decisions today, such as burning fossil fuels, entail consequences for tomorrow, the people making them do not always have to live with the consequences of their decisions. As Pigou (1929) argued a half century ago, it seems to be human nature to underestimate – and hence under-provide for – future needs. Current markets for natural resources are by definition incomplete if only because future generations cannot participate in them.

(c) The intellectual debate: Natural resource exports and economic dependency

Another important intellectual debate has focused on the question of whether natural resources are a "blessing" or a "curse" for the economic development of countries. Although economists have traditionally seen natural resource endowments as a key determinant of comparative advantage and critical to economic growth, some have argued that excessive dependency on natural resource exports can actually trap countries in a state of "underdevelopment".

(i) Singer-Prebisch thesis

The "underdevelopment" thesis was first advanced by Raul Prebisch (1950) and Hans Singer(1950) in the 1950s. Noting that the price of primary commodities had continued to decline over time relative to the price of manufactured goods, they argued that the resulting decline in the terms of trade of primary commodity-exporting developing countries locked them into a state of underdevelopment.

One source of the problem was the highly competitive nature of many commodity markets which meant that productivity improvements tended to result in declining prices rather than higher incomes (versus the more monopolistic organization of markets for manufactured goods, where productivity improvements could be captured in higher incomes). Another problem was that as incomes rose, the demand for manufactured exports grew faster than for commodity exports. Because falling commodity prices meant that developing-country exports had to grow continually in order to buy a given quantity of manufactured goods, poor countries were unable to accumulate the surplus capital needed for investments in the infrastructure, technology and industrial capacity that was a prerequisite for further development.[20]

It was these differences in power between commodity-dependent developing countries and manufacturing-intensive industrialized countries – between the "periphery" and the "core" – that trapped poorer countries in a cycle of declining export earnings, weak investment and underdevelopment. In order to break this cycle, Prebisch and Singer urged developing countries to diversify their economies and lessen their dependence on primary commodities by developing their manufacturing industry – including through using selective protection methods and attempting to replace imports with domestically produced goods. More generally, the Singer-Prebisch thesis implied the novel concept that it was the intrinsic structure of world markets, not the failings of individual countries, that was responsible for widening inequalities in the global economy.

(ii) Dependency theory

The Singer-Prebisch thesis has underpinned a growing body of economic thought, broadly referred to as "dependency theory", which built on the insight that the apparent failure of many countries to develop was the result of unequal power relations between a "periphery" of poor and underdeveloped countries and a "core" of wealthy, industrialized states. Because of these structural inequalities, resources flow from the periphery to the core, enriching industrialized countries at the expense of the poor, denying developing countries the capital and technology needed to industrialize, and perpetuating existing inequalities and disparities. Against the neoclassical idea that open trade and economic expansion benefits all countries and that growth in industrialized countries will eventually lead to growth in poorer countries (the "stage theory" of development), dependency theory holds that existing economic relations – and the nature of global integration – lock developing countries into a state of perpetual underdevelopment and economic subservience.

Under the umbrella of dependency theory, a number of explanations have been advanced for how and why structural inequalities are perpetuated in the global economy. As we have seen, Prebisch (1950) and Singer (1950) focused on poorer countries' declining terms of trade and how this contributes to underdevelopment. Paul Baran (1957) highlighted the ways that developing countries' "economic surplus" is extracted by industrialized countries, and how the international division of labour (between skilled workers in the centre and unskilled workers in the periphery) reinforce dependency. Together with Samir Amin, he also emphasized how elites in peripheral countries cooperate with elites at the centre to perpetuate natural resource exploitation. Arghiri Emmanuel (1972) introduced the concept of "unequal exchange" to the debate, suggesting that it was historically established wage levels that set prices, not the other way around, further contributing to developing countries' deteriorating terms of trade.

More recently, Matias Vernengo (2004) suggested that the dependency relationship is a reflection less of trade or technological inequality than of the differences in financial strength between the core and the peripheral countries – in particular, the inability of developing countries to borrow in their own currency. Andre Gunder Frank (1971; 1972) and other "world-system" theorists broadened this analysis, viewing the stratification of the world economy into "core" and "peripheral" countries as the global reflection of Marx's class divisions – i.e., the owners versus the non-owners of the means of production. Similar ideas about the structural nature of "core" and "peripheral" relations can also be found in Johan Galtung's (1971) structural theory of imperialism.

Dependency theorists also differed in their proposed solutions to unequal international economic relations. Writers ranging from Prebisch and Singer to Osvaldo Sunkel (1969) and Fernando Henrique Cardoso (1979), viewed the problem in terms of the nature of the global economy and the history of international economic development. Poorer countries needed to embark on a separate or autonomous development path and reduce their dependence on trade with developed economies, including by embarking on programmes of infant industry protection and replacing imports with domestically produced goods. In contrast, Marxist economists, such as Baran and Gunder Frank, tended to see the problem of developing-country dependency as endemic to the capitalist system itself. The movement towards worldwide socialism – and an end to foreign domination and imperialism – was a precondition for the elimination of underdevelopment.

5. Conclusions

Natural resources are indispensable for the functioning of modern economies, and for achieving and maintaining high standards of living in all countries. They are primary inputs in the production of all manufactured goods (e.g. ores and other minerals). They provide the energy needed to transport people and goods from place to place, to light our cities, and to heat our homes and places of work (fuels). They are also a potentially unending source of valuable materials and a habitat for wildlife and plant species (forests, oceans). Finally, in the case of water, they are necessary for sustaining all life on the planet. It is no exaggeration to say that the way the world manages its natural resources will go a long way towards determining the sustainability of the global economy.

In this section we have examined some of the factors that make natural resources trade different from trade in other types of products, surveyed data on global trade flows, taken a closer look at some of the mechanisms through which resources are actually traded in commodity exchanges, and sketched the history of this trade since the industrial revolution. Taken together, these analyses provide some insight into why trade in natural resources is sometimes controversial.

On the positive side, trade in resources allows countries with limited domestic supplies to benefit from the use of these materials. Trade also contributes to efficiency in production, provides exporting countries with earnings that can be re-invested in future production, and enables them to diversify their economies. On the negative side, by contributing to production, trade may exacerbate a number of adverse consequences associated with resource use, such as air pollution caused by the burning of fossil fuels, or a reduction in biodiversity brought about by the destruction of natural habitats. It should be borne in mind, however, that the solution to such problems is not likely to reside in the contraction of trade, but rather in the proper management of scarce resources and the mitigation of the harmful environmental effects of economic activity.

The intellectual and political debate about natural resources, summarized in Section B.4, has seen public attitudes and expert opinion alternate between optimism and pessimism about whether precious natural resources will continue to be available for future generations. Growing concern for the environment, combined with the steady rise in natural resource prices in recent years, has once again brought these issues to the forefront of public consciousness.

While trade in natural resources will almost certainly continue to grow in the future, improved international cooperation and domestic regulation should be able to contribute to efficiency gains, the elimination of the adverse consequences of extracting and using natural resources, and perhaps increased stability in the market prices of these goods. This section has presented some essential background information on these issues, but for a deeper understanding of the challenges facing policymakers a coherent theoretical framework is needed. The development of this theoretical apparatus is the subject of Section C.

Endnotes

1 Another way of expressing the idea that natural resources must be scarce and economically useful is that they must command a positive price in markets and can be used either as inputs in production or directly as a source of utility to consumers.

2 Proved reserves are defined as "quantities of oil that geological and engineering information indicates with reasonable certainty can be recovered in the future from known reservoirs under existing economic and operating conditions".

3 The distribution of other fuels is similarly concentrated, with 20 countries possessing 90 per cent of global natural gas supplies and just nine countries having 90 per cent of the world's coal reserves(British Petroleum, 2009).

4 These are distinct from "forward" contracts, which are not traded in organized exchanges, but over-the-counter, i.e. directly between a buyer and seller (Valdez, 2007).

5 The clearing houses are under the watch of independent regulators.

6 These are likely to be important for landlocked routes.

7 In the case of natural gas, however, while markets in the United States and the United Kingdom, are dominated by organized exchanges, those in other European countries are dominated by long-term contracts (Neuhoff and von Hirschhausen, 2005).

8 Such contracts may be characterized by an acute "hold-up" problem, i.e. governments are unable to commit not to renegotiate the terms of any contract and hence investors are likely to be deterred by the consequent risk. This is likely to result in a systematic bias towards under-exploration and development (Collier and Venables, 2009). See Section E.3.

9 Smith (2009) notes that vertical integration in the oil industry has declined somewhat during the past two decades. This may simply be because several large oil producers have agreements to swap crude oil streams to minimize transport costs.

10 See www.chevron.com.

11 Long-distance iron ore trade rose from 23 per cent of world production in 1960 to 36 per cent in 1990. Trade in coal rose from 2 per cent in 1960 to 13 per cent in 2005. Tankers now carry some 2 billion barrels of oil annually – up from less than 400 million barrels in 1950. Natural gas, the bulkiest traded natural resource, is the latest commodity to be subjected to the forces of globalization due to declining transport costs. Until the 1980s, transport by pipeline was the dominant delivery mode, which meant that natural gas trade had a limited geographical reach and markets remained regionally segmented. However, advances in liquefied natural gas (LNG) technology and the ability to transport gas economically in large tankers are rapidly erasing these remaining geographical barriers. In 2005, 26 per cent of global natural gas production was traded internationally, more than a quarter of this as LNG (Lundgren, 1996; Radetzki, 2008).

12 As Smith explained, "every individual ... neither intends to promote the public interest, nor knows how much he is promoting it .... He is, in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. By pursuing his own interest he frequently promotes that of society more effectively than when he really intends to promote it" (Smith, 1776).

13 He argued that "there would be no attempt by capitalists to invest in manufactures designed for distant sale as long as agriculture resources remained unused" (Smith, 1776).

14 "The power of population is indefinitely greater than the power in the earth to produce subsistence for man", Malthus argued: "No fancied equality, no agrarian regulations in the utmost extent, could remove the pressure of it even for a single century" (Malthus, 1798).

15 "Increased capital enables the miner to descend double the distances and the value is now greater than at first. A further application of capital enables him to descend successively to 300, 500, 600, 1,000 or 1,500 feet, and with ever successive application the property acquires a higher value, notwithstanding the quality of coal that has been taken out" (Carey, 1840).

16 *The Global 2000 Report* was commissioned by President Carter in 1977. An additional report under the title *Global Future: Time to Act* was published in 1981 (Council on Environmental Quality (CEQ) and the U.S. Department of State, 1980).

17 "Growth, being the central goal of society, nothing, naturally enough, is allowed to stand in its way", observed Galbraith: "That includes its effect, including its adverse effect, on the environment, on air, water, the tranquillity of urban life, the beauty of the countryside" (Galbraith, 1974; Mishan, 1967).

18 Natural Capitalism is a movement that sees the world's economy as being within the larger economy of natural resources and ecosystem services that sustain us. This implies that we should attribute value to all things – from human intelligence and cultures, to hydrocarbons, minerals, trees, and microscopic fungi. The authors argue that only through recognizing this essential relationship with the earth's valuable resources can businesses, and the people they support, continue to exist (Hawken et al., 2009).

19 In 1980, Julian Simon bet biologist Paul Ehrlich that after a decade, a set of natural resources (decided upon by Ehrlich) would be cheaper in constant dollars than they were at the start. Simon won the bet (Simon, 1984).

20 A modern variant of this terms of trade thesis has been put forward by Daron Acemoglu and Jaume Ventura. In attempting to explain the relative stability (and inequality) of world income distribution since the 1960s, they argue that countries that accumulate capital faster than average experience falling export prices and declining terms of trade – which in turn depresses the rate of return to capital and discourages further accumulation (Acemoglu and Ventura, 2002).

C. Trade theory and natural resources

This section looks at key features of natural resources trade from a theoretical perspective. Does trade provide an efficient mechanism for ensuring access to natural resources? What is the impact of trade on finite or exhaustible resources, including under conditions of "open access" where there is a common ownership of – and access to – a natural resource? Is there a relationship between trade and its impact on the environment? Does trade reinforce or reduce problems associated with resource dominance in certain economies? And how does trade affect resource price volatility? These broad questions are addressed by surveying the relevant theoretical literature on the determinants and effects of trade in natural resources.

Contents

1. Trade theory and resource distribution

Countries' differing natural resource endowments – and their uneven geographical distribution – play a critically important part in explaining international trade. Traditional trade theory emphasizes that differences in factor endowments prompt countries to specialize, and to export certain goods or services where they have a comparative advantage. This process allows for a more efficient allocation of resources, which in turn leads to an increase in global social welfare – the "gains from trade".

Relative differences in countries' resource endowments are key to the standard version of the Heckscher-Ohlin theory of international trade. This states that a country will export the good which requires the intensive use of the country's relatively abundant (and therefore cheap) factor for its production, and import the good which requires the intensive use of the country's relatively scarce (and therefore expensive) factor for its production. This includes cases in which the natural resource is directly exported (after a minimal amount of processing), rather than being used as an input in another good that is later sold in international markets.

Hence, endowments of immobile and scarce natural resources may form a source of comparative advantage that guides the pattern of international trade. Consistent with this theory, Leamer (1984) finds that the relative abundance of oil leads to net exports of crude oil and that coal and mineral abundance leads to net exports of raw materials. Trefler (1995) finds similar results with respect to trade in resource-intensive goods. While most of the report focuses on trade in natural resources, Box 4 provides an example of the static gains associated with trade in goods that embody a resource (water).

The Heckscher-Ohlin theory has been modified and extended by introducing other factors besides resource endowments, such as transportation costs, economies of scale and government policy,[1] that also influence comparative advantage. For example, distance from world markets can be a decisive factor when the natural resource in question is bulky, such as natural gas, and when transportation costs are high. Complementary inputs, such as technology, capital and skilled labour, are also significant when a natural resource sector is characterized by difficult or technically complex extraction processes.

Variables such as education, infrastructure and institutions have also been observed to affect sectoral patterns of natural resources trade (Lederman and Xu, 2007). Only when these other determinants of comparative advantage are in place will a resource-abundant country tend to export resources to countries with a relative abundance in capital and skilled labour and import capital-intensive goods in return (Davis, 2009). In short, natural resource endowments may represent a necessary but not sufficient condition for the production and export of resources or resource-intensive goods.

Box 4: **Virtual trade in water**

Trade can help to address problems related to the unequal geographical distribution of a natural resource when it is the goods embodying that resource that are exchanged rather than the resource itself – as is the case with trade in "virtual water".

Growing food where water is abundant and trading it with areas lacking in fresh water has the potential to save water and to minimize new investments in dams, canals, purification systems, desalination plants and other water infrastructure. Ricardo's theory of comparative advantage has been extended to explain the effect of water availability on international trade (Wichelns, 2004). This theory of "virtual water trade" suggests that the importation of a water-intensive commodity is attractive if the opportunity cost of producing that commodity is comparatively high due to scarce freshwater reserves or low water productivity. Similarly, exporting these commodities is attractive when freshwater reserves are abundant or productivity is high.

It follows that countries facing freshwater scarcity should import water-intensive products and export less water-intensive products. They can consequently save domestic fresh water and direct it towards producing water-intensive products with higher marginal benefit. Given that agriculture accounts for almost 90 per cent of total freshwater usage, international trade in agricultural commodities could play a major role in addressing the problem of water scarcity.

There is clear empirical evidence that trade in water-intensive products saves fresh water (Hoekstra, 2010). The most comprehensive study on this subject found that some 352 billion m^3 of water is already saved each year by trade in agricultural products (Chapagain et al., 2006). Table A shows the net water savings achieved through virtual water trade for a selection of countries. Japan, which was the largest net importer of water-intensive goods over the period 1997-2001, was able to save almost four and a half times its domestic use of water through trade in virtual water (Hoekstra, 2010).

However, trade in virtual water can also have a negative impact on water conservation when the incentive structures are wrong. For instance, according to Hoekstra and Chapagain (2008a), Thailand experiences water shortages partly because too much water is used to irrigate rice crops for export. Similarly, Kenya depletes water resources around Lake Naivasha to grow flowers for export. In another study, Nascimento and Becker (2008) find that fruit exporters in the São Francisco River region in Brazil are prospering in part because of an artificially low pricing system for water. In short, trade in virtual water can exacerbate, rather than reduce, water scarcity problems unless exporting countries account fully for the opportunity costs of fresh water use and address any potential negative environmental impacts. A properly managed water sector is key to ensuring that virtual water trade maximizes the productivity of this scarce resource – a point which will be explored in detail in Sections C.3 and C.4.

Table A: **Examples of nations with net water saving as a result of international trade in agricultural products, 1997-2001**

Country	Total use of domestic water resources in the agricultural sector[1] (10^9 m^3/yr)	Water saving as a result of import of agricultural products[2] (10^9 m^3/yr)	Water loss as a result of export of agricultural products[2] (10^9 m^3/yr)	Net water saving due to trade in agricultural products[2] (10^9 m^3/yr)	Ratio of net water saving to use of domestic water (per cent)
China	733	79	23	56	8
Mexico	94	83	18	65	69
Morocco	37	29	1.6	27	73
Italy	60	87	28	59	98
Algeria	23	46	0.5	45	196
Japan	21	96	1.9	94	448

[1] *Source:* Hoekstra and Chapagain (2008a).
[2] *Source:* Chapagain et al. (2006). Agricultural products include both crop and livestock products.

2. Trade theory and resource exhaustibility: The problem of finite supplies

A defining feature of non-renewable natural resources is their finite availability – and the fact that extraction and consumption today irreversibly alters the extraction and consumption possibilities of future generations. The traditional model of trade discussed above does not directly address this problem of exhaustibility and the inter-temporal trade-offs involved. Understanding how trade impacts on the exploitation of non-renewable natural resources involves looking beyond the standard version of the Heckscher-Ohlin model, and adopting a dynamic approach that takes into account the change over time in the availability of a finite resource.

(a) Efficient resource extraction: The Hotelling rule

In his pioneering work on the economics of exhaustible resources, Hotelling (1931) developed a framework for predicting the behaviour of prices and extraction paths in light of inter-temporal trade-offs – or "depletion opportunity costs".[2] In doing so, he addressed two key questions: how should a resource be extracted over time in order to maximize the welfare of current and future generations, and can economic competition sustain the social optimum level of extraction? Although he worked within a closed-economy model, his insights provide a benchmark for understanding how trade impacts on non-renewable resources in open economies.

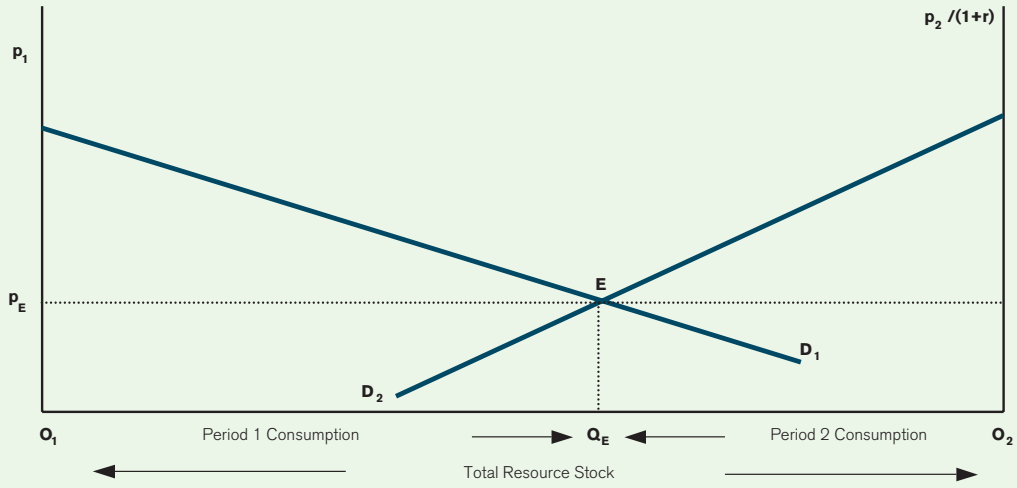
In response to the first question, consider the case of a social planner who chooses a resource extraction rate to maximize the welfare of current and future generations. The planner understands that, due to the fixed supply of the resource, any change in the rate of extraction in one period will trigger an opposite effect at some later period, with negative consequences for the welfare of later generations (i.e. an increase in consumption of the resource today may benefit the current generation, but it will reduce the consumption possibilities of a future generation). According to the Hotelling rule, the social optimum is achieved when the price of the resource net of extraction costs grows at a rate equal to the rate of interest. This, in turn, determines the efficient path of extraction of the natural resource. In essence, when the present value of one unit extracted is equal in all periods, there is no social gain from increasing or reducing the amount of the resource available in each period (Devarajan and Fisher, 1981).

The second question is, how does the extraction rate described above compare with that of a competitive, profit-seeking entrepreneur? In other words, should we assume that competition will lead to over-exploitation of non-renewable natural resources? To answer this question, imagine that the world lasts two periods: today and tomorrow. Assume that the marginal cost and the average cost of resource extraction are negligible, so that they can be set equal to zero. Under this scenario, the resource owner faces the dilemma of whether to extract all the resource today, tomorrow or to split the extraction between the two periods. His final decision will depend on the price of the resource in the two periods: the higher the price tomorrow, the higher the profits from future extraction and the lower the incentive to exploit the resource today.

Figure 12 captures the essence of the dilemma of when to extract resources. The horizontal axis is the total amount of the resource. Consumption in Period 1 is measured from left to right, while consumption in Period 2 is measured from right to left. The two vertical axes measure the price of the resource. On the left, there is the price in Period 1, while the right axis is the price of Period 2 discounted to the first period (i.e. the present value of the future price). Finally, the two lines are the demand curves of the resource in the two periods which, as usual, are downward sloping as the quantity demanded increases as the price of the resource falls.

The equilibrium is at point E, where the two demand curves intersect and where a producer is indifferent between selling an extra unit of the resource in the first or in the second period. The equilibrium price p_E is such that $p=p_2/(1+r)$ where r is the interest rate, while the equilibrium consumption (and extraction) of the two periods are given by the segments $(O_1\text{-}Q_E)$ for Period 1 and $(O_2\text{-}Q_E)$ for Period 2 respectively. It is instructive to understand why the competitive equilibrium is the one that corresponds to the Hotelling rule. If p_2 is greater than $(1+r)p_1$, it will be more profitable for the resource owner to extract tomorrow and not today, which will reduce the price of the resource tomorrow and increase the price of the resource today up to the point where the equality will be restored; while if p_2 is less than $(1+r)p_1$, it will be more convenient to increase the extraction of the resource today, with the opposite effect on prices.

Figure 12: **Perfect competition and the Hotelling rule**



In a competitive setting, price is usually equal to the marginal cost of production. But in this framework, the price is higher because the resource owner takes into account the depletion opportunity cost in addition to the marginal cost of production (i.e. the extraction cost). If he did not take the depletion opportunity cost into account, current profits would come at the expense of future profits, which is inconsistent with the profit-maximizing behaviour of competitive entrepreneurs. Since the depletion opportunity cost is taken into consideration by producers, the competitive outcome will be equal to the social optimum. In essence, Hotelling demonstrated that a competitive producer behaves like a social planner, taking into account the consequences of depleting resources by extracting less today.

However, in practice the Hotelling rule has not proved an accurate predictor of the evolution of observed price trends for non-renewable resources. According to his model, prices of non-renewable resources should have increased over time, whereas in fact they have moved erratically. This is largely because the Hotelling model does not take into account other important factors influencing price trends, such as the fact that the market structure of non-renewable resource sectors is better characterized as imperfect (such as monopoly or oligopolistic producers) rather than perfect competition, that on-going technological changes affect incentives to extract resources, that extraction costs tend to increase over time (e.g. digging deeper mines) (Hotelling, 1931; Peterson, 1975; Weinstein and Zeckhauser, 1975) and that uncertainty regarding future supply and demand affects decisions (Arrow and Chang, 1978; Hoel, 1978; Devarajan and Fisher, 1981; Weinstein and Zeckhauser, 1975).[3] Several of these specific points will be analysed below.

(b) Heckscher-Ohlin model in the context of natural resources

Do the main predictions of the Heckscher-Ohlin theory continue to hold when exhaustible natural resources are used as factors of production – including the situation where they are sold directly in international markets?

One study devised the following three scenarios to test the theory's validity (Kemp and Long, 1984). In the first scenario (defined as the *Anti*-Heckscher-Ohlin

model), each final good is produced using only two exhaustible resources. In the second case (referred to as the *Hybrid* model), one of the two resources used in production is exhaustible (as in the first model), while the other is not (as in the traditional theory). The third scenario assumes that the production of final goods requires that two non-exhaustible resources are combined with an additional exhaustible resource (*Generalized* Heckscher-Ohlin model) (Kemp and Long, 1980; Kemp and Long, 1982).

What was found under each scenario[4] is that a country which is initially relatively well endowed with a non-renewable resource will specialize in that resource sector – and/or in the production of goods which are relatively intensive in the use of that resource. In other words, even when finite resources are involved, trade patterns (i.e. what countries export and import) are still explained by comparative advantage driven by differences in resource endowments.[5] Welfare gains from trade are still possible because specialization allows for the efficient allocation of limited resources.

Importantly, in this environment there is no over-exploitation of the natural resource as extraction is set (either by a social planner or by competitive producers) to maximize social welfare of present and future generations. This is not to say that trade never leads to over-exploitation of finite resources, but rather that over-exploitation is affected by trade opening only when market failures (such as imperfect competition or externalities) or political economy failures (such as rent-seeking or corruption) are involved.[6]

(c) Imperfectly competitive markets

So far the discussion has not departed from the traditional assumptions that markets are perfect, firms produce under constant returns to scale and that all stages of production occur in the same location. Under these assumptions, the economic literature shows that the predictions of standard trade theory hold true – namely, that under free trade, countries specialize according to their comparative advantage and exchange different goods.

However, several features of natural resource markets make them particularly prone to various forms of market power. First, the fact that natural resources are often concentrated in few countries increases the scope for collusion and limits the scope for the development of perfectly competitive markets. Second, the relatively scarce supply of many natural resources creates potential for extracting "scarcity rents" (see Box 5) which in turn encourages rent-seeking activities. Third, due to the high fixed costs of extraction, production and

Box 5: **What is a rent?**

In economics, the concept of economic rent is equivalent to that of (positive) economic profit – that is a return in excess of normal profit, where the latter is the return that an entrepreneur should earn to cover the opportunity cost of undertaking a certain activity rather than its best alternative. In other words, any revenue exceeding total costs including the opportunity cost (or normal profit) is economic rent (or economic profit) (McConnell and Brue, 2005).

Economists generally distinguish three types of rents:

1. Differential or Ricardian rent

The classical notion of differential rent is related to land. The idea is that greater rent accrues to land of higher productivity and better quality (e.g. greater fertility), with marginal land receiving no rent. More generally, differential or Ricardian rents arise when producing firms operate under different conditions – that is, at production sites with more or less favourable characteristics. For example, there may be deposits from which it is easier and cheaper to extract oil or mineral resources; as a consequence, some firms face lower or higher costs than others and earn more or less than others, respectively.

2. Scarcity rent

Scarcity rents arise when there are restrictions on the supply of a natural resource, so that demand exceeds supply. These restrictions can be natural or legal. Natural limitations exist because natural resources are generally available in finite amount, whereas legal limitations can derive from an export or a production restriction.

3. Quasi-rent

Quasi-rents are attributable to entrepreneurial skills and managerial efforts. Firms can adopt innovative practices and undertake strategic investments in advertising, training of employees and so on, thereby attaining higher prices (e.g. better reputation, higher productivity) or lower costs (e.g. better technology).

In general, the resource rent is the total of the differential rent and the scarcity rent. Quasi-rents can also be resource rents when they accrue to natural resources. The fundamental difference is that while differential rents and scarcity rents exist even in markets characterized by free entry and perfect competition (as they relate to the innate characteristics of natural resources), quasi-rents are driven to zero as competitors adopt profitable strategies as well (Van Kooten and Bulte, 2000).

transportation that many resource-based companies face, natural resource sectors tend to exhibit increasing returns to scale[7] – which can in turn lead to imperfect competition. Finally, some natural resource markets have a monopsonistic structure – that is, they are characterized by a dominant buyer – representing another departure from perfect competition.

The following discussion looks at the optimal extraction path for finite natural resources under imperfect competition, and then explains the implications for trade in these kinds of commodities. Since the literature on natural resources trade under imperfect competition is fragmentary, the question of how trade impacts on resource sustainability can only be answered for specific circumstances.

(i) Market structure and optimal extraction of exhaustible natural resources

Cartels provide the simplest case of imperfect competition that can be analysed in an inter-temporal economic model – the model which, as noted above, best reflects the exhaustible nature of non-renewable natural resources. Because other forms of imperfect competition, such as duopolies or oligopolies, involve strategic interactions among agents, they introduce a number of analytical complexities which limit the model's applicability and relevance.[8]

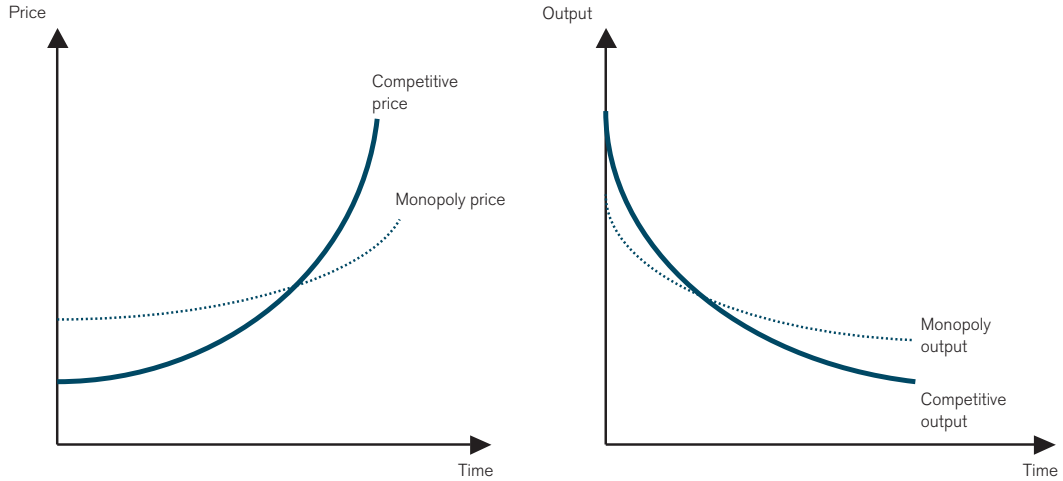
In general, economic theory suggests that an imperfect market structure will generate a dynamically inefficient outcome with a bias towards the initial conservation of non-renewable resources – a result that holds true for monopolies, core-fringe market structures, oligopolies and monopsonies.[9] In the case of a fully cartelized market, the intuition is as follows: when a natural resources cartel includes all producers, it will behave as a full monopoly. Given world demand for the cartelized commodity, the monopolist will at each moment in time set prices at the point on the demand curve corresponding to the quantity where marginal cost equals marginal revenue. In other words, the monopolist at each moment in time will set prices at a level above marginal cost.[10]

Therefore, as with the static theory of cartels, non-renewable natural resource cartels will restrict output relative to the output of a perfectly competitive (or oligopolistic) industry, in order to raise prices and profits. Over time, the optimal price and extraction path for a resources cartel will be described by a modified Hotelling arbitrage condition, whereby the marginal revenue, rather than the price, will grow at the rate of interest. This is because when extraction costs are negligible,[11] the value for the monopolist of extracting a unit of the commodity some time in the future must be the same as the money the monopolist would get if they extracted it now and kept the money in a bank.

What this means is that prices – and thus depletion – will increase faster or slower than under perfect competition depending on the changes over time in demand responsiveness to price changes (elasticity of demand). In particular, economic theory suggests that a monopoly will slow resource depletion when the elasticity of demand increases with price or over time, and will accelerate resource depletion when the elasticity of demand decreases. In short, it will deplete resources at exactly the same rate as a perfectly competitive industry when the elasticity of demand is constant (Dasgupta and Heal, 1979; Stiglitz, 1976; Lewis, 1976).

Figure 13 represents the price and output path when the responsiveness of demand to price changes (i.e. the elasticity) increases over time. This is generally thought to be the more realistic case because as the price increases over time, a substitute for the resource may become available – and consumers will more readily shift away from the consumption of the initial commodity (Devarajan and Fisher, 1981; Teece et al., 1993). In this case, a monopoly cartel will deplete resources more slowly than a perfectly competitive industry (see Box 6 for a discussion on why natural resources are prone to cartelization). The intuition is that, knowing that demand elasticity will grow over time, a monopolist will take advantage of the chance of extracting higher rents today when the elasticity is low by limiting extraction and charging high prices, thus preserving resources longer.

Figure 13: **Output and price paths in perfect competition and monopoly**



Box 6: **Why are natural resources prone to cartelization?**

The general case

A producer cartel is about monopolistic coordination aimed at jointly cutting supply or raising price, thus leading to increased revenue for the group. The conditions for cartel formation and cartel duration are not well understood, but economic theory can provide some useful insights. There is a clear incentive to form a cartel when the gains of setting a monopoly price exceed the costs of implementing and enforcing the cartel agreement. This is more likely to happen when the cartel's share of global supply is high and when the world demand as well as the outsiders' supply of the cartelized commodity is not too sensitive to price changes (Radetzki, 2008).

There are three major problems that a cartel must overcome if it is to be successful. First, there is the problem of determining the optimal level of output and the rules governing the allocation of that output among cartel members. This is an issue suppliers are likely to disagree upon, as they differ in technology, discount rates and forecasts of future demand. Similarly, when a cartel is formed among countries, the differing interests pursued by their governments, as well as the differing social and political contexts in which they operate, may reduce the likelihood of striking a deal.

Second, once output decisions have been taken, cartel members have an incentive to renege on the agreement and sell additional output, thus reaping additional profits. The temptation to depart from the agreement is positively affected by the elasticity of demand: a higher responsiveness of demand to whatever price discount is offered by the producer is associated with a stronger temptation to defect. In addition, defection depends upon the probability of detection and punishment: the easier it is to detect deviations from commitments undertaken under the cartel, the less likely it is that members will defect.

Third, a cartel has to be able to prevent entry by new firms. High profits will, in fact, provide an incentive for other firms to enter the market, and this would disrupt the cartel's original production and price targets.

The case of natural resources

In the case of depletable natural resources, different forecasts about the amount of reserves and the strategic value of such reserves make it particularly difficult to reach an agreement on output and price levels as well as on terms of revenue sharing.

There are, however, characteristics typical of natural resources that make the markets for these commodities particularly prone to cartelization. First, natural resources tend to be concentrated in few countries, hence few producers generally account for a large proportion of world supply. This reduces negotiation and enforcement costs among cartel members as the number of members required to cover a large share of world supply will be small.

Second, natural resources tend to exhibit high fixed costs of extraction. These costs reduce the risk of dissolution of a cartel due to entry by new firms, as they make it difficult for outside producers to equip themselves with the production capacity necessary to enter the market.

Third, natural resources tend to be relatively homogeneous. This increases the incentive for firms to defect, as a higher responsiveness to price changes is associated with less differentiated goods. However, deviations from a cartel agreement are easier to detect when products are similar than when they are differentiated (in the latter case it is easier to circumvent the agreement by varying quality, for example).

It is important to emphasize the limitations of economic theory in describing something as strategically complex as decisions about exhaustible resource extraction under imperfect competition. In an inter-temporal framework, decisions are made on the basis of expectations, especially about the actions of other agents. Assumptions about the way expectations are formulated are therefore crucial to determining the outcome. One common assumption is that future prices will be "announced" at the initial date and that agents do not deviate from the announced path. That is, producers set their extraction paths and consumers their demand path given each other's strategic choice at the beginning of the period. This is equivalent to assuming the existence of well-functioning future markets. In their absence, commitments to a certain price path will, in general, not be credible, as at some later stage the best choice of one of the parties, assuming that all others continue to behave as predicted, may differ from the one envisaged at the initial date (Newbery, 1981; Ulph, 1982).[12]

(ii) Imperfect competition and trade in natural resources

The effects of trade opening on exhaustible natural resources under imperfect competition remain largely unexplored in the economic literature. This is because the exhaustibility of natural resources and imperfect competition introduce dynamic and strategic considerations that significantly complicate welfare comparisons. The existing literature does, however, help to reveal some broad patterns.

To the extent that natural resources are geographically concentrated in one country or controlled by a cartel, it is clear that that country or cartel has a comparative (as well as an absolute) advantage in producing the resource and will export it. Furthermore, in the absence of barriers to trade, the extraction path chosen by the monopolist will depend only on how the inter-temporal world (foreign plus domestic) demand for the resource will change over time. Therefore, the expectation that imperfect competition will deliver a more conservative exploitation path than perfect competition continues to hold true (Bergstrom, 1982).

As far as patterns of trade under imperfect competition are concerned, economic theory suggests that the prediction of the standard Heckscher-Ohlin theorem – i.e. that countries will export goods using the factor with which they are relatively better endowed – also holds true (Lahiri and Ono, 1995; Shimomura, 1998). This explains why mineral-rich countries tend to export mineral products and import manufacturing-intensive products from capital-rich countries. It is worth noting, however, that in the case of fully cartelized commodities, the amount each country exports will depend on the production quotas agreed by the cartel's members. Considerations other than comparative advantage may affect decisions on quota allocation among cartel members, and thus trade patterns may depart from comparative advantage under these circumstances.

Furthermore, imperfect competition may also help to explain two-way trade (or intra-trade) in the same natural resource.[13] According to evidence based on the Grubel-Loyd index, this is relatively common for some resources (see Section B). The standard explanation for such two-way trade in a given market is that countries are trading different varieties of the same good (Krugman, 1979).[14] This cannot be easily applied to trade in natural resources given the similar nature of these products. There are simply not that many variations of iron ore or copper, for example. Nor can trade in natural resources within an industry be explained fully in terms of differentiated products – i.e. the two-way exchange of a resource at different stages of the production process to exploit countries' comparative advantages or increasing returns of scale. This is because the cost of transporting bulk commodities limits the scope for creating geographically fragmented production chains. Indeed, many natural resources are not even saleable until a certain amount of processing has been undertaken.

Instead, an important explanation for intra-industry trade in natural resource sectors may be the prevalence of imperfect competition in these markets and the phenomenon of reciprocal dumping. When markets are sufficiently segmented, firms can successfully price discriminate between foreign and domestic markets, allowing them to charge a low price for exports in order to make additional sales (Brander and Krugman, 1983). The rationale is the following: suppose that the same natural resource is produced by a monopolist in each of two identical countries. If the monopolist firm in each country charges the same price, no international trade will take place. However, if the foreign and domestic market can be segmented, domestic residents cannot easily buy goods designated for export and each monopolist can price-discriminate – i.e. set a lower price abroad than at home.[15]

By selling into the foreign market, each firm makes additional sales and profits (even if the foreign price is lower than the domestic price) and trade within an industry results. One study by Vasquez Cordano (2006) explains intra-industry trade in liquefied petroleum gas (LPG) in Peru by the presence of a dominant group of refiners that face international competition and a fringe of LPG importers. If the dominant group of refiners also controls the supply of LPG in the country, and if it is able to charge higher prices at home than abroad, then the competitive fringe will have to import LPG to be able to produce the refined product at a competitive price.

(d) Sustainability, technology and trade

Can an excessive use of exhaustible resources by current generations affect the potential for future economic growth? Will open trade facilitate or hinder sustainable growth? The Brundtland Report on the Environment and Development (United Nations, 1987) broadly defined sustainable growth as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs". The focus here is more narrowly on the economic forces that may offset the exhaustibility of finite resources and how they interact with international trade.

From the economic perspective, this debate centres on whether the world as a whole can sustain the current rate of output growth in the face of a declining stock of non-renewable resources that are essential to the production process. Recent policy and academic work has emphasized that limits to growth arise, not only because of the finite supply of natural resources, but also because of "nature's limited ability to act as a sink for human waste" (Taylor and Brock, 2005). In the latter sense, sustainable growth depends on the impact that the by-products of economic activities (e.g. solid pollutants, toxic chemicals, CO_2 emissions) have on the quality of the environment. While the two interpretations of sustainable growth are related – in that the environment is itself a scarce natural resource – the following discussion focuses more on resource supply limitations than on environmental constraints.[16]

Many economists argue that the more pessimistic prognoses for the sustainability of economic growth fail to take into account adequately the forces that can offset natural resource limitations, namely technological change and the substitution of man-made factors of production (capital) for natural resources (Dasgupta and Heal, 1974). In particular, they have attempted to identify the conditions under which capital can provide an alternative to depleting exhaustible resources, and

how technology can guarantee sustained production and consumption growth over time. Key to the discussion is the issue of how international trade enters into this process, and to what extent flows of goods and services may promote a sustainable rate of economic growth.

Solow (1974a) shows that constant consumption can be sustained by a suitable path of capital accumulation, despite declining resource flows. This is possible only if there is a certain degree of substitutability between capital and a natural resource, and if the latter is a non-essential input.[17] This intuition was translated into a policy rule by Hartwick (1977), who argued that the rent derived from resource extraction should be invested in building the capital stock (broadly defined to include infrastructure, physical capital, education) needed to guarantee constant consumption over time.

There are also various ways in which technological change can help to address problems associated with resource exhaustion. Resource-saving inventions can reduce natural resource requirements per unit of real output (Solow, 1974b). New technology can also have a substitution effect, increasing the demand for alternative resources. For example, as the internal combustion engine gradually eclipsed the steam engine in the early 20th century, it generated a growing demand for oil which was effectively a resource substitute for coal. Finally, improved technology can reduce extraction costs or facilitate exploration, thus increasing the availability of a given resource. Consider the case of a non-renewable resource with escalating extraction costs. If prices rise too high, demand will be extinguished, producing "economic exhaustion" even if some of the resource remains in the ground. However, the cost increasing effect of depletion can be more than offset by the cost reducing effects of new technologies and the discovery of new deposits.

Two other considerations regarding technology and exhaustibility are relevant. First, technology can influence the eventual "exhaustibility" of a resource. Consider a situation in which, at current consumption, a non-renewable resource will be fully depleted at time T. Then, a new technology is introduced which either increases resource supply (e.g. because of new discoveries, improved recycling methods), or reduces resource demand (through substitution or efficiency gains) – effectively postponing the point of depletion from T to (T+n). As a result, continuous technological change shifts this depletion point indefinitely and a non-renewable resource begins to resemble a renewable resource.

Second, while technology is generally seen as reducing the problem of resource exhaustibility, the opposite effect cannot be excluded. For instance, technologies that increase productivity in the extracting sector can also lead to an acceleration of resource exhaustion (Copeland and Taylor, 2009).[18]

A last point that should be highlighted in any discussion of technology and non-renewable resources is the role of international trade in facilitating the transfer of new technologies across national borders and in spurring research and development (R&D) activities among countries (World Trade Organization (WTO), 2008). Recent studies have found that technological spillovers are greater with imports from high-knowledge countries (Coe and Helpman, 1995) and that in developing countries total factor productivity is positively correlated to the R&D activity of their trading partners (Coe et al., 1997). This channel is termed "direct spillovers". Countries also benefit from "indirect spillovers" – i.e. the idea that a country can benefit from another country's knowledge even when they do not trade with each other directly as long as they both trade with a third country (Lumenga-Neso et al., 2005). Empirical evidence suggests that what matters most is how much knowledge a country can access – and absorb – through the totality of its global trade relations. Therefore, international trade can help guarantee sustained growth to the extent that it promotes the diffusion of technologies that offset the exhaustion of natural resources.

3. Trade theory and resource exhaustibility: The problem of open access

The previous section looked at the impact of trade on finite natural resources, and examined how markets can help to promote resource management and sustainable extraction and consumption. The following section discusses the specific problems related to "open access" – a situation where common ownership of, and access to, a natural resource can lead to its over-exploitation and eventual exhaustion. It examines how this affects the pattern of international trade, factor prices and the gains from trade. Under certain conditions, the existence of poorly defined property rights (see Box 7 for a more detailed discussion of property rights in economics) can result in the natural resource exporting country losing from free trade since, compared with autarky, free trade leads to a permanent reduction in its stock of natural resources.

This apparently overturns the standard welfare result from international trade theory which predicts that countries gain from freer trade. While this is possible, it is not the only probable outcome even if there is open access to the natural resource. The reason for this is that a lot of other things come into play. The structure of demand, population pressure, the technological capacity to harvest the resource and the strength of the property rights regime interact in a complex way to determine the final outcome. In particular, property rights are neither binary nor exogenous. Rather than being completely perfect or completely absent, the strength of property rights in a country falls along a continuum. Property rights to natural resources may be strengthened with more open trade, depending on how other elements that determine the definition and enforcement of property rights are affected.[19]

Box 7: **What are property rights?**

A full set of property rights over an asset entitles the owner to: a) use the asset in any manner that the owner wishes provided that such use does not interfere with someone else's property right; b) exclude others from the use of the asset; c) derive income from the asset; d) sell the asset; and e) bequeath the asset to someone of the owner's choice (Alston et al., 2009).

Demsetz (1967) provides one of the earliest economic analyses of property rights, explaining why it arises and the characteristics of different property rights regimes. He argues that it is the presence of externalities, whether positive or negative, which explains why property rights arise. The assignment of property rights allows economic agents to take these benefits or costs into account. The classic example he gives is the development of property rights among the Montagnes Indians in Quebec and the growth of the fur trade in the late 17th century. Before the development of the fur trade, there did not exist anything resembling private ownership in land among the Montagnes Indians. However, following commercialization of the fur trade, there was increasing economic value in being able to hunt on land on which fur-bearing animals lived. By the early 18th century, the Montagnes Indians had developed a custom of appropriating pieces of land for each group to hunt exclusively. This further developed into a system of seasonal allotment of land.

The extremes of perfect property rights and of no property rights (i.e. the tragedy of the commons) (Hardin, 1968) may be theoretically useful concepts but are unlikely to describe reality. The strength of the property rights regime applying to a natural resource may be better described as lying along a continuum (i.e. a series of intermediate cases). Ostrom (1990), for example, has documented the variety of institutional arrangements by which local communities have successfully managed common resources. These arrangements do not involve the extremes of complete privatization nor full government control. Copeland and Taylor (2009) suggest that one way to think of this continuum is in terms of the difficulty faced by a government or regulator to monitor and enforce rules on access to the natural resource.

Monitoring is imperfect so some unauthorized harvesting of the resource will take place, but it will be effective enough to deter such behaviour in many other instances. Alston et al. (2009) take a different tack by focusing on the question of who enforces property rights. They distinguish between *de jure* property rights which are enforced by the power of the state and *de facto* property rights which are enforced by the owner of the resource or in alliance with a group, e.g. tribe, community, etc. It is assumed that the state has the comparative advantage in enforcement, the individual has the least advantage and the group's ability lies in between the two. Whether the property rights regime is *de facto* or *de jure* depends on how crowded the commons become from encroachment by others. If there are few users of the common resource, rent per user is high and the individual can defend his property rights by himself. But as encroachment increases, rent becomes dissipated and there are gains from banding together to try to exclude others from the resource or seeking *de jure* protection from the state.

(a) Open access problem

Open access refers to a situation where common ownership of – and access to – a natural resource can lead to its over-exploitation and eventual exhaustion. Consider the case of a lake stocked with fish that no one owns. In the absence of defined property rights, there will be too many fishermen on the lake. This depletes the available stock of fish and reduces the efficiency of the effort to catch fish. This is obviously an economic, as well as an environmental, problem. The reason for this is that each fisherman on the lake reduces the productivity of all other fishermen. However, individual fishermen do not take into account the negative impact of their activity on the productivity of other fishermen. In effect, too much effort is spent to catch too few fish.

The result of too much entry is that the total catch from the lake is barely able to cover the cost of the effort to catch the fish. The degree to which rent – the difference between total revenues from the catch and the total cost incurred in catching the fish - is dissipated is thus a measure of the inefficiency introduced by uncontrolled access (see Box 8 for estimates of the amount of economic profits that could be generated from more efficient management of the natural resources stock).

This focus on economic efficiency is not inconsistent with the environmental desire to keep the lake stocked with fish. It could be argued that the economic and environmental interests coincide in this case because as shall be seen, the economist's preferred solution – strengthening of property rights over the natural resource – rations fishermen's access to the fish in the lake and reduces overfishing, producing an outcome that is in line with the environmentalist's goal.[20]

Since open access is such a significant feature of certain natural resources, this concept shall be explained in greater detail. The renewable resource grows at a rate that depends positively on the size of the current stock.[21] Given the ability of the resource to replenish itself, it is possible for humans to harvest the resource in a way that the size of the population remains stationary. This "sustainable" harvest will be possible only if each period's growth is harvested, leaving the rest of the stock untouched. "Sustainable" here is

equivalent to what economists refer to as the steady state equilibrium so the two terms shall be used interchangeably.[22]

The quantity harvested depends on the amount of labour employed and on the size of the natural resources stock. The more fish there are in a lake, the easier it will be to catch fish. Initially, as effort is increased, so does the amount of the sustainable harvest. However, over time, increased effort results in the amount of sustainable harvest eventually declining. The reason for this decline in productivity is the negative relationship between effort and the stock of the natural resource arising from the steady state condition. The greater the effort put in, the smaller is the equilibrium stock of natural resources.[23] The smaller the equilibrium stock of the resource, the more difficult it is to harvest or catch a given amount of the resource. Eventually, the impact of a smaller equilibrium stock outweighs the impact of additional effort.

Box 8: **Rents and open access**

Box 5 has already explained various definitions of rent (differential, scarcity and quasi-rent) and has clarified how rent in the natural resources sector is best conceived as the sum of the differential rent (when producing firms operate under different conditions) and the scarcity rent, which arises when there are restrictions on the supply of a natural resource. In the case of natural resources suffering from open access, since it is not possible to exclude others from using the resource, rent goes to zero because effectively the resource is not scarce.

As discussed above, the degree to which rent is being dissipated is an important indicator of how much open access is reducing the efficiency of harvesting a natural resource. Private ownership or government ownership and regulation of the resource represent different ways of trying to address the open access problem. In both instances, access to the resource is being restricted although possibly with different considerations in mind. In the case of private ownership, and assuming that the resource owner has a zero discount rate, access will be restricted so as to maximize the rent that accrues to the owner (see fuller discussion below). In the case of government ownership, the restriction may well have maximization of rent as an objective, but it could also have some other objective in mind, e.g. biological or environmental objective such as maximum sustainable yield.

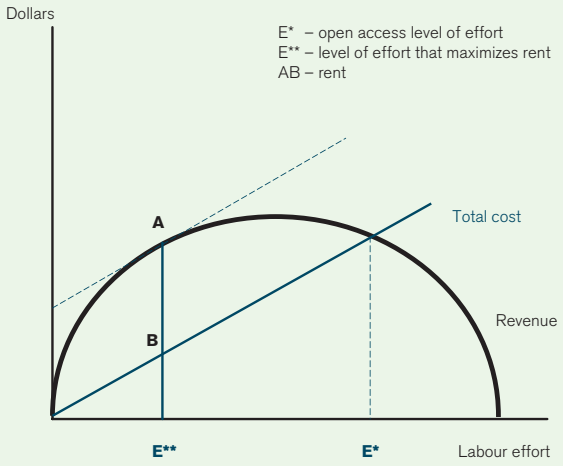
One popular method for controlling overfishing is the use of individual transferable quotas (ITQs) – permits to harvest specific quantities of fish. The total allowable catch (TAC) in a fishery is determined by a regulator, who may determine this total for a given year on the basis of economic or ecological considerations. Generally, members of the fishery are granted permits to harvest a share of the TAC. Since these permits are transferable, the current owner can sell the permit to a buyer, who will then acquire the right to harvest a share of the TAC. The sum of these shares, converted into quantities of fish, equals the total allowable catch set by the regulator. If the total catch determined by the regulator falls significantly below the open access outcome, rents will be generated and the ITQs will reflect the present value of the stream of future rents. If the total allowable catch is not substantially lower than the open access outcome, the ITQs will not have any value (there is rent dissipation).

ITQs have been used in a number of OECD countries and information on the prices of ITQs are available from studies that have examined these experiences. Perhaps the most dramatic example of the rents generated by managing fishery resources comes from Iceland. Arnason (2008) estimates that between 1997 and 2002, the value of fishery ITQs averaged about 40 per cent of Iceland's GDP and 20 per cent of the market value of its physical capital. One of the early adopters of the ITQ system was New Zealand. Using data covering nearly 15 years, Newell et al. (2002) tested the arbitrage relationship between the rate of return on ITQs and other financial assets. The reason for doing this is that if ITQs were effective instruments for fisheries management, they would bring a rate of return to quota owners comparable with other financial assets in the New Zealand economy. This was indeed what they found: the rate of return on ITQs was close to the overall market interest rate in New Zealand.

If it is assumed that the price of the natural resource is unity (one), then the yield curve is also the revenue curve, i.e. revenue = price times yield (see Figure 14). The revenue curve shows how total revenue changes with the amount of labour exerted to harvest the natural resource. Suppose that the cost of harvesting the natural resource is linear in effort i.e. C=c * E, where c is the per unit cost of effort. The rent or profit earned is equal to the difference between the revenue and cost curves, i.e. rent is equal to the vertical distance between the revenue curve and the linear cost.

With open access, each worker will try to capture the rent from harvesting the natural resource. There will be entry of workers until the last unit of effort just exhausts the remaining rent. This takes place at E^* where total revenue equals total cost. In contrast, if ownership of the fish stocks were assigned to a single fisherman, and if he did not discount the future, he would have an interest in maximizing the sustainable rent that could be earned from his ownership of the resource. The fisherman would limit access to the lake's fish stocks and would allow other fishermen to expend effort only

Figure 14: **Open access and optimal harvest of natural resources**



until marginal revenue equalled marginal cost. This would be at the level E^{**} where the slope of the revenue curve equals the slope of the cost line and sustainable rent is at a maximum. At this economically efficient point, the equilibrium stock will be larger than the stock corresponding to open access. An alternative way to interpret the level of effort E^{**} is that it would be the allocation of effort in the natural resources sector that would have been chosen by a regulator whose objective is to maximize social welfare.

On the other hand, if the owner of the fish stock discounts future revenues, he would choose a steady state stock that is lower than that which maximizes rent. He can achieve this by allowing greater fishing than E^{**}, reducing the existing fish stock, but yielding him additional revenues. This additional revenue will come at the expense of lower future rents because the steady state stock will be lower. But a positive discount rate means this reduction in future rent is valued less, providing the incentive for the resource owner to harvest more of the existing stock. As the discount rate goes to infinity, the owner will harvest everything today even if it means the resource is extinguished. This is because an infinite discount rate means the resource owner attaches no value at all to future revenues. [24]

Although the simple model serves as a useful illustration of the problems related to open access resources, in the real world the management of such resources is typically far more complex. For example, many fisheries operate under various government-imposed regulations, such as gear limitations, area closures, or length-of-season restrictions. This had led some economists to develop an alternative framework, "regulated open access", for analysing resource systems where authorities are able to effectively enforce regulations but where otherwise there is free entry by fishermen so that rents are fully dissipated (Homans and Wilen, 1997). The system lies somewhere between open access, at one extreme, and rent-maximization, at the other. It may well be that most fisheries in developed countries fall within this intermediate category. Since it is assumed that the regulation is effective, the stock of the natural resource will be greater in long run equilibrium under this system than in the open access case, and consequently, the quantity of fish harvested will be greater since the fishery is more productive. Simulations by Homans and Wilen (1997) for the North Pacific Halibut fishery[25] – which they consider an example of a regulated open access system – suggest that the difference in stock and harvest levels over the pure open access model can be dramatic.

(b) Patterns of trade

What is the impact of international trade on open access natural resources? To illustrate the principles at work, imagine two countries that have equal amounts of a natural resource, the same technologies and identical tastes, but differ with respect to property rights. Access to the stock of the natural resource is perfectly controlled in the first country, but there is open access to the natural resource in the second country. In autarky, it can be supposed that the second country will harvest a larger quantity of the natural resource – and at a relatively lower price – than the first country. When trade is opened up, the second country will then export the natural resource to the first country.

In standard trade theory, countries that have identical tastes, endowments and technologies have no reason to trade. However, introducing differences in the strength of each country's property rights creates the basis for trade despite the countries being identical in all other respects. This means that a property rights regime can serve as a *de facto* basis of comparative advantage – a conclusion that is supported by the economic literature on the subject – (Chichilnisky, 1994; Brander and Taylor 1997; Brander and Taylor, 1998; Karp et al., 2000).

Now suppose that the countries also differ in the size of their natural resource stocks, and that it is the country with strong property rights that has relatively more abundant stocks. One would have assumed that free

trade would result in the natural resource-abundant country exporting that good to the natural resource-scarce country. However, the relative strength of the countries' property rights regimes exerts an independent influence on comparative advantage and hence on the pattern of trade. It is possible for the country which is less abundant in the natural resource to end up exporting that good to the natural resource abundant country if the former's property rights regime is sufficiently weak.

Of course, other things have to be taken into account. In particular, predictions about the patterns of trade also depend on the structure of demand. Building on the work of Brander and Taylor, Emami and Johnston (2000) show that if the demand for the natural resource is relatively high, then the country with the weak property rights can end up importing rather than exporting the natural resource (see Box 9). This can be explained as follows: the combination of high demand for the resource good and poor property rights leads to massive depletion of the stock, even in autarky, and a small harvest. Thus, if trade is opened up, the country with poor property rights will rapidly deplete its resource stock and end up importing the good.

(c) Gains from trade

When a natural resource sector suffers from open access or common pool problems, in principle the basic "gains from trade" result is undermined. While the long-run (steady state) welfare of the resource-importing country rises with trade, it declines for the resource-exporting country. Intuitively, this is because free trade exacerbates the exploitation of the natural resource so that the steady state stock is lower than in autarky (Brander and Taylor, 1998). Since the size of the natural resource stock affects labour productivity, the lower steady state stock means that the economy will be harvesting a smaller quantity of the natural resource good under free trade. An alternative way of understanding why the size of the natural resource stock affects welfare is that it represents capital (in this case, natural capital) from which the economy can earn a stream of future returns. The smaller the stock of the natural resource, the smaller future harvests will be. An example of how the combination of open trade and weak property rights can lead to the near extinction of a natural resource and a welfare loss for the exporter is the 19th century slaughter of the Great Plains buffalo (Taylor, 2007).

However, introducing additional features to this simplified model can produce a very different result. If the demand for a natural resource is relatively high, the standard gains from trade will result (see Box 9), and free trade will increase the welfare of both the natural resource importing and exporting countries (Emami and Johnston, 2000). As explained earlier, with high demand for the natural resource, the country with strong property rights exports the natural resource to the country with weak property rights. This implies that the long-run stock of the natural resource in the country with poor property rights will actually be higher than in autarky and so lead to a welfare gain. The welfare of the country with strong property rights also rises since its natural resource sector is being optimally managed (price equals marginal cost). In other words, even in the case of open access resources, free trade can increase the welfare of both countries.

Box 9: **The role of demand**

To better explain the role of demand, an example of two countries that produce manufactured goods and harvest a natural resource with labour is considered. The only difference between these two countries is their property rights regimes. The structure of demand is identical in both countries. We shall examine the resulting pattern of trade when they move from autarky to free trade. The result demonstrates that even though the property rights regime is critical in determining the pattern of trade and whether there are welfare gains from trade, the intensity of demand for the natural resource can dramatically alter the results.

One country has such weak property rights that it suffers from open access. Under open access, the relative supply curve (S_w) for the resource is backward bending, which means that as the price of the natural resource rises, the amount of harvest declines. The reason for this unconventional shape of the supply curve is that as the price of the natural resource rises, more labour is drawn to the sector. This increase in effort reduces the stock of the natural resource, leading to a decline in the productivity of workers. If the price rises sufficiently high enough, the loss in productivity can lead to a decrease instead of an increase in total harvest, despite the greater amount of labour being used in the sector.

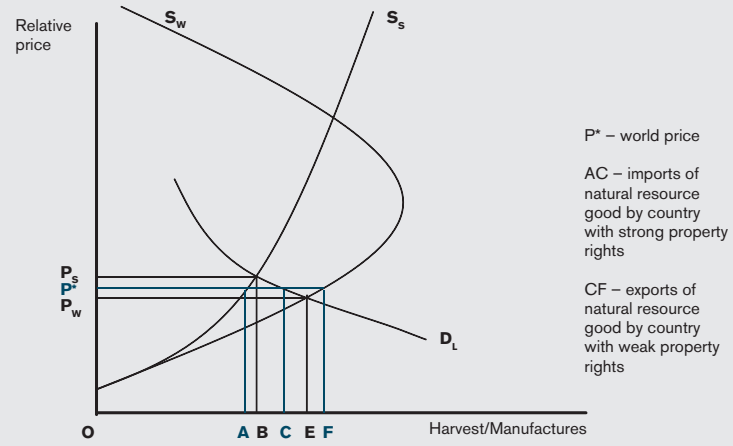
For the country with strong property rights, the relative supply curve for the resource will have the conventional shape – it is positively sloped (S_s). It corresponds to the marginal cost curve of harvesting the resource. This is because the resource owner (or the regulator) allows harvesting of the natural resource only up to the point where marginal revenue equals marginal cost. In effect, the externality posed by the individual harvester to others (his harvesting decreases the opportunity of others to catch more) is internalized by the single resource owner or the regulator. In resource systems with open access, the supply curve in contrast corresponds to the average cost curve since effort in harvesting continues until total revenue equals total cost.

What happens when both these countries open up to trade? Two scenarios can arise. In the first scenario, relative demand for the resource is low, so the demand curve intersects the upward sloping part of both these countries' supply curves. In the other scenario, demand for the resource is high, so the relative demand curve intersects the backward bending part of the supply curve of the country with weak property rights. The pattern and the benefits from trade will differ depending on the situation.

Relative demand for the resource is low (see Figure A)

Relative demand in both countries is given by D_L. In this case, the autarky price of the country with weak property rights is given by P_w with production at OE. The autarky price of the country with strong property rights is given by P_s with production at OB. When trade is opened up, the free trade price P^* will settle between the two autarky prices. The country with weak property rights will export the natural resource to the other country, depleting the stock of its resource. Its export (CF) is given by the horizontal distance at the world price between the demand curve and its supply curve. Correspondingly, the import (AC) of the country with strong property rights is equal to the distance between the demand curve and its supply curve. As a consequence of this pattern of trade, the country with poor property rights will have a lower steady state natural resource stock and suffer from a welfare loss. The country with strong property rights will reap the standard gains from trade since it suffers from no domestic distortion.

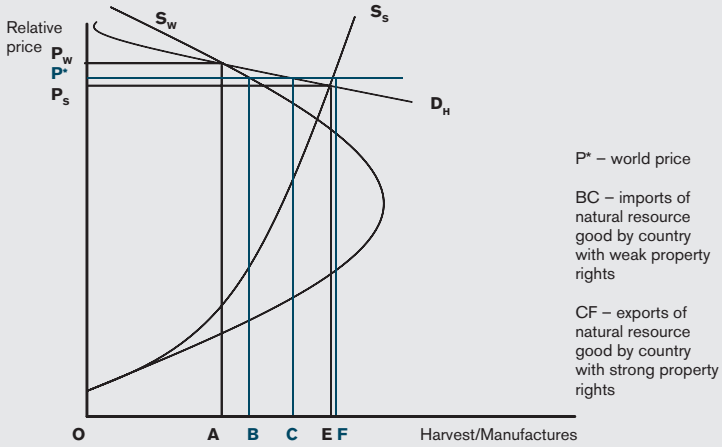
Figure A: **Free trade when relative demand for a natural resource is low**



Relative demand for the resource is high (see Figure B)

If in autarky there is a high relative demand for the natural resource (D_H) in both countries, the country with little or no property rights will be operating in the backward bending portion of its supply curve, with the average cost of harvesting the resource being very high. High demand leads to a lot of labour being devoted to the natural resource sector, causing the stock to run very low. Since the size of the stock affects labour productivity, harvest will be low in the country with poor property rights. The autarky price of the country with weak property rights will be P_w and production will be at OA. In the country with strong property rights, the autarky price is at P_s and production at OE. When trade is opened up, the country with strong property rights ends up exporting the natural resource (equal to CF) to the country with poor property rights. The country with strong property rights will reap the standard gains from trade since it suffers from no domestic distortion in the first place. The free trade stock of natural resources will be higher in the country with poor property rights than under autarky and it will also gain from trade.

Figure B: **Free trade when relative demand for a natural resource is high**



(d) Factor prices

According to the Heckscher-Ohlin theory, international trade leads to factor price equalization. In other words, trade in goods substitutes for the movement of the factors of production. In the literature on trade in renewable natural resources, the only factors of production are labour and the stock of natural resources. In almost all cases, the real wage of labour is the same across countries.

However, factor prices in the natural resources sector will not be equalized. Take the simplest example where countries differ only in property rights. In autarky, there will be rents from optimally using the resource in the country with strong property rights, whereas the rents will be driven down to zero in the country without property rights. With free trade, rents will continue to be zero in the country with open access whether it ends up importing or exporting the natural resource. If its trade partner has stronger property rights, rents will continue to be earned under free trade. The result obtained here – factor prices are not equalized by trade – should, perhaps, not come as a surprise given the existence of a market failure.

(e) How trade affects property rights

What about the case where the property rights regime is endogenous – i.e. where the ability of governments to enforce property rights is affected by trade opening and relative prices (Copeland and Taylor, 2009)? The answer to this question is a mixed one. The strength of a property rights regime depends on a variety of factors, including the ability to monitor and prevent cheating; the capacity to extract or harvest a resource; and the economic incentive to deplete a resource. An increase in resource prices as a result of free trade can affect each of these factors in different ways. For example, a higher price could increase incentives to extract more of a resource, but it could also reduce incentives to poach the resource if the penalty is to lose access to the now more valuable resource forever. Higher prices could encourage investments in resource extraction, but it could also enhance regulatory capacity, thus assisting the transition to more effective resource management.

The endogeneity of the property rights regime means that there could be a variety of outcomes from trade opening. In particular, resource-exporting countries could gain from free trade. For some economies, where the autarkic price of the resource was low to start with, the increase in relative price arising from free trade can lead to a transition to more effective management. These economies have enough enforcement capability so that rents are generated at a sufficiently high price for the natural resource. However, for some economies, it remains true that the move to free trade will lead to resource depletion and real welfare losses. These economies are those where the natural resource is slow to replenish itself, where economic agents have a strong preference for current consumption, over-harvesting is hard to detect, harvesting technology is more productive, and where a large number of agents have access to the resource.

Highlighting the variety of possible outcomes, Copeland and Taylor (2009) offer several examples where the opening of trade opportunities sometimes facilitated better management of natural resources and other times led to over-exploitation. One example of success is the geoduck[26] fishery in British Columbia, which was initially open access but became a well-managed fishery with individual harvest quotas primarily in response to export demand from Asia. One example of over-exploitation is the North American buffalo that was discussed earlier. Another example they cite is the opening of the Estonian coastal fishery to exporting in the 1990s, which contributed to the rapid depletion of fish stocks.

(f) Changes in population and technology

Does population growth lead automatically to increased pressure to circumvent property rights and exploit natural resources? A study of forest cover in India by Foster and Rosenzweig (2003) provides empirical evidence that population and economic growth can, under certain circumstances, actually encourage better resource management. Population growth has two contradictory effects: on the one hand, it raises harvesting capacity, which in turn makes it easier to deplete a given resource. On the other hand, it increases the domestic price of resource products, due to growth in demand, generating rents in that sector and reinforcing incentives to better regulate and manage the resource.

The key question is whether growing demand for the resource increases its price sufficiently to offset the increased capacity to harvest the resource. If the country experiencing population growth is small relative to global markets and cannot influence the world resource price, then the negative relationship between population size and resource stock will hold. However, if the country is large relative to the world economy – so that the population increase triggers a rise in the price of the natural resource – it is possible for resource management to improve.

Similarly, technological improvements can have a mixed impact on property rights enforcement and the depletion of natural resources. For example, improvements in surveillance technology can assist fishermen to better detect the location of fish, thereby putting more pressure on the resource; but they can also help regulators to better detect illegal fishing, which leads to better resource management.

4. Natural resources and the problem of environmental externalities

So far, two kinds of negative effects have been analysed in the context of exhaustible resources. The first is strictly related to the fact that some natural resources are finite. In such a situation, if either a producing firm or

a social planner does not take this issue into account when deciding how much to extract today, consumption levels above the social optimum in the present will imply less consumption for future generations. The second effect is related to the open access problem of exhaustible resources, whereby the collective ownership of a resource might result in its overuse and depletion.

The use of exhaustible resources in production and consumption activities leads to a third kind of negative effect that manifests itself through changes to the environment. In the case of fossil fuels, for instance, oil or coal extraction causes acidification of the sea and produces atmospheric CO_2. In the case of forestry, excessive timber extraction leads to loss of natural habitat for plant and animal species due to declining soil fertility and changes in climate and biogeochemical cycles. Finally, in the case of fisheries, over-harvesting one species might have a negative impact on other species and hence on biodiversity.

This third type of effect – which economists define as environmental externalities – is the focus of this sub-section. An externality of an economic activity refers to its impact on a party that is not directly involved in such activity. In this case, prices do not reflect the full costs or benefits in production or consumption of a product or service. An example of environmental externalities is the fact that oil producers may not take into account the full costs that the extraction and use of this resource imposes (on future, as well as present, generations) through pollution. This implies that the price of oil will not reflect its environmental impact. Killing dolphins as a by-product of catching tuna is another example of environmental externalities. In this case, the market price of tuna does not take into account the negative effect of the tuna fishery on biodiversity.

This sub-section discusses the characteristics and types of environmental externalities generated by the extraction and use of exhaustible resources. The effects of trade on the environment will also be illustrated taking into account the interaction that environmental effects have with the other types of externalities previously discussed in this report.[27]

(a) Fossil fuels, pollution and trade

To understand the effects of the use of energy resources on the environment, it is useful to classify environmental externalities into two categories: flow and stock externalities.[28] Flow externalities represent the environmental damage caused by the current extraction or use of the resource. An example of flow externalities is air pollution generated by the use of energy in oil extraction or mining. Stock externalities arise when environmental damage is a function of cumulative emissions. Examples of stock externalities include the atmospheric accumulation of carbon dioxide and its effect on the global climate, contamination of ground water from oil or coal extraction that is only slowly reversed by natural processes, and irreversible damage to natural landscapes through strip mining.

A general conclusion of existing studies[29] on environmental externalities is that postponing resource extraction today – and thus reducing polluting emissions – is optimal. In the case of flow externalities, the fact that resources are exhaustible partially offsets the problem. Following the Hotelling rule,[30] a pattern of rising prices reflecting the increasing scarcity of finite fossil fuels implicitly addresses part or all of the environmental damage generated by the extraction of such resources. In addition, the market may react to price increases by developing alternative energy technologies which can also help to address the environmental damage caused by the current extraction or use of the resource.

In the case of stock externalities, the market-determined rate of depletion is too high. Studies such as Babu et al. (1997) show that a modified Hotelling rule, which incorporates costs related to damage flowing from accumulating pollution stocks, would slow down extraction today and hence would ensure a social optimum. While under the original Hotelling rule, an additional unit of resource will be conserved only if the resource price rises at a rate faster than the market rate of interest, under this new modified framework, an additional unit of resource would be conserved even if the equilibrium resource price rises at a slower pace than the interest rate. This comes from the fact that an increase in the consumption of resources today will increase the pollution stock tomorrow. In each subsequent period there will be an additional disutility (i.e. welfare loss) caused by higher pollution stock created in earlier periods. In these cases, an additional unit of resource would be conserved in the current period to prevent higher disutility in future periods even if the resource price is rising more slowly than the market rate of interest.

What is the relationship between trade in fossil fuels and environmental externalities? This question is partly answered by a series of models in which the presence of trade across countries is implicitly taken into account. In these studies, it is assumed that resources are consumed by all countries, both exporters and importers – a realistic assumption given that most non-renewable energy resources are unevenly distributed geographically (see Section B.1) and the global economy is highly dependent on fossil fuels.[31] Therefore, if the demand of non-producer countries coincides with their imports, the relationship between trade and environmental externalities will depend on a series of factors, discussed below, directly affecting the optimal rate of extraction or use of the resources.

Some of these factors may accelerate resource consumption compared with the social optimum and exacerbate the negative impact on the environment related directly to the extraction and use of fossil fuels. First, the presence of asymmetric information on resource availability can encourage both exporters and importers to behave strategically. For example, importers might have an incentive to announce the development of a backstop technology[32] to increase their bargaining power and to drive down resource

costs, while exporters might be tempted to exaggerate existing resource stocks in order to delay the development of substitutes.[33] In both situations, the extraction rate of the resource will be faster than the social optimal rate, and environmental damage will increase. In the first case, exporters will react to the threat of a backstop technology by raising the extraction rate and lowering the resource price. In the second case, exporters will follow a faster extraction path that is consistent with the over-estimated resource stock, in order to lend credibility to their exaggerated claims about the extent of resource reserves.

Second, cost-reducing technologies tend to have a negative impact on resource prices, by decreasing the marginal costs of resource extraction. The overall effect on the rate of extraction of the resources and hence on environmental damage will depend on the trade-off between technological progress and resource exhaustibility. Studies by André and Smulders (2004), Farzin (1992) and Krautkraemer (1985) show that, in the short run, decreasing costs due to a technological advance tend to off-set increasing costs due to the rising in situ value of the resource. Price decreases will lead to higher consumption, and thus more pollution. In the long run, however, the rising value of the resource still in the ground will outweigh the decreasing costs of extraction, so prices will rise again. The pollution generated in the short run will persist over time, so even if the rate of resource extraction decreases in the future, the negative effect on the environment remains.

Third, the discovery of new resources can have an effect similar to that of cost-reducing technologies.[34] Because new discoveries generally mean that resource extraction becomes easier and cheaper, prices decline and consumption increases – with negative effects on the environment. In the long run, however, exploration opportunities will run into diminishing returns and resource prices will rise again.[35] The overall effect on the environment will depend on how long the additional pollution generated over the short term remains.

Lastly, as already discussed in Section C.4, property rights in certain natural resource sectors are not well-defined or protected. Consider a situation in which concession rights to exploit a resource are granted by a government that is either corrupt or weak. Faced with political uncertainty, resource owners have an incentive to speed up resource extraction above the social optimum level in order to lock in profits – which will in turn be detrimental to the environment.

On the other hand, new technologies can also help to limit the negative impact on the environment – as, for example, when carbon-reducing technology limits the CO_2 generated by resource extraction (Welsh and Stähler, 1990; Tahvonen, 1997; Grimaud et al., 2009). In other words, if an abatement technology exists, and if its cost is sufficiently low, then the optimal rate of resource extraction speeds up and environmental constraints are partially loosened – reducing the sacrifice of the current generation. In addition, if the abatement technology helps to reduce the impact on the environment caused by cumulative emissions , then in the long run total emissions will also decrease. An abatement technology can be thought as a "cleaner" way to extract polluting resources.[36]

The role for trade in this process is worth highlighting. When energy resources are highly substitutable and when their pollution content can be clearly differentiated, trade might help to mitigate some of the environmental externalities deriving from fossil fuel use. For example, countries using oil or coal as their principal source of energy could switch to imports of natural gas – the "cleanest" fossil fuel in terms of carbon dioxide emissions[37] – thereby slowing the accumulation of pollutants and doing less harm to the environment.

(b) Renewables, biodiversity and trade

Environmental externalities can also be the by-products of harvesting natural resources such as fish and forests. The following discussion focuses on effects of trade in exhaustible resources on biodiversity.

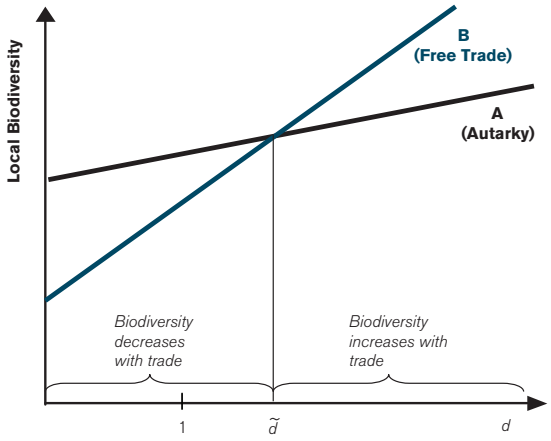
(i) Habitat destruction and trade

Because timber or agricultural production requires the use of land, habitat destruction can be a direct result of the expansion of such economic activities. Habitat destruction is a major cause of declining numbers of species – or reduced biodiversity – because it intensifies the competition among species for basic resources such as food and water and makes their survival more difficult.[38] Different studies[39] have analysed the effects of trade on production patterns across countries, on habitat destruction and on biodiversity. The general conclusion is that the classical gains from trade opening may no longer hold, once the negative impact related to declining biodiversity is taken into account.[40]

To understand the effects of trade in natural resources on biodiversity, consider two identical countries, a home country and a foreign country, which have the same fixed amount of two types of natural habitat, forest and grassland (Polasky et al., 2004). The number of different incumbent species represents the ecological productivity of each type of habitat. In addition, an increase in the size of the habitat will raise the number of species. However, marginal ecological productivity decreases with respect to habitat size.[41] In other words, the bigger the existent habitat the smaller the number of extra species that will be produced by a marginal increase in its size.

In the absence of trade, both countries produce timber and grain. For the production of timber, forestland has to be converted, whereas the production of grain requires the conversion of grassland. Once land is converted to productive use, it can no longer support native biological species. If the home country has a comparative advantage in producing timber and the foreign country in producing grain, then opening to trade will lead to an equilibrium in which the home country specializes in the production of timber and

Figure 15: **Biodiversity, ecological productivity and trade**



imports grain. The opposite will happen in the case of the foreign country. In addition, full specialization of production will lead to full specialization in natural habitat conservation. In the home country, for instance, specialization in timber production will make the country specialize in the conservation of grassland at the expense of forests. What then is the impact of trade opening on the countries' biodiversity?

The effect of trade on biodiversity will depend on the relationship between the ecological productivities of each habitat. To better understand this result, consider Figure 15 where the productivity in producing species of grassland relative to ecological productivity of forestland (d) in the home country is represented in the horizontal axis. Lines A and B illustrate respectively the local biodiversity of the domestic country in autarky and in free trade. These two lines cross each other at $\tilde{d} > 1$, because the marginal ecological production of each habitat is positive but decreasing in land size.

If both forest and grassland habitat have the same ecological productivity ($d = 1$) and the home country starts specializing in the production of timber, the negative impact deriving from a reduction in forestland will be greater than the benefit of an increase in grassland. Trade in timber production will have a positive impact on the home country's biodiversity only if the ecological productivity of grassland relative to forestland is sufficiently large ($d > \tilde{d}$) to offset habitat damage caused by a decrease in forestland.

The impact of trade opening on global biodiversity will depend on the degree to which species are specific to a certain country.[42] More precisely, if each species is specific to each country, the effects of trade on aggregate biodiversity will coincide with those of country-specific biodiversity. If, however, prior to opening up to trade the same species live in all countries, trade can be beneficial even if both countries have the same ecological productivity. In this last case, trade opening will lead to a local decline of species in the specializing sector but also to an increase of species in the importing sector. Since each country specializes in a different product, the overlap of species will be reduced (species that existed in multiple countries exist now in only one country), but worldwide biodiversity will increase.[43]

(ii) Open access, biological interaction across species and trade

Studies looking at the relationship between trade, open access problems and biodiversity typically focus on fisheries.[44] They suggest that outcomes depend to a significant extent on the nature of the biological relationship between the traded species (see Table 6). These relationships can be classified into the following three types: a positive or symbiotic relationship (where the stocks of the two species are mutually beneficial); a negative relationship (where the stock of one species [e.g., fish parasites] reduces the productivity or survival possibilities of another species); and an asymmetric relationship (where the first species serves as prey for the second species).

Consider a situation in which there is no trade between two countries and there is a trans-boundary common pool problem, as both countries fish in the same water (Fischer and Mirman, 1996). In addition, assume that both countries catch and consume two types of species – and hence are concerned about the biological cross-effects between them. Under this scenario, the problem of over-harvesting will be mitigated if the biological relationship across species is positive and the rate of reproduction of one species is higher than the cross-effect between the two species. Since harvesting the first species will reduce the stock and hence, the total consumption of the second one, then an optimal solution will be to reduce the total harvesting of the first species. When the biological relationship between species is negative, the problem of over-harvesting is more acute. More precisely, the fact that a reduction in one species implies an increase in the stock of the other species itself leads to over-harvesting. Finally, in the asymmetric case, there will be even greater harvesting of the

Table 6: **The effects of trade on the common access problem (small country case)**

SPECIES RELATIONSHIP	AUTARKY	TRADE
Positive relationship between species	*Under-harvesting*	*Over-harvesting*
Negative relationship between species	*Over-harvesting*	*Under-harvesting*
Prey-Predator relationship	Predator: *Over-harvesting* Prey: *Under-harvesting*	Predator: *Under-harvesting* Prey: *Over-harvesting*

predator fish while over-harvesting of its prey will be reduced.

Consider now a situation in which the two countries can trade and each of them specializes in catching one of the species and imports the other (Datta and Mirman, 1999). If countries take international prices as given,[45] the fact that a country is depleting its own resource will not be reflected in the other resource's price. More precisely, agents will not care about the biological cross-effect they will produce when harvesting and therefore, in the presence of a positive biological relationship between species, countries will harvest more than what would be globally optimal. In contrast, if the biological relationship between species is negative, there will be under-harvesting. In this case, both countries could harvest more because a reduction in one species is beneficial for the other and vice versa.

As the number of countries exploiting each species rises and trade increases, there is no clear cut conclusion as to whether the common pool problem worsens or lessens in the presence of biological interactions across species. Whether there is over- or under-harvesting will depend on a variety of factors such as the number of countries, the price effect, consumer preferences and the type of biological relationship across species.

5. The natural resource curse

A distinctive feature of many natural resource endowments is that they are not widely dispersed among countries, but rather are geographically concentrated in a few fixed locations. This helps to explain why natural resources often represent a disproportionate share of economic production and exports in certain countries.[46] Oil- and mineral-rich economies, for instance, frequently exhibit very high ratios of natural resources to merchandise exports and to GDP. It is often claimed that such resource abundance does not always lead to sustained economic growth and development for the countries concerned, and that in fact it can have the opposite effect – a phenomenon termed the "resource curse hypothesis" or the "paradox of plenty". The following section surveys the theoretical and empirical literature on the mechanisms through which the natural resource curse might operate, and tries to draw some broad conclusions about its relevance.

(a) The "Dutch disease"

An increase in revenues from natural resources can de-industrialize a nation's economy by raising the real exchange rate and thus rendering the manufacturing sector less competitive. This tendency towards de-industrialization has been called the "Dutch disease".[47]

De-industrialization following a natural resources boom can be of two types: direct and indirect.[48] Direct de-industrialization, or "factor movement effect", refers to the shift in production towards the natural resources sector. In an economy with three sectors, natural resources, manufacturing and a sector producing non-traded goods, the booming natural resources sector will take factor inputs (including labour) away from the rest of the economy. This creates an excess demand for non-tradable goods, thus the relative price of non-traded goods increases. If the economy is small, with the price of traded goods determined on world markets, this is equivalent to an appreciation of the real exchange rate, which makes the manufacturing sector less competitive.

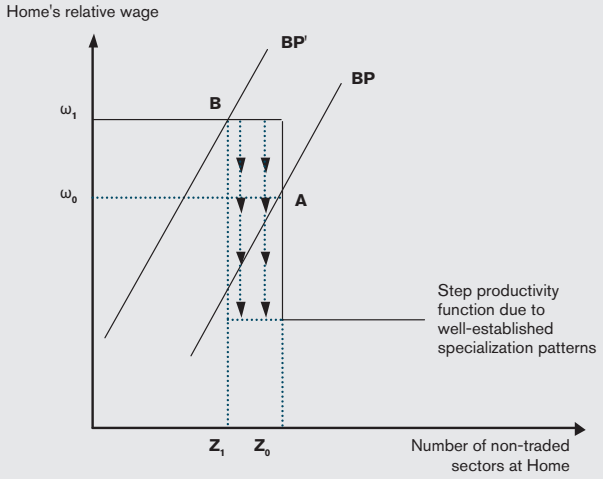
Indirect de-industrialization, or the "spending effect", refers to the fact that additional spending caused by the increase in natural resource revenues results in a further appreciation of the real exchange rate. Namely, the extra revenues originating from the resource exports boom raise domestic income as well as internal demand for all goods. Since the price of tradables is set on world markets, the additional spending boosts the relative price of non-tradables – resulting in a further appreciation of the real exchange rate.[49]

In an economy marked by perfect competition in goods and factor markets and constant returns to scale (the so-called "neoclassical economy"), the decline in the traded sector implied by the Dutch disease should not be viewed as a problem, let alone a "curse", because it is optimal for countries to specialize in those sectors where they have a comparative advantage. The Dutch disease becomes a problem if the shrinking manufacturing sector is characterized by positive spillovers on the rest of the economy (van Wijnbergen, 1984; Sachs and Warner, 1995). Krugman (1987) considers the case in which in the manufacturing sector productivity increases with production (learning-by-doing). In the short run, a natural resource boom raises the wage in the booming home economy, relative to the foreign economy. Because the home country's increase in relative wage worsens the competitiveness of the manufacturing sector, the production of some goods in this sector moves abroad, and the benefit of learning-by-doing is foregone. The home country's relative productivity worsens in those goods over time, so when the resource boom ends, market share and relative wage will have been permanently reduced (see Box 10 for a more analytical discussion of the Krugman model).

Box 10: **Krugman's model of Dutch disease with learning-by-doing**

Krugman (1987) extends the Ricardian model with a continuum of goods of Dornbusch et al. (1977), by assuming that unit labour requirements evolve over time. Respectively, the unit labour requirement in sector z at time t is equal to a(z,t) at home and to a*(z,t) abroad. As shown in the figure below, the schedule of relative productivities A(z,t) = a(z,t)/a*(z,t) is a step function, because specialization patterns become entrenched with learning-by-doing. The equilibrium in the model is obtained at the intersection between the relative productivity function A(z,t) and the balance of payments equilibrium condition, BP. A natural resources boom, modelled as a pure transfer T from the foreign country to the home country, shifts the BP curve inward (equilibrium moves from A to B). Therefore, in the short run, the transfer (resources boom) raises the relative wage in the recipient home country (booming economy) from ω_0 to ω_1. The home country has a comparative advantage in tradables, z, as long as its relative wage is lower than its relative productivity. With a large transfer, the increase in ω is enough to offset the home country's productivity advantage, thus some sectors move abroad and z falls from z_0 to z_1.

Because of foregone learning-by-doing, the shift in production from the home to the foreign country implies declining relative home productivity in the sectors between z_0 and z_1 over time. Graphically, the A(z,t) function develops a middle step, which deepens over time (downward-pointing arrows in the figure). In the long run, if the transfer is of sufficiently long duration, those sectors remain abroad even when the transfer ends. In other words, manufacturing export sectors – hit by the loss of competitiveness induced by a natural resources boom – are unable to recover when natural resources run out. Long-run welfare in the home country is permanently depressed.

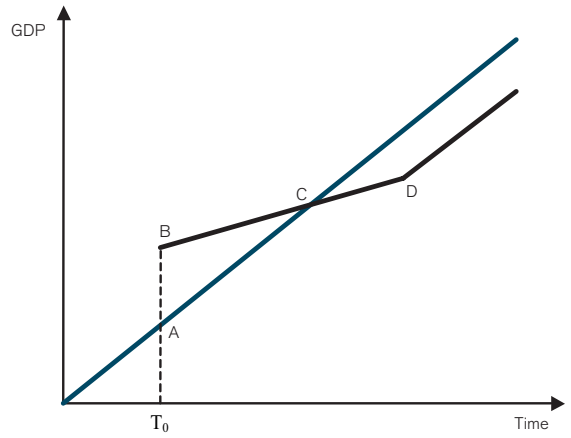


If the manufacturing traded sector is the "engine" of economic growth (Lewis, 1954) for a country, because of production externalities, increasing returns to scale or learning by doing, a contraction in its output induced by the Dutch disease is likely to reduce its growth rate, with permanent negative effects on income levels. This point is illustrated in Figure 16.[50] Suppose there are two identical economies, both initially growing at the same rate, so that GDP proceeds along the straight line between point O and point A. Now suppose that one economy has a resources boom at time T_0 so that GDP immediately rises to point B. In the short run, this economy will have a higher GDP. However, if the resources boom causes a decline in growth because it drags resources from the growth-producing sector, GDP in the booming economy will eventually fall below GDP in the other economy. Even if the booming economy eventually reverts to its pre-boom growth rate, it may still have a permanently lower level of GDP than the other economy.[51]

The Dutch disease, and its potential negative effects on income levels, can occur only if the real exchange rate appreciates following a natural resources boom. However, there might be a number of reasons why the real exchange rate depreciates, rather than appreciates, under such circumstances. For instance, the real exchange rate might depreciate if the non-traded sector is more capital intensive than the traded sector, and labour is needed to secure the windfall natural resource revenues (Corden and Neary, 1982).[52] Real depreciation can also occur in the presence of learning-by-doing and inter-sectoral learning spillovers. In a model incorporating these two features, Torvik (2001) shows that a foreign exchange gift results in a real exchange rate depreciation in the long run, due to a shift in the steady-state relative productivity between the traded and the non-traded sector. In contrast to standard models of the Dutch disease, production and productivity in both sectors may go up or down.

Allowing for real exchange rate depreciation reverts the theoretical underpinning of the Dutch disease. Since we lack empirical studies on whether natural resource booms are associated with real exchange rate appreciation or depreciation, the link between such booms and de-industrialization becomes more tenuous. The macroeconomic situation is also likely to affect the

Figure 16: **A permanent reduction in GDP following a resource boom**



likelihood of de-industrialization following a natural resources boom. If the economy is at full employment, the aggregate response to a spending boom normally runs into diminishing returns, reducing the value of spending. This is because spending translates into higher prices and crowds out alternative activities, rather than drawing more resources into use. Higher domestic prices show up as a real appreciation of the currency, the basis for Dutch disease effects. However, if there are under-employed resources ("Keynesian economy"), this crowding-out effect need not materialize. In this case, extra demand can be met by drawing under-employed resources into use. Due to multiplier effects, the final increase in income is larger than the increase in demand. Income will continue to rise until the increase in income equals the extra foreign exchange supplied by the windfall divided by the marginal propensity to import (Collier et al., 2009).[53]

The theoretical predictions of the Dutch disease have been tested both in simulations and econometric analyses, which indicate that the phenomenon is empirically relevant. Several studies have measured the net effect of expansion in the energy sector on the output of other tradable sectors. In a simulation model of a multi-sector open economy, Bruno and Sachs (1982) show that this effect is negative, with its size depending on government budget policies concerning the redistribution of oil-tax revenues to the private sector. Other studies use an econometric approach to examine the impact of energy booms on the manufacturing sector. In a cross-country study comprising Norway, the Netherlands, and the United Kingdom, Hutchison (1994) finds little empirical evidence supporting the Dutch disease hypothesis that a booming energy sector will draw resources out of the manufacturing sectors (Norway being the only exception, and the adverse effects were short-term). However, Brunstad and Dyrstad (1992) explain that Hutchison's analysis is most likely to capture effects coming through the spending channel. In a study using Norwegian data, they find that manufacturing industries have been affected by the energy boom through the resources movement effect rather than through the spending effect.[54]

Other studies have looked at the effects of resource abundance on the growth of the manufacturing sector, using data from many countries. In a cross-section of 52 countries, Sachs and Warner (1995) show evidence that resource-intensive economies did indeed have slower growth in manufacturing exports, after holding constant the initial share of manufacturing exports in total exports.[55] The most direct test of Dutch disease effects is provided by the gravity model of Stijns (2003), who estimates the impact of a natural resources boom on real manufacturing exports. The author finds the Dutch disease hypothesis to be empirically relevant. The price-led energy boom tends to systematically hurt energy exporters' real manufacturing trade. A 1 per cent increase in a country's net energy exports and a 1 per cent increase in the world energy price are associated with a reduction in the energy exporting country's real manufacturing trade of 0.47 per cent and 0.08 per cent, respectively.

(b) Weakening of institutions

It would seem that the resource curse operates in some political contexts, but not in others. And that it is strongly associated with certain natural resource sectors, but leaves others largely immune. In attempting to explain these differences, theories stressing political economy considerations, such as rent-seeking, have gained prominence (Deacon and Mueller, 2004).

Institutions, such as legal systems, have been shown to be crucial determinants of growth and development (Acemoglu et al. (2001) and Rodrik et al. (2004)). Resource dominance will therefore have an indirect effect on economic growth through institutions – beyond any direct effect through de-industrialization. It can either hamper growth in the presence of weak institutions, or it can itself contribute to institutional weakening.

First, resource abundance hampers economic growth in the presence of weak institutions, such as poorly defined property rights, poorly functioning legal systems, weak rule of law and autocracy. For instance, Bulte and Damania (2008) claim that under autocratic

leadership, policies are guided by the desire to extract bribes from firms rather than by welfare considerations.[56] When a resources boom occurs, the value of government support for the resources sector increases, thereby raising the incentives to bribe the incumbent. Sectoral support policies become more biased towards the resources industry at the expense of manufacturing. If the latter sector benefits from network effects and other spillovers, the fact that it is receiving less than a social optimum level of support works to the detriment of economic growth.

Second, when natural resource booms occur, there might be a tendency for institutions to weaken because of rent-seeking. On the demand side, agents have an incentive to engage in rent-seeking to appropriate some of the resource income available in the economy (so-called "voracity effect", described by Tornell and Lane, 1999). On the supply side, a natural resource boom can stimulate corruption among bureaucrats and politicians who often allocate the rents deriving from the exploitation and exportation of natural resources. When agents switch from profit-making economic activities to rent-seeking activities, it generates negative self-reinforcing effects that more than offset the extra income from resource revenues, thus lowering social welfare.

In their pioneering empirical study, Sachs and Warner (1995) argue that resource-rich economies generally grow at a slower pace. Countries with high ratios of natural resource exports to GDP in 1970 were found to have low average annual rates of growth in real GDP over the two subsequent decades.[57] This negative correlation remains significant after taking into account other traditional determinants of growth, such as initial income level, trade openness, investment rates, and institutional quality (see also Torvik, 2009). However, this broad conclusion has been contested by a number of follow-up studies. For instance, Papyrakis and Gerlagh (2004) find that while resource wealth (measured by the share of mineral production in GDP) seems to impede economic growth, the coefficient on this measure of resource abundance becomes insignificant – and even turns positive – after taking into account corruption, investment, openness, terms of trade and schooling.

Sala-i-Martin and Subramanian (2003) use a two-stage empirical strategy to demonstrate that natural resources have strong, robust and negative effects on long-run growth, but only indirectly via their detrimental impact on political and social institutions.[58] Once institutions are taken into account in their growth regressions, natural resources either have little remaining harmful effects or even beneficial effects. However, this conclusion is disputed by Alexeev and Conrad (2009), who claim that the statistically significant negative coefficients of the resources (oil) wealth in the institutional quality regressions presented in Sala-i-Martin and Subramanian (2003) are largely a consequence of the positive link between GDP and oil, rather than some substantive negative influence of the oil endowment on institutions.

Finally, some studies test the hypothesis that resource abundance negatively affects economic growth in the presence of growth-adverse institutions, by including interaction effects between resource abundance and institutional quality. Mehlum et al. (2006) find a positive and significant interaction, which implies that in countries with institutions of sufficient quality there is no resource curse. This result, too, has been contested by Alexeev and Conrad (2009). They claim that there is no negative indirect effect of resource abundance on the quality of institutions when per capita GDP, rather than average growth rates over a given period of time, is used as a dependent variable.[59] They conclude that countries with good institutions that would have been rich anyway tend to benefit less from the positive effect of natural resources, while countries with weak institutions that would have been poor in the absence of substantial natural endowment reap relatively large benefits from their natural resources wealth.

(c) Conflict

The most severe manifestation of the resource curse is the onset, or continuation, of civil conflict. Two widely cited explanations of how natural resources may cause conflicts are the so-called "looting" (or "greed") mechanism and the "grievance" mechanism (Collier and Hoeffler, 2004; Ross, 2004). According to the first explanation, primary commodities represent profitable opportunities for emerging rebel groups, who can raise money either by extracting and selling the commodities directly, or by extorting money from others who do. By enabling nascent rebel organizations to fund their start-up costs, natural resources increase the probability of civil wars. In the grievance model, resource extraction creates grievances among the local people who feel they are being insufficiently compensated for land expropriation, environmental degradation, inadequate job opportunities, and the social disruptions caused by labour migration. These grievances in turn lead to civil wars.

The link between resource abundance and conflict is particularly strong for easily appropriable "point-source" natural resources - that is, resources that occur naturally in dense concentrations, such as oil and minerals, rather than forestry which is more diffused throughout the economy. These resources induce intensified rent-seeking because revenues and rents are easily appropriable.[60] Moreover, as claimed by Deacon and Mueller (2004), countries with abundant point resources will tend to evolve governance structures based on centralized agglomeration of power directed at controlling those resources, and their histories will be replete with struggles to retain that control.[61]

The empirical literature on conflict has investigated the role of ethnic divisions in the build up of civil wars (Montalvo and Reynal-Querol, 2005). Natural resources are often unevenly distributed within countries: think for instance of the oil-abundant Niger Delta region in Nigeria, or minerals in the Congo's south-eastern Katanga region. Morelli and Rohner (2009) develop a

theoretical model where civil conflict arises from the interconnection between uneven distribution of natural resources within a country and conflicts of interest that assume an ethnic character. Consider that there are two ethnic groups, group j that controls the government and group i that is dominated. Groups i and j have to agree on any of four potential outcomes, two peaceful ones (peace or accepted secession) and two conflictual ones (secessionist or centrist conflict).[62] Preferences over these possible outcomes are essentially determined by the surplus-sharing agreement – that is, the share of total surplus of natural resources production accruing to the disadvantaged group i.

If there were only one form of conflict (centrist conflict), bargaining and transfer could always assure peace, as the destruction of war creates some peace dividend to be distributed. In the presence of multiple forms of conflict, however, it is not always possible to find an agreement that assures peace, because there might be a war dividend that makes bargaining fail despite the availability of credible transfers. Bargaining failure is most likely under two conditions. The first of these is when the amount of natural resources extracted in the region more densely populated with the dominated group i (denoted r_1) is large. The second condition is when the winning probability of group i in secessionist conflict, relative to the winning probability of group i in centrist conflict (p_S/p_C), is large. Intuitively, for low r_1 or p_S/p_C, secessionist conflict becomes less attractive, and the situation would be similar to when there is only one form of salient threat (i.e. centrist conflict).

The empirical evidence regarding natural resources and civil conflict is mixed, and sometimes contradictory. On the one hand, Collier and Hoeffler (2004) find that countries relying heavily on exports of primary commodities face higher risk of civil war than resource-poor countries, and that this is true for primary commodities of all types – including oil, minerals, and agricultural goods. On the other hand, subsequent studies have challenged the claim that natural resources invite civil conflict. Brunnschweiler and Bulte (2008) find that civil war creates dependence on primary sector exports, but the reverse is not true, and that resource abundance is associated with a reduced probability of war onset. Others have noticed that the relation between natural resource abundance and war onset depends on the type of natural resources involved.

De Soysa (2002) and Fearon and Laitin (2003) suggest that resource abundance being associated with a greater likelihood of war only applies to oil. In contrast, Humphreys (2005) points out that it is dependence on agricultural production that matters. Using newspaper reports of violent skirmishes in 950 Colombian municipalities between 1988 and 2005, Dube and Vargas (2006) find that violence was negatively correlated with coffee prices in locations where a large fraction of land area was under coffee cultivation. In other words, more violence occurred when coffee prices were low. The opposite was true for oil: it was higher prices that intensified conflict in areas with productive oil wells or pipelines.[63]

The studies focusing on conflict duration do not reach consensus either. Doyle and Sambanis (2000) demonstrate that civil wars are harder to end when they occur in countries that depend on primary commodity exports. However, Collier et al. (2004) show that primary commodities have no influence on the duration of conflicts. The most solid pattern identified by this literature is that "lootable" commodities that are prone to contraband, such as gemstones and drugs, are linked to the duration of conflict. For instance, Fearon (2004) finds that gems and drugs tend to make wars last longer. [64]

(d) Is the natural resource curse empirically relevant?

As already noted, the claim that resource-rich economies generally grow at a slower pace has been challenged and qualified in empirical work following Sachs and Warner (1995). A number of recent studies have further questioned the validity of previous empirical tests of the resource curse hypothesis, based on doubts about the measures of resource abundance, the failure to take into account additional variables that are linked with resource abundance in cross-country regressions and the failure to assess the impact of resource depletion over the sample period.

The first critique concerns how sensitive the resource curse is to the measurement of resource abundance. Lederman and Maloney (2007) use net natural resource exports per worker to measure resource abundance, finding that it has a positive effect on growth. Any negative impact on growth relates to the high export concentration that is typical of resource exporters. Rambaldi et al. (2006) and Brunnschweiler and Bulte (2008), on the other hand, argue in favour of alternative measures of resource abundance to replace the commonly used output- and export-related variables which are prone to endogeneity problems and can lead to biased estimates. Endogeneity is an econometric problem that may emerge, for example, because there is a two-way relationship between a country's economic growth and its natural resource exports. They suggest, respectively, using (non-renewable) resource rents per capita and total natural capital, or mineral resource assets, in US dollars per capita. With such measures, the negative relationship between resource abundance and economic growth no longer holds. Rambaldi et al. (2006) do not find either direct or indirect evidence of a resource curse. Brunnschweiler and Bulte (2008) show that resource abundance is significantly associated with both economic growth and institutional quality but, contrary to the predictions of the resource curse hypothesis, greater resource abundance leads to better institutions and faster growth.[65]

The second critique concerns the issue of omitted variables. Manzano and Rigobon (2007) find that the negative influence of resource production on economic growth is confirmed in the cross-sectional framework of Sachs and Warner (1995), but that the result disappears in fixed effects panel regressions. This indicates the

omission of one or more variables correlated with resource abundance, which biases the regression coefficients in the cross-sectional work. Manzano and Rigobon (2007) argue that the omitted variable is debt-to-GNP ratio, which is positively correlated with resource abundance. When debt-to-GNP ratio is included in the cross-sectional estimates, the resource curse disappears. The message, as emphasized by Davis (2008), is that a large pre-existing public debt and inappropriate risk management, rather than resource abundance, are the problem.

Finally, Davis (2006) and Alexeev and Conrad (2009) notice that, even if the existing empirical literature is correct, it is possible that a large resource endowment results in high growth rates in the early stages of extraction and slower growth rates as depletion sets in.[66] Davis (2006) shows that after taking changes in the level of resource production over the sample period into account, the resource curse disappears: economies with shrinking minerals-sector output saw slower growth, while those with increasing mineral output grew faster. This observation may also help to explain why some studies find evidence of a resource curse, while others do not. Measuring the rate of minerals output only at the start of the growth period would tend to identify mineral producing countries that are subject to depletion, not those that are subject to slow growth. Likewise, measuring the rate of minerals output at the end of the period would tend to identify as mineral producing countries those whose mineral output has grown over the sample period. This is why papers that measure mineral production (or reserves) near the end of the sample period find no evidence to support the resource curse (Brunnschweiler and Bulte (2008) is an example), while Sachs and Warner (1995) and others who measure mineral production at the start of the sample period find the opposite.

In order to take into account the effect of resource depletion, Alexeev and Conrad (2009) measure long-term growth via GDP per capita levels rather than by calculating growth rates over a given period of time. Their conclusion is that countries endowed with oil resources tend to have relatively high levels of GDP, suggesting that natural resources enhance long-term growth.

In conclusion, the empirical literature does not reach a consensus on whether natural resource abundance leads to slower or faster growth. What does seem clear is that the literature has progressively moved away from the initial consensus on the existence of a "resource curse" and towards a more benign view of the impact of natural resource abundance on economic growth (see example in Box 11).

Box 11: **How Botswana escaped the resource curse**

The mineral sector in Botswana – largely dominated by the diamond industry and, to a smaller extent, by copper and nickel mining – has been a major generator of economic production, government revenues and export earnings. The mineral shares of total GDP, government revenues and export earnings increased from almost zero in 1966 (year of the first diamond mine discovery) to around 50 per cent, 60 per cent and 90 per cent, respectively, in 1989 (Sarraf and Jiwanji, 2001). Mineral development has led to an extraordinary economic record. GDP grew at an annual average of 13.9 per cent in the period 1965-80, 11.3 per cent in the period 1980-89, and 4.75 per cent in the period 1990-98 (Sarraf and Jiwanji, 2001).

The reason underlying the country's success is the way in which the mineral boom of the 1970s was handled. Botswana beat the natural resources curse thanks to sound macroeconomic policies and prudent management of windfall gains (Modise, 1999). The government essentially decided not to increase public spending whenever mineral revenue increased, but to base expenditure levels during boom periods on longer-term expectations of export earnings. This is relatively unusual behaviour in a booming economy, where the tendency is to over-spend when times are good (see Section D.5). Instead, any excess revenue was used to accumulate foreign exchange reserves, and build up government savings and budget surpluses. These were drawn on in leaner years, thus avoiding drastic expenditure cuts and/or surges in public borrowing and external debt when export receipts started to decline. Such policy conduct was a strong stabilizing force; it helped reduce inflationary pressures, keep healthy public finances, and set the economy on a sustainable growth path.

Botswana also escaped the "Dutch disease" thanks to the accumulation of international reserves, which sterilized the monetary impact of the mineral export surge and prevented the national currency from strengthening. This control over the nominal exchange rate allowed other tradable goods (namely manufacturers) to maintain competitiveness on world markets, and hence encouraged economic diversification. Preserving jobs (or promoting the creation of new ones) in non-mineral sectors, including services, proved highly beneficial, given that the labour requirements of the mineral sector are limited by the capital-intensive nature of mining operations (Sarraf and Jiwanji, 2001). Therefore, thanks to a combination of mineral wealth and high-quality political institutions and macroeconomic management, Botswana achieved output and employment growth.

6. Natural resources and price volatility

Section B.1 (e) noted that an important characteristic of natural resources is their price volatility over certain periods of time. In the past, these price swings were principally supply-driven, often linked to geopolitical events – an example being the oil price shocks of the early and late 1970s. More recently, demand-driven factors, such as the rapid income growth of key emerging markets, have also influenced resource prices (Kilian, 2009b). This is particularly true for the most recent commodity boom – one of the largest and most long-lasting in history, covering a broad range of commodities – where no single and straightforward cause exists for the price acceleration and subsequent decline. This is an important development, since the economic implications of volatility may differ depending on the underlying factors driving the sudden swings in commodity prices. Box 12 discusses the above argument for the case of oil.

From 2003 to early 2008, the prices of a wide range of commodities rose sharply and over a sustained period of time. By mid-2008, energy prices were 320 per cent higher in dollar terms than in January 2003, and mining products were 296 per cent higher. By November 2008, however, all commodity prices were falling, with the dollar price of crude oil having fallen more than 60 per cent (World Bank, 2009). This considerable volatility in commodity prices can be seen in Figure 17 which depicts price trends for major commodity groups.

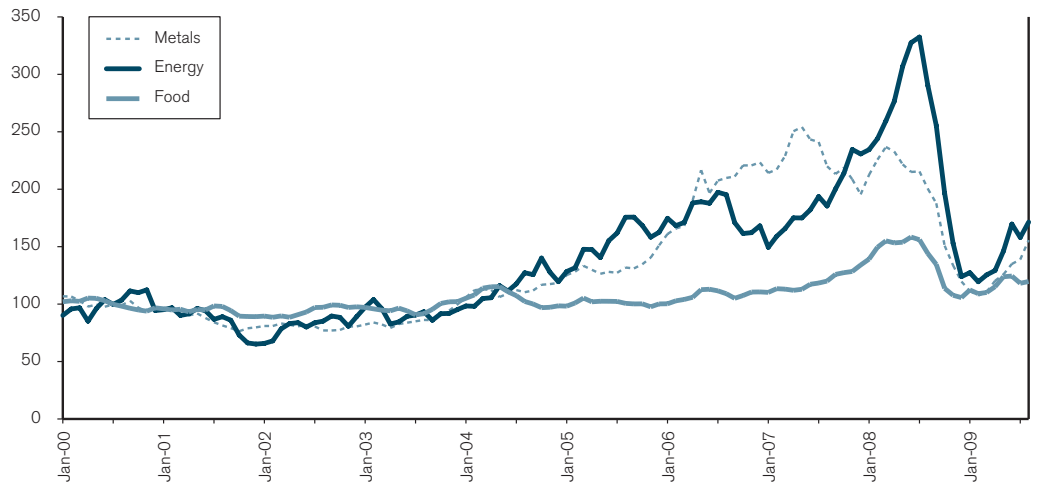
Box 12: **Economic implications of the changing nature of oil price shocks**

The large increases in the price of oil triggered by the Arab-Israeli war in 1973, and the Iranian revolution of 1979, respectively, have been conventionally associated with low growth, high unemployment and high inflation in most industrialized economies. Since the late 1990s, however, the global economy has experienced two periods of oil price volatility of a magnitude comparable with those of the 1970s but, in contrast with the latter episodes, GDP growth and inflation have remained relatively stable in much of the industrialized world.

It has been argued that improvements in monetary policy, the lack of concurrent adverse shocks, a smaller share of oil in production and more flexible labour markets all played an important role in determining the mild effects on inflation and economic activity of the recent increase in the price of oil (Blanchard and Gali, 2007). However, the literature has not found a consensus on this point.

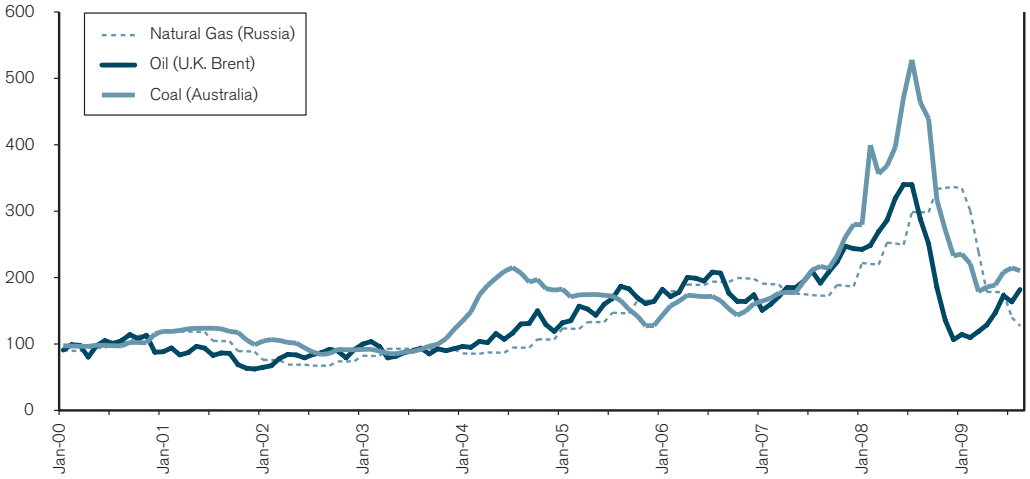
Edelstein and Kilian (2009) and Kilian and Lewis (2009) argue that there is no compelling evidence that the evolution of the share of energy in consumer expenditures or in value added, a decline in the volatility or magnitude of energy price shocks, reduced real-wage rigidities, or improved monetary policy responses can explain the declining importance of oil price volatility. A possible explanation of this phenomenon that has been advanced relates to changes in the nature of the oil price fluctuations. For instance, the recent surge in the price of oil did not cause a major recession even after years of rising oil prices partly because, unlike in the past, much of that increase was driven by unexpected strong global demand for industrial commodities (Hamilton, 2009a).[67] Such global demand shocks have both a stimulating and an adverse effect on economic growth, with the latter working through higher oil and commodity prices. Empirical estimates for the US economy suggest that, in the short run, the positive effects are strong enough to sustain growth, as global commodity prices are slow to respond and the world economy is booming. US real GDP gradually declines subsequently, as energy price increases gain momentum and the economic stimulus from higher global demand weakens (Kilian, 2009c). A more complete discussion on the causes of recent commodity price volatility is provided below.

Figure 17: **Real prices of selected commodities, Jan. 2000-Aug. 09** (Index Average of Year 2000 = 100)



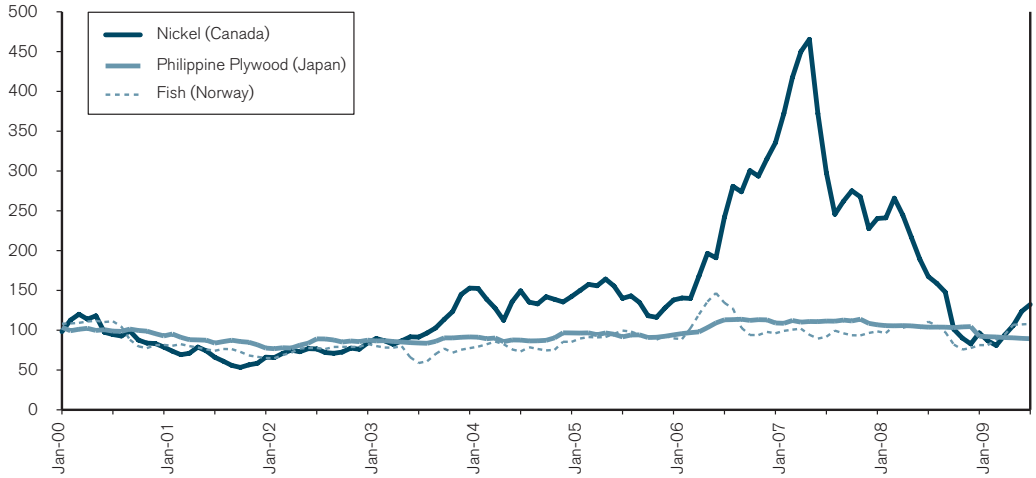
Note: Prices are deflated by world CPI, average of year 2000=100. In this database, the category of "metals" includes minerals such as iron ore.
Source: IMF, International Financial Statistics.

Figure 18: **Real prices of energy commodities: oil, natural gas and coal, Jan. 2000-Aug. 09**
(Index, Average of Year 2000 = 100)



Note: Prices are deflated by world CPI, average of year 2000=100.
Source: IMF, International Financial Statistics.

Figure 19: **Real prices of nickel, plywood and fish, Jan. 2000-July 09**
(Index, Average of Year 2000 = 100)



Note: Prices are deflated by world CPI, average of year 2000=100.
Source: IMF, International Financial Statistics.

Figure 18 depicts a similar boom and bust cycle for different energy commodities, the category characterized by the highest price volatility. Figure 19 does the same for a metal commodity and contrasts this with the markets for plywood (forestry product) and fish. The dramatic acceleration of prices from 2006 onwards for a range of commodities created the suspicion that, in addition to fundamental economic factors, prices were being pushed up by a "speculative bubble" (Talley and Meyer, 2008).

This sub-section reviews possible explanations for the observed commodity price volatility in recent times, starting with the controversial debate on the role of "speculators" (i.e. non-traditional investors betting on price movements with no interest in physically acquiring the underlying commodity) in driving prices. Thereafter, the role of fundamental economic factors in explaining the recent period of commodity price volatility will be discussed. The sub-section concludes with a brief review of some of the consequences of commodity price volatility in both importing and exporting countries.

(a) Speculation in commodity markets

(i) Speculation: definition

"Speculation" is often referred to as the assumption of the risk of loss in return for the uncertain possibility of a reward (Robles et al., 2009). It usually entails the purchase of an asset for resale rather than for use, or the temporary sale of a borrowed asset with the intention of repurchase at a later date in the hope of making a profit from a price change in the intervening period. In other words, speculators can be on the long or short side of a transaction, where the former refers to the purchase of an asset with the expectation that it will rise in value and the latter implies the sale of a borrowed

asset with the expectation that it will fall in value. Speculation may be driven by expectations of future demand and supply, which represent market fundamentals, or by self-fulfilling expectations that result in a speculative bubble.

(ii) Speculation: theory

In a seminal article, Fama (1970) presented the case for the "Efficient Market Hypothesis" (EMH), which argues that prices are always consistent with market fundamentals. The underlying logic is that, assuming rational expectations and perfect information (e.g. in the stock market), prices fully reflect all known information, thereby implying that tomorrow's price change will reflect only tomorrow's news and will be independent of the price changes today. However, news is, by definition, unpredictable and, thus, resulting price changes must also be unpredictable.[68] In this context, prices may change in response to any news about future demand or supply because it alters the expectations of market participants. Such "speculative" shocks have their roots, however, in market fundamentals and are consistent with the EMH. This is because forward-looking expectations of traders are incorporated into their actions today and hence are reflected in current prices.

Over time, the intellectual dominance of the EMH has diminished, largely due to the emergence of "behavioural economics", which argues that psychological elements make prices at least partly predictable (DeLong et al., 1990; Shleifer and Vishny, 1997; Abreu and Brunnermeier, 2003; Miller, 1997; Harrison and Kreps, 1978; Scheinkman and Xiong, 2003). It emphasizes a "feedback", "bandwagon" or "herding" effect that is indicative of the "irrational exuberance" (Shiller, 2000) of market participants, which leads to self-fulfilling speculative bubbles.[69] This divergence of prices from their fundamental values may be explained as follows. When prices go up, it generates word-of-mouth enthusiasm and heightens expectations for further price increases. In turn, this increases investor demand, and thus generates another round of price increases. If this feedback is not interrupted over a period of time, it creates a speculative bubble, in which high expectations for further price increases support high current prices.

The high prices, however, are ultimately not sustainable, since they are high only because of expectations of further price increases. Hence, the boom is followed by a bust (Stiglitz, 1990; Brunnermeier, 2008). Anecdotal evidence of such self-fulfilling speculative bubbles includes the rise and crash of the stock market during the 1980s, the dot-com bubble in the late 1990s and exchange rate overshooting in the Republic of Korea and Thailand in 1997 (Flood and Hodrick, 1990).

(iii) Speculation in commodity markets: the role of non-traditional investors

The speculation debate in commodity markets centres on the role of non-traditional investors, such as index funds,[70] hedge funds and others who have no interest in buying or selling the actual underlying commodity (Masters, 2008; Robles et al., 2009). Since they do not take or make physical delivery of the commodity, these non-traditional investors participate in futures markets, but not in spot markets, where physical delivery of a product is immediately arranged. They engage in futures trade to make a profit from the successful anticipation of price movements (United Nations Conference on Trade and Development (UNCTAD), 2001). For example, a speculator might purchase a futures contract today believing that once it expires in six months, it will sell for a higher price. A speculator thereby enables hedging by taking on risk that other market participants want to shed (see Box 13).

The increasing importance of these non-traditional investors in commodity markets during the last few years is attributable to the following. First, natural resource commodities have emerged as a new "asset class", enabling investors to better diversify their overall portfolio. This is because commodities are negatively correlated with other asset classes, such as stocks and bonds, but positively correlated with inflation (Gorton and Rouwenhorst, 2004).[71] Second, low nominal interest rates coupled with inflation can lead to the availability of "cheaper-than-free money",[72] thus enabling investors to

Box 13: Investment in commodity futures: providing insurance

Taking the example of the live cattle market, Greer (2005) describes the crucial role that futures investors can play in providing price protection. Assuming that a producer has cattle coming to the market six months from now, he/she will market the cattle regardless of price. Obviously, the producer will need to cover its unit costs of production if it wishes to stay in business. If there is a common belief (assuming markets are efficient) that price will be 10 per cent higher than cost at that future point in time, it would be advantageous for the producer to lock in this price with the client at the present day. However, the processor (buyer) may not be amenable to such a deal. If the buyer sells a certain amount of processed meat to a steak house at market price, the same price protection as the cattle producer is not needed.

In fact, if the processor were to lock in the input cost without having a guaranteed sales price of the final product, the processor would be increasing its business risk. By contrast, a futures investor may be willing to take on the producer price risk, albeit at a discount ("insurance premium"). By the same token, the producer is now sure to sell its cattle with a benefit, although at a slightly lower price than currently expected. Both parties "win" (unlike in financial futures markets, which are often considered to be "zero-sum"), since the objectives of producers in the commodity futures market are different from investor objectives.

Besides the risk premium, another component of total return is rather specific to investment in commodity futures and has to do with commodity consumption relative to inventories. Staying with the example above, assume that as the delivery date approaches, cattle supply turns out to be lower than expected (e.g. owing to disease). The processor may wish to ensure that its contractual commitment to supply a certain amount of meat to the steak house is honoured and that all processing capacities are fully employed. It may therefore decide to buy the imminent futures contract, which allows it to take delivery at several designated locations and to gain certainty to have sufficient animals to process. At the same time, if the anticipated cattle shortage further drives up prices, the processor can use the proceeds from its long futures position to help finance the purchase of the more expensive cattle.

Hence, the price of the nearby future contract may go up if processors are ready to pay for the "convenience" of knowing that they will have enough cattle to process. Depending on the "precariousness" and volatility of the market, this "convenience" yield can be a quite important source of returns to investors (Lewis, 2005). This has been the case, for instance, in the oil market, where shutting down and restarting refinery capacity is costly and demand is inelastic (i.e. demand is not linked to price fluctuations). In other markets, such as gold, where inventories are large compared with consumption, the convenience yield has been low. However, more recently, especially due to demand from emerging economies, certain industrial non-ferrous metals have seen positive convenience yields due to strong declines in inventories.

increase their demand for commodities through a simple income effect (Larson, 2008). Third, the development of commodity-based instruments, such as index certificates, has made investment in commodities more accessible to a larger number of people (Greer, 2005).

In sum, the increasing importance of commodity-related financial markets creates new opportunities as well as challenges. On the one hand, financial markets can enhance the liquidity of commodity trades, help price discovery (i.e. to determine market prices) and contribute to the efficient allocation of risk. On the other hand, the simultaneous increase in prices and speculator interest in commodity futures markets can potentially magnify the impact of supply-demand imbalances on prices. Some have argued that the high activity of non-traditional investors has increased price volatility and pushed prices above levels justified by market fundamentals. These arguments, counterarguments and the related empirical evidence are reviewed below.

(iv) Role of speculation in the recent commodity price boom and bust

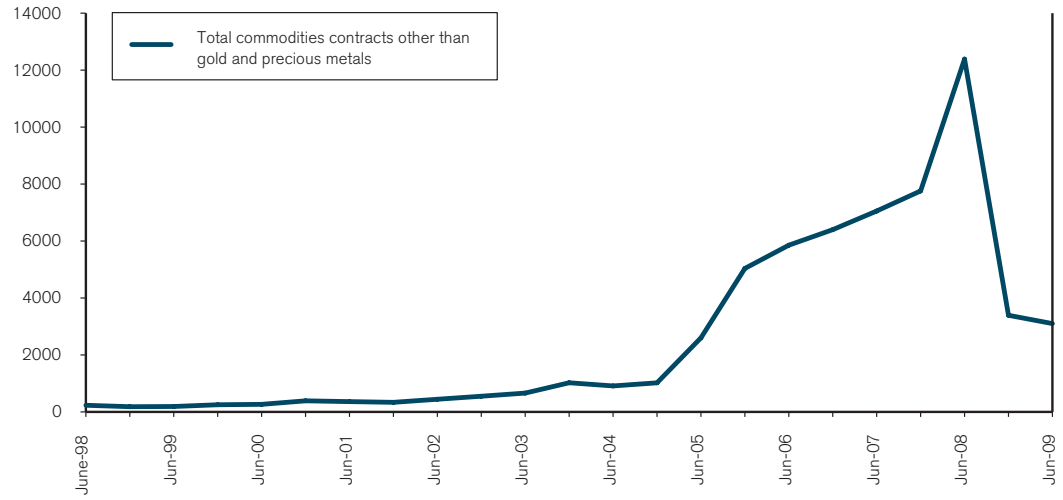
The main thrust of the argument that commodity markets have been characterized by speculation is that large amounts of money from non-traditional financial investors, who take long positions in the futures market (in both organized exchanges and over-the-counter (OTC) markets), have resulted in a significant upward pressure on prices.[73] This may be indicative of the "feedback" or "herding" effect mentioned above, whereby futures prices may have been high only because these investors believed that prices would be higher at a later date, when "fundamental" factors did not seem to justify such expectations, i.e. speculative bubbles. However, it may also reflect the expectations of participants that are based on economic fundamentals. For instance, suppose markets expect the occurrence of a natural disaster or a certain geopolitical event which would adversely affect production capacity, creating concerns about future shortages of a resource. This could lead to a genuine desire to hold increased inventories, thereby pushing up prices (Costello, 2008). In this context, Kilian (2009c) argues that Iraq's invasion of Kuwait in 1990 is a case in point.

Kilian argues that crude oil prices saw a significant rise in the mid-1990s not merely because of decline in production in Iraq and Kuwait, but also because of concerns that Iraq might also invade Saudi Arabia, causing a much larger oil supply disruption. Empirically, it is difficult to distinguish between the two sources of speculation. But given that non-traditional investors view commodities as a financial investment and are not necessarily well-acquainted with the workings of the commodity business, their behaviour in these markets may be associated with a "herding" effect.

As evidence, proponents of the speculation hypothesis highlight the increased involvement of non-traditional investors in commodity markets. For example, Büyükşahin et al. (2008) report that from 2004 to 2008, the market share of financial traders in the oil futures market increased from 33 to 50 per cent, while the share of traditional traders, such as oil producers, refiners and wholesalers, fell from 31 to 15 per cent.[74] In addition, as shown in Figure 20 for a sample of advanced countries, the number of commodity contracts traded in OTC markets increased in the first half of 2008. In view of the fact that these are largely unregulated markets, the argument has been made that this rise in activity may be indicative of the role of speculation in the recent commodity price hike (Masters, 2008).

The empirical literature examining more specifically the relationship between speculative money flows and commodity prices is rather thin. While Robles et al. (2009) show that some indicators of speculative activity can help forecast spot price movements, other studies merely present anecdotal evidence or simple correlations between futures investment and commodity prices (Masters, 2008). Some studies seem to work under the assumption that speculators have an undesirable impact on market prices. For instance, for a range of commodity markets, Chevillon and Rifflart (2009), Cifarelli and Paladino (2009) and Sornette et al. (2009) claim that because changes in supply and demand fundamentals

Figure 20: **Notional amounts outstanding of OTC commodity derivatives, June 1998-June 2009** (Billion dollars)



Note: Countries covered are Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the UK and the United States.
Source: Bank for International Settlements, Quarterly Review.

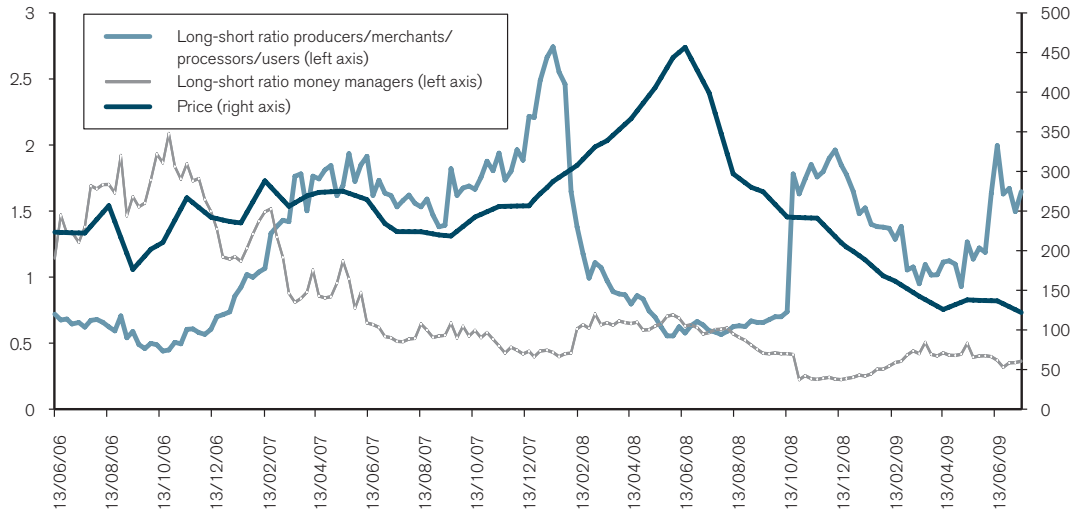
cannot fully explain the recent drastic increase in prices, large flows of money, typically in long positions, must have pushed commodities to extremely high levels. This leads to another section of the literature which argues that the body of evidence described above ignores the inherent complexity of price determination in commodity markets and is often not based on rigorous statistical methods.

(v) Not speculation after all?

A range of authors disagree with the proposition that "speculators" played a major role in the recent commodity boom and bust. First and foremost, it is argued that money flows into futures markets should not be equated with demand for physical commodities because futures contracts are settled for cash (Hieronymus, 1977). These are zero-sum markets where buying by non-traditional investors is "new demand" just as the corresponding selling by hedgers is "new supply". Second, the rigid classification of traditional investors as risk-avoiders and non-traditional investors as risk-seekers or speculators may not necessarily be true. This is because many traditional traders speculate (Stultz, 1996) and many non-traditional investors sell short in anticipation of a future decline in equilibrium prices (Frankel, 2008).

Third, the participation of financial traders is limited to futures markets, which consist of purely financial transactions. Even if their purchase of a futures contract leads to a future price increase, its eventual sale negates their existing long position and their account is closed. These financial traders do not take or make physical deliveries and hence do not participate in the spot market

Figure 21: **Natural gas – long-short positions by class of investor, June 2006-July 09** (Ratio and dollars)



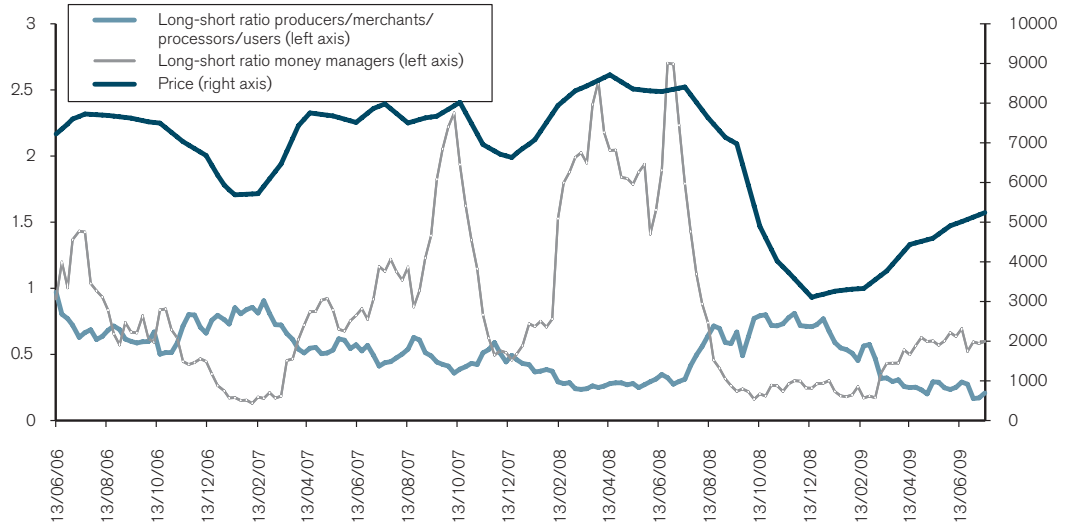
Note: left y-axis – long and short positions in contract units of 10 billion British terminal units.
Right y-axis – nominal spot price, henry hub, louisiana, united states of america.
Money managers comprise commodity trading advisors (CTAs), index funds and hedge funds.
Source: United States Commodity Futures Trading Commission and IMF, International Financial Statistics.

where long-term equilibrium prices are determined (Smith, 2009; Garbade and Silber, 1983). Speculative trading may raise spot prices only if it induces participants in the physical market to hold commodities off the market and build up inventories ("hoarding").

Anecdotal evidence suggests that the current situation in commodity markets is inconsistent with the arguments of a speculative bubble. First, the increase in "long" speculation has not been excessive when compared with the increase in "short" hedging (Irwin et al., 2009). Second, speculators have often been net "short" sellers rather than "long" buyers. Hence, they may have delayed or moderated the price increases, rather than initiating or adding to them (World Bank, 2009). Both these facts are reflected in Figure 21, which correlates the ratio of long-to-short positions, by category of participant, to prices for natural gas at the New York Mercantile Exchange (NYMEX). It shows that, in the early half of 2008, while prices increased, this ratio was fairly flat for money managers (investment funds). This lack of correlation, however, is not as evident in certain commodity markets. Figure 22 shows the case for copper.

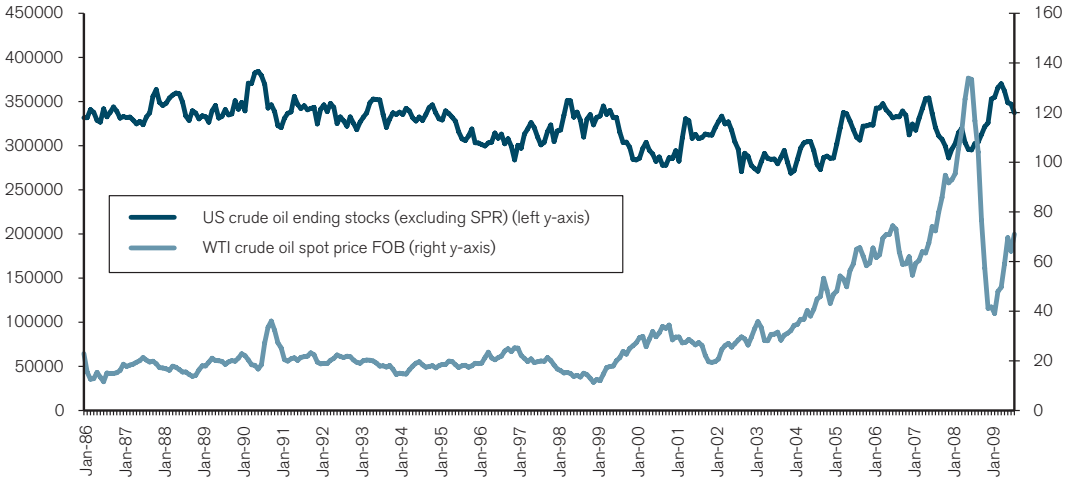
Third, Irwin and Good (2009a) show that from 2006 to 2008, high prices have been observed for commodities with no futures markets. Furthermore, spectacular price increases were concentrated in commodity markets with little index fund participation, whereas modest or no price increases were seen in markets with the highest concentration of index fund positions (Irwin et al., 2009). Fourth, data suggest that inventories of, for instance, crude oil have stayed relatively flat and have fallen sharply for a range of other commodities from 2005 to 2008 (Smith, 2009; Krugman, 2008). Figure 23, which depicts the case of United States oil stocks, shows that there is no clear evidence of "hoarding", especially when prices increased steeply in 2008.

Figure 22: **Copper – long-short positions by class of investor, June 2006-Aug. 09** (Ratio and dollars)



Note: Left y-axis – Long and short positions in contract units of 25000 Pounds, NYMEX, United States of America.
Right y-axis – Nominal spot price in U.S.$ per metric ton, London Metal Exchange, U.K. (original monthly data linearly interpolated to get weekly data).
Source: United States Commodity Futures Trading Commission and IMF, International Financial Statistics.

Figure 23: **United States monthly oil stocks and oil price, Jan. 1986-Aug. 2009**
(Ten million barrels and dollars per barrel)



Note: WTI refers to the West Texas Intermediate Exchange.
Source: US Energy Information Agency.

A number of recent studies use a variety of sophisticated econometric methods to make a more formal assessment of the role of speculation in the recent commodity price boom (Sanders et al., 2004; Sanders et al., 2008; Sanders et al., 2009; Sanders and Irwin, 2009; Bryant et al., 2006). For instance, using publicly available data on positions of different trader groups in the United States, Sanders et al. (2008) find that measures of position change have a statistically significant effect on commodity futures prices in only five out of 30 cases. In contrast, reversing the causality test indicates statistical significance in all but three cases.

In sum, empirical evidence points towards a range of fundamental market factors as the major explanation for the dramatic increase in commodity prices in recent years, with less emphasis on speculative forces. This is analysed in the section to follow.

(b) Role of economic fundamentals in explaining commodity price volatility

Commodity prices during the recent boom may have been affected by a variety of fundamental market forces on the demand and supply side (Irwin and Good, 2009b; Hamilton, 2008; Headey and Fan, 2008). These include buoyant global economic growth, limits to increasing production capacity in the short-run, relative prices of substitutes and government policies. Again, much of the literature is on the oil market, which will be used on several occasions for illustrative purposes, but is applicable to other natural resources as well (Davis, 2009).

(i) Demand

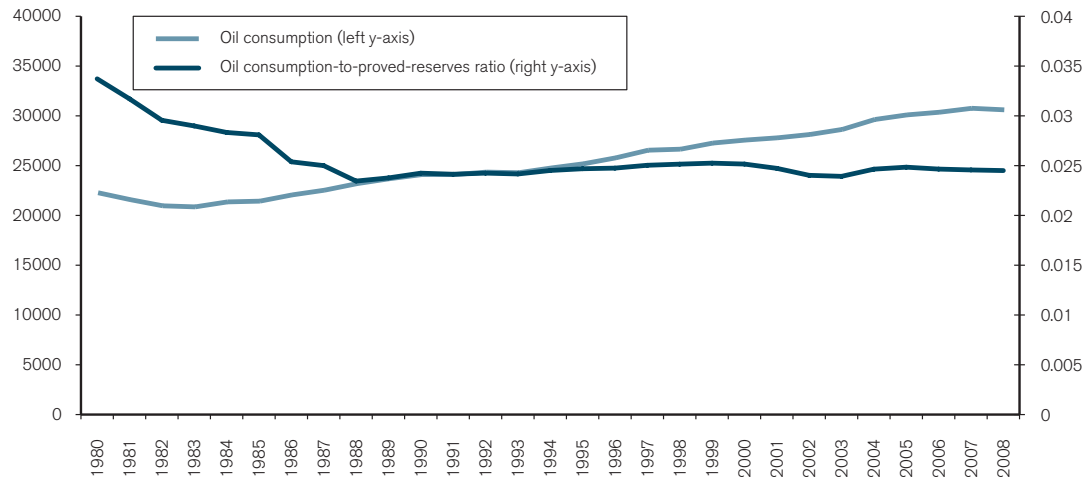
Annual increases in the global consumption of major commodities from 2002 to 2007 were larger than they had been during the 1980s and 1990s (Helbling et al., 2008). Strong income growth in some major emerging economies has been a major contributing factor in this regard (Cheung and Morin, 2007). For example, during this period, demand from China, India and the Middle East accounted for more than half of the growth in oil consumption and China alone accounted for about 90 per cent of the increase in the world consumption of copper (Helbling et al., 2008). The latter may be attributable to rapid industrialization and urbanization characterized by a high metal-intensity of growth in the early stages of development (World Bank, 2009). On the other hand, the sharp decline in commodity prices since mid-2008 may be explained, in part, by a contraction of world demand owing to slower GDP growth during the recession. Figure 24 reveals an increasing world demand for oil, which Kilian (2009c) argues is a result of unexpected growth in emerging Asian economies together with solid growth in the OECD.

Figure 24 shows that while world consumption of oil increased from 1980 to 2008, world proved reserves of the commodity also increased. A falling consumption-to-proved reserves ratio until the late 1980s implies that reserves increased faster than consumption until that point in time. Thereafter, the ratio remains about constant as the increase in proved reserves is more or less in tandem with rising consumption. The less pronounced increase in proved reserves may be attributable to the technological challenges involved in exploiting non-conventional sites such as deep sea fields or oil sands.

(ii) Limits to increasing supply capacity in the short-run

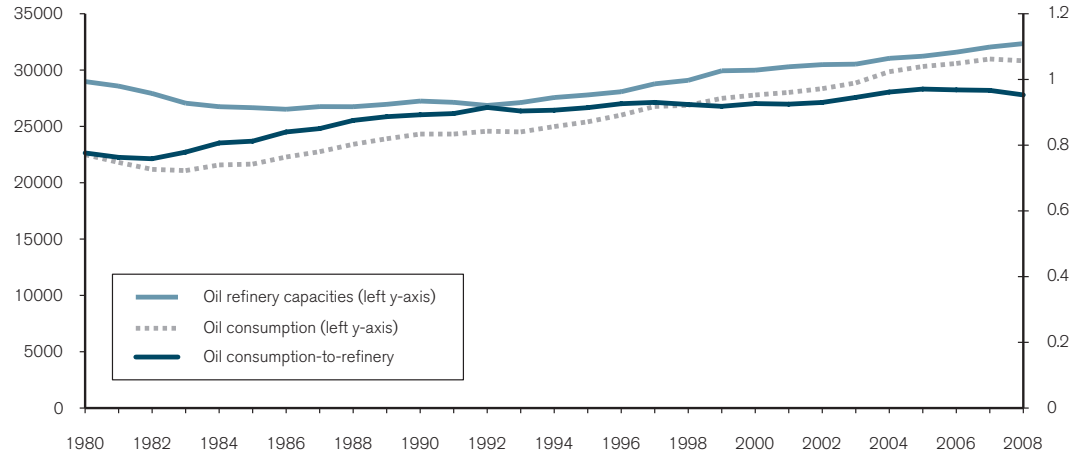
Despite the steady increase in proved reserves of energy commodities such as oil and natural gas, extraction, production and refinery capacity have not followed suit, leading to a subdued supply response in the short-run, as witnessed during the recent commodity boom. One of the reasons for the lack of investment in new capacity was the build-up of idle capacity in several resource sectors during the 1980s and 1990s, which in turn was attributable to the following. First, for oil, global

Figure 24: **World oil consumption and consumption-to-proved-reserves ratio, 1980-2008**
(Million barrels and ratio)



Note: Proved reserves are the portion of known deposits that can be economically extracted at prevailing prices using available technology.
Source: British Petroleum Statistical Review of World Energy 2009.

Figure 25: **World oil refinery capacities, consumption and consumption-to-refinery capacities ratio, 1980-2008** (Capacity and consumption in thousand barrels per day)



Source: British Petroleum: Statistical Review of World Energy 2009.

demand fell sharply following the 1980s oil shock. Second, for oil, metals and minerals, demand among former Soviet bloc countries fell by almost 50 per cent during the 1990s, as these countries began to allocate resources in a more market-oriented way (World Bank, 2009; Borensztein and Reinhart, 1994).

Given the above, excess demand was accommodated by a run-down of inventories, and prices increased when all idle capacity was finally absorbed in the first half of the early 2000s (Helbling et al., 2008). Figure 25 shows that in the case of oil, for example, refinery capacity declined or remained relatively constant from 1980 to the early 1990s, after which it saw an upward trend. Despite this, we can see that the consumption-to-refinery ratio remained relatively constant from the early 1990s to 2006, implying that consumption grew at approximately the same rate. This reinforces a section of the literature which argues that high and sustained oil prices after 2003 are primarily driven by demand, especially because the ability to increase production or refining in the near future is limited (Kilian, 2009c).

Higher oil prices do not stimulate global production in the near future because the short-run price elasticity of oil supply is near zero (i.e. oil supply is not very responsive to price changes in the short-run) (Kilian, 2009b). At the same time, in the case of oil, there is no evidence to suggest that, on the supply side, the Organization of the Petroleum-Exporting Countries (OPEC) attempted to act as a cartel and hold back production from 2004 to 2008 (Smith, 2009; Kilian, 2009c). On the flipside, high commodity prices during the boom are likely to have stimulated investment in production capacity, thereby alleviating supply-side constraints to an extent. Together with contracting world demand, this may have been a contributing factor for the bust following the boom.

(iii) Linkages across commodities

Linkages across different commodity markets have played a role in recent price increases. For instance, higher oil prices have had an important effect on other commodities not only through the traditional cost-push mechanism, but also through substitution effects, e.g. natural rubber prices have risen because its substitute is petroleum-based synthetic rubber and coal prices have risen because of utilities switching from more expensive oil to coal for power generation (Helbling et al., 2008).

Furthermore, high oil prices have led to a surge in the use of bio-fuels as a supplement to transportation fuels, thereby diverting a significant share of feedstock, especially corn, rapeseed and sugar from food supplies in major producing countries (Helbling et al., 2008). This has naturally pushed up the prices of some major food crops. Hence, this inter-linkage may explain part of the correlation between energy price and food price developments, as presented in Figure 17. On the other hand, the bust which followed the recent boom in oil markets may have contributed to the overall decline in commodity prices by reducing the demand for bio-fuels. In the long-run, the linkage between energy and food markets may weaken with the development of alternative sources of energy, e.g. solar power (World Bank, 2009).

(iv) Effective dollar depreciation

Several resource commodities are priced in US dollars and hence movements in the dollar exchange rate may affect demand and supply. The effective dollar depreciation seen over the past few years has made commodities less expensive for consumers outside the dollar area, thereby increasing the demand for those commodities (Helbling et al., 2008). On the supply side, the declining profits in local currency for producers outside the dollar area have put price pressures on the same commodities (Helbling et al., 2008).

Consider a foreign firm that produces a commodity which is priced in dollars. A depreciating dollar implies that producers will increase prices as they demand more dollars from each sale as compensation. Investors

anticipate this and start putting money into these commodities, thereby driving prices higher. Hence, it may be argued that investors have been pouring resources into the commodities market to protect themselves against the depreciating dollar. On the flipside, with the onset of the financial crisis, this source of the commodities boom reversed and possibly contributed to the sharp price decline in mid-2008. It was attributable to increased investment in "less-risky" US treasury bills, thereby resulting in an appreciation of the US dollar vis-à-vis the currencies of most developing countries.

In a speech in March 2009 on the reform of the international monetary system, the Governor of the People's Bank of China proposed a more prominent role of the IMF's Special Drawing Rights (SDR) as an international reserve currency (Zhou, 2009). One of the objectives of this proposal is to address the volatility of commodity prices denominated in a national currency (generally US dollars). Specifically, Zhou (2009) argued that promoting the role of the SDR in international trade and commodity pricing could effectively reduce price fluctuation relative to a system where commodities are denominated in a single national currency.[75]

(c) Consequences of price volatility in importing and exporting countries

In view of the dominance of natural resources in the economy of many exporters and their strategic importance in the production of importing countries, commodity price volatility has often been of widespread political concern. Below, the effects of volatility in both exporting and importing countries are discussed in turn.

(i) Effects of volatility on natural resource exporters

Hausmann and Rigobon (2003) show that in an economy where an extractive resource (say, oil) represents about 20 per cent of GDP, a shock to the price of oil has a significant effect on GDP.[76] This empirical finding is indicative of the fact that price volatility has long been considered a problem for exporters that mainly rely on natural resource exports as a source of revenues. The literature attributes this to the following reasons: risk-averse consumers, fiscal implications, and volatility as a channel of the natural resources curse.

Risk-averse consumers

If consumers are risk-averse, volatility may have an adverse effect in exporting countries, because consumers are willing to spend some of their income on hedging against the risk of large swings in resource prices. Hausmann and Rigobon (2003) hold that this negative impact on economic growth is likely to be small in the absence of further disruptions to the economy.[77]

Fiscal implications

Focusing on oil exporters, Kilian (2009c) notes that falling prices can put serious strains on their fiscal balances and ability to borrow from abroad. In contrast, rising prices can typically be accommodated easily, by financing imports from the rest of the world and recycling some of the additional oil revenues into the global financial system.[78] However, a sudden increase in natural resources wealth may induce policy-makers to increase public spending in a way that is impossible to finance once the natural resource revenues dry up.

For instance, during the episodes of high oil prices in the 1970s, banks identified oil producers as creditworthy borrowers, extending them large loans. These loans, however, financed higher imports and higher domestic consumption levels, and proved to be a miscalculation because oil prices did not remain high forever. This led these oil-rich countries into default, threatening the stability of the international financial system (Kilian, 2009c). Similarly, after the discovery of natural gas in the Netherlands and the global oil price shocks during the 1970s and 1980s, successive Dutch governments responded with large public spending increases. It then took two decades to put the Dutch welfare state on a financially sustainable footing again (Van der Ploeg, 2006).

Volatility and the natural resources curse

In a framework proposed by Hausmann and Rigobon (2003), volatility arises from an interaction between specialization and financial market imperfections, and can be a source of the resources curse.[79] They consider an economy that is specialized in the resources (non-tradable) sector, which fully employs a fixed quantity of labour. The sector's supply can be expanded only by increasing the level of capital per worker. Given fixed labour, this implies that the productivity of each additional unit of capital would be falling. Capital is, however, required to get the international rate of return, hence the price of non-tradables must increase. This would lead to an appreciation of the real exchange rate. At the same time, an increase in the price of non-tradables will cause expenditure-switching away from the now more expensive non-tradables into tradables, raising the price of tradables. This would lead to a depreciation of the real exchange rate.

Unlike a diversified economy which will have a constant real exchange rate because it can absorb demand shocks with intersectoral reallocation of labour, a specialized economy will experience a volatile real exchange rate. In addition, if this specialized economy is marked by financial market imperfections, interest rates are likely to be sensitive to the volatility in the real exchange rate. According to Hausmann and Rigobon (2003), under reasonable assumptions the interest rate is bound to go up as the volatility of the real exchange rate increases, making it even more difficult for the economy to attract investment into the "dynamic" tradable sector. The authors note that this volatility-

induced channel of the resources curse is more compatible with GDP and price developments experienced in certain resource-rich economies than competing explanations, such as the Dutch disease or rent-seeking approaches discussed earlier.

There is a vast literature on the negative effects of volatility (in commodity prices, terms of trade, unanticipated output growth or government spending) on growth performance.[80] A recent study (Van der Ploeg and Poelhekke, 2009) tests for the direct effects of natural resource abundance on economic growth and its indirect effects through volatility of unanticipated output growth.[81] The authors find that the resource curse exists only for countries affected by high volatility. Although the level of resource abundance may have a positive direct effect on growth, this effect can be swamped by the indirect negative effect resulting from volatility. Therefore, natural resources abundance may be a curse for countries affected by high volatility (e.g. Zambia and some other African countries), but a boon for those less affected (e.g. Norway and the Asian Tiger economies). In light of these results, a reduction of volatility may be desirable from the point of view of resource exporters.

(ii) Effects of volatility on natural resource importers

Price volatility is as important a concern for natural resource importers as it is for exporters. This can, in principle, be the case for any commodity imported in large quantities, and has especially been the case for oil, due to its eminent role as an input in production in virtually every sector. Since the 1970s, and at least until recently, macroeconomists have viewed changes in the real price of oil as an important source of economic fluctuations (so-called "business cycle"), as well as a paradigm of a global shock, likely to negatively affect many importing economies simultaneously.[82] The following is an analysis of the various transmission mechanisms of real oil price shocks on oil-importing economies, and how their relative magnitude has evolved over time.

Supply-side channel

An increase in the real price of oil from the point of view of an oil-importing economy is a terms-of-trade shock (i.e. an increase in the price of imports relative to exports). Such terms-of-trade shocks traditionally have been thought to matter for the oil-importing economy through their effects on production decisions, with oil being treated as an intermediate input in domestic production. A widely addressed but still unresolved issue is whether, and to what extent, oil price changes can explain real GDP fluctuations, based on this intermediate input cost or supply channel. Some argue that oil price fluctuations are not a major determinant of the business cycle (e.g. Backus and Crucini, 2000) while others argue that oil price shocks exert major effects on real GDP (e.g. Rotemberg and Woodford, 1996; Atkeson and Kehoe, 1999; Finn, 2000). However, the latter studies do not appear to have much empirical support.

Demand-side channel

According to another branch of the literature, a key mechanism whereby oil price fluctuations affect the economy is through a reduction in consumers' and firms' spending. This view is consistent with evidence from recent surveys (Hamilton, 2009b) and industry sources (Lee and Ni, 2002). Energy price changes have direct effects on private expenditure.[83] The effects on consumption and investment expenditures all imply a reduction in aggregate demand in response to unanticipated energy price increases. Recent empirical evidence confirms the predominance of such demand effects over the supply-side channel.[84]

Monetary-policy channel

Monetary policy is another channel that may amplify the effects of oil price fluctuations on the real economy. A central bank, when faced with potential or actual inflationary pressures triggered by oil price shocks, may respond by raising interest rates, thereby exacerbating the drop in real output associated with rising energy prices. The extent to which monetary policy contributes to the drop in real output following a rise in the price of oil has been estimated using a range of econometric models (Bernanke et al., 1997; Hamilton and Herrera, 2004; Leduc and Sill, 2004; Carlstrom and Fuerst, 2006). However, the various estimates obtained from these studies are sensitive to model specification, and thus the reliability of results remains questionable. In a recent study, Kilian and Lewis (2009) find no evidence that monetary policy responses to oil price shocks were to blame for the recessions of the 1970s and early 1980s.

(d) Summary and policy linkages

This sub-section has presented the causes and consequences of price volatility in natural resources, focussing particularly on the most recent commodity boom and bust.

Commodity price changes are influenced by a multitude of factors that work simultaneously. Economic fundamentals, such as a levelling out of production capacities, linkages across commodities, effective dollar depreciation and strong demand from emerging economies, are important factors in explaining the recent commodities boom. Similarly, market fundamentals such as slower income growth due to the recent financial crisis and the build-up of supply capacity following the long boom period are important factors in explaining the sharp decline in commodity prices in mid-2008. In the short-run, this sharp decline may also have been attributable to forward-looking expectations of slower growth as underlying supply and demand conditions are unlikely to have changed instantaneously. In the long-run, the extent to which demand slows down and supply catches up with

demand will depend on population growth, global economic growth, trade policies, technological change, and other factors such as climate change (World Bank, 2009).

From the recent commodity boom and bust cycle, it has also become clear that excessive price volatility in energy and other essential natural resources can generate important transfers of income within and between countries. Impacts have been particularly large among poor urban populations and in countries with fewer domestic alternatives to those energy and food items whose prices increased the most (World Bank, 2009). With certain commodities being vital for the well-being of many poor people around the world, a possible role (even if not the main cause) of traders not connected to the commodity business in bringing about price volatility has been a matter of concern. The social unrest provoked by these developments led certain countries to adopt extreme measures, such as export prohibitions. Despite their immediate price-dampening effect at home, such measures are likely to have exacerbated and prolonged high market prices, notably by reducing incentives to increase production.

These events have fed into at least two important debates on the need for international policy coordination. First, there is the question of the relationship between export measures and global commodity price volatility (see Section D). Second, the need to address problems of price volatility at their source has been highlighted, notably by appropriately regulating financial markets. This includes, for instance, a discussion of better reporting and registration requirements of OTC commodity derivatives trading in order to improve transparency and thus pricing efficiency in these markets (Pace et al., 2008). Questions on the need for further international policy coordination and cooperation in the field of trade will be further discussed in Section E.

7. Conclusions

Understanding the effects of trade opening on the exploitation of natural resources requires a dynamic approach that takes into account the trade-off between extraction today and extraction tomorrow. This significantly complicates the economic analysis in natural resource markets. As a result, economic literature on natural resources is fragmented and does not provide a comprehensive account of the effects of trade on the allocation of the resources and on their long-run sustainability.

Existing trade theory of natural resources shows that the traditional prediction that trade reflects comparative advantage also holds when the specific feature that natural resources are exhaustible is explicitly taken into account. However, traditional assumptions about the overall gains from trade hold true only under certain assumptions, such as the absence of externalities and imperfect competition. Such market failures are empirically relevant in natural resource sectors, whose markets have been often characterized by various forms of market power (e.g. cartels), weak property rights and environmental externalities. The dominance of natural resources in certain countries' economies and the prevalence of high price volatility also place limitations on traditional expectations regarding the gains from trade.

First, when the imperfectly competitive structure of some natural resource markets is taken into account, economic theory predicts that, in general, resources will be depleted more slowly than under perfect competition. However, the existing literature does not provide an account of the extent to which these results hold true in a more general model of trade, with countries endowed with different types of natural resources. Nor does it explain the impact of this more complex global market on the gains from trade.

Second, when the open access problem associated with weak property rights is taken into account, some of the standard predictions from the theory of international trade about the patterns of trade and the gains from trade may be reversed. When property rights are poorly defined, trade may exacerbate the problem of resource over-exploitation and make the resource-exporting country worse off. However, this is not the only possible outcome. The final result will depend on the specific structure of demand, population pressures and harvesting technologies. More importantly, trade may be beneficial in terms of helping to strengthen a country's property rights regime. One important situation that the existing literature does not address is when natural resources are shared by two or more countries – a situation where open access problems are most acute.

Third, trade may not necessarily generate overall gains when the negative effects of extraction of natural resources on the environment are taken into account. For example, opening up to trade can exacerbate or mitigate the common pool problem depending on the relationship between species (that is, whether the stock of two species are mutually beneficial or one reduces the survival productivity of the other) and on the number of countries involved. Although economic models that study the environmental effects of the extraction and use of non-renewable resources do not generally look at the impact of trade, trade can have a positive impact on the environment if it is associated to the transfer of emission-reducing technologies or access it allows to alternative (less environmentally damaging) resources.

Fourth, when examining the dominance of the natural resources sector in certain economies, existing studies are divided on whether resource abundance translates into faster or slower economic growth. Some stress the risks of over-specialization in the resources sector, including de-industrialization (the so-called Dutch disease), problems associated with excessive price volatility, economic instability and civil conflict. Others, however, point to examples of economies that have successfully harnessed resource specialization for economic growth, and conclude that other factors, besides resource endowments, are key predictors of economic success or failure.

Finally, studies examining the causes and the effects of high price volatility in natural resource markets have emphasized the two-way relationship between volatility and trade. On the one hand, trade allows for a more efficient diversification of input sources, thus reducing the sensitivity of natural resource prices to commodity-specific shocks. On the other hand, volatility may also adversely influence countries' openness to trade (triggering export-restricting policy responses) or how they trade (e.g. organized exchanges versus bilateral long-term contracts). The literature also stresses the important role that commodity-based financial instruments may have in providing a hedge mechanism against the risk of volatility or in contributing to sudden price swings via herding effects. One weakness of the literature is that it focuses mainly on oil price movements. While some of the insights may be applicable to other commodities, the absence of studies on the causes and consequences of volatility in other resource sectors is regrettable.

Endnotes

1 See WTO (2008) for a discussion of these extensions.

2 The opportunity cost of depletion is also known as user-cost, in situ-value or resource-rent.

3 The list of extensions of the Hotelling model is not an exhaustive one. For recent surveys of the theoretical and empirical literature on non-renewable resource economics, see Livernois (2009) and Krautkramer (1998).

4 Some underlying assumptions are built into the models. First, each country is small relative to world markets and is able to sell and buy at a given and constant terms of trade. Second, markets are perfectly competitive. Third, no economic or political distortion exists: a social planner chooses the allocation of resources to maximize present and future social welfare (i.e. the present discounted value of the flow of future utilities).

5 The only departure from the Heckscher-Ohlin theory (under the "Hybrid" scenario) is that an economy would obviously switch its specialization from one commodity to another when the rate of resource extraction declines to zero and its initial comparative advantage disappears.

6 These issues will be addressed in Sections C.3 and C.4.

7 Fixed costs are those that firms have to pay for certain goods or services independently of how much they ultimately produce. As the overall level of output rises, the fixed costs get distributed over a larger number of units, and, hence, the firm's average costs of production decline.

8 In particular, theoretical literature has followed two approaches to model a partially cartelized industry with a competitive fringe. Some have modelled market competition as a Cournot-Nash equilibrium, in which each producer is assumed to choose output to maximize its own profits, taking as given the production schedules of the others (Salant, 1976; Pindyck, 1978; Ulph and Folie, 1980; Lewis and Schmalensee, 1980). Others have treated the cartel as a dominant firm in a so-called Stackelberg game, in which the cartel acts as a leader. The competitive fringe will have to accept the price fixed by the cartel, but the cartel will have to fix the price taking into account the output produced by the competitive producers (Gilbert, 1978; Newbery, 1981; Ulph, 1982; Groot et al., 1992; Groot et al., 2003).

9 For a discussion on the possible role of forward trading on the allocation of resources under imperfect competition see Liski and Montero (2008).

10 At each moment in time prices will exceed marginal costs by a markup. This markup will depend on (is the reciprocal of) the price elasticity of demand. In particular, the more rigid world demand, the higher the cartel markup.

11 In the simpler model considered by Hotelling, marginal costs are negligible. When they are not, the Hotelling rule is in terms of prices (for a perfectly competitive economy) and marginal revenue (for a monopoly) net of marginal costs.

12 Economic theory has shown that in the absence of methods to enforce long-term commitments, time consistent equilibria exist under a set of very limited conditions (Newbery, 1981; Ulph and Folie, 1980; Maskin and Newbery, 1990).

13 Recall that the Hecksher-Ohlin theorem only explains inter-industry trade, that is the exchange of different goods between two different countries. In an Heckscher-Ohlin framework trade takes place because countries are different, therefore there is no reason for countries to exchange identical goods.

14 Two-way trade in horizontally differentiated goods is explained in economic theory by the so-called "new" trade theory. In this set up, increasing returns to scale favour each country's specialization in a limited number of varieties and consumers' love of variety ensures that foreign and domestic varieties of a certain product are consumed. The model assumes that firms operate under monopolistic competition. But, this assumption is the necessary consequence of increasing returns to scale, rather than the determinant of trade.

15 This decision depends on whether the firm perceives its sales in the foreign market to be more responsive to price reductions than in the domestic market.

16 Refer to Block and Taylor (2005) for an extensive review of the economic literature on the link between growth and the environment.

17 More technically, if the elasticity of substitution between the non-renewable resource and other inputs is greater than or equal to one, and if the elasticity of output with respect to the natural resource is lower than the elasticity of output with respect to physical capital, then it is possible to guarantee a constant consumption path with a growing population (Stiglitz, 1974; Solow, 1974b; Solow, 1974a).

18 In some ways, these results parallel the findings of the literature on environmental quality: technological progress can have opposite effects on the environment depending on what sectors are involved. Indeed, technological change in goods production has a "scale effect" that raises emissions, while technological progress in the abatement sector drives emissions downwards, through a pure "technique effect" (Taylor and Brock, 2005).

19 It is important to point out one limitation in the literature reviewed in this sub-section. The papers all consider a situation where the natural resources stock is subject to exploitation only by citizens of the country and do not consider the circumstance where the resource is shared by two or more countries. However, some of the most severe forms of open access problems are transboundary in nature, e.g. fish in the open ocean that are not under the jurisdiction of any single nation or migratory/straddling stocks that pass between jurisdictions. A complete discussion of transboundary problems associated with natural resources are found in Section D on regional agreements and in Section E of this report.

20 Unfortunately, this will not always be the case. First, the environmentalist may have the size of the stock corresponding to maximum sustainable yield as an objective. But the size of the natural resources stock corresponding to maximum rent will usually be smaller. Second, if the discount rate is higher than the maximum rate of growth of the resource, the economically efficient decision will be to extinguish the stock.

21 The growth function is $\dot{S}(t) = \frac{dS(t)}{dt} = rS(t)(1 - \frac{S(t)}{K})$, where $\dot{S}(t) = \frac{dS(t)}{dt}$ is the rate of change of the stock; r is the maximum possible biological growth rate of the resource; S(t) is the size of the current stock which depends on time, and K is the environmental carrying capacity of the resource. The solution to this first-order differential equation is a logistic function. The relationship is often called the Schaefer curve after fisheries biologist Schaefer (1957) who used it extensively in his work.

22 The steady state condition is given by: $\dot{S}(t) = \frac{dS(t)}{dt} = h(E,S)$ where $h(E,S) = E * S$ is harvest. Harvest depends positively on effort (E) and the stock of natural resource (S). Using these relationships and the growth rate, it is possible to solve for the stock as a function of effort and substitute the result into the harvest equation, which finally gives harvest (or revenues) as a function of effort in Figure 14.

23 Using the growth function and the steady-state condition, it is possible to show that there is a negative relationship between stock and effort in the steady state.

24 For a fuller discussion of the role of the discount rate, see chapters 2 and 3 of Clark (1990).

25 This fishery is located in the Northwestern Pacific waters of Canada and the United States.

26 Geoduck is a species of very large saltwater clam that is native to the northwest coast of Canada and the United States.

27 This report focuses on trade in natural resources and hence it will not deal with the literature analysing the effect of trade on the environment when environmental externalities are mainly generated in the production sectors (e.g. industrial pollution). For a description and analysis of this literature see WTO-UNEP (2009).

28 This classification is also valid for renewable resources. An example of flow externalities is forest harvesting. The stock externality of this activity involves deforestation, soil erosion, species extinction, and an increased concentration of carbon in the atmosphere.

29 While models such as Sinclair (1994), Ulph and Ulph (1994), Withagen (1994), Hoel and Kverndokk (1996), Kolstad and Krautkraemer (1993), Babu et al. (1997) and Welsh and Ståhler (1990) consider the externalities in a partial equilibrium framework, Stollery (1998), Schou (2000) and (2002), Grimaud and Rougé (2005) and (2008), Groth and Schou (2007) and Acemoglu et al. (2009) use general equilibrium models.

30 For a discussion of the Hotelling rule see Section C.1.

31 Data show that 87 per cent of total consumption of energy in 2000 was represented by fossil fuels such as oil (40 per cent), coal (25.7 per cent) and natural gas (22 per cent). See Kronenberg (2008).

32 The concept of backstop technology was first introduced by Nordhaus (1974) and refers to an alternative way of producing a certain output which does not rely on exhaustible resources. Examples in the context of electricity generation are solar or wind energy.

33 OPEC countries also have an incentive to boost their reserve estimates, because their export quotas depend on the total amount of reserves they have. See Campbell and Laherrère (1998).

34 See for instance Krautkramer (1998).

35 It is assumed that the probability of a new discovery is decreasing over time.

36 This technological option has currently become promising for the fossil energy extraction industry. In fact, the possibility and viability of capturing and sequestering some fraction of the carbon dioxide arising from fossil fuel combustion has been recently demonstrated. This process, often labelled as CO_2 capture and storage (CCS), consists of separating the carbon dioxide from other flux gases during the process of energy production; once captured, the gases are then disposed into various reservoirs.

37 While the combustion of natural gas releases 117,000 pounds per billion btu of energy input (p/btu) of carbon dioxide, 92 p/btu of nitrogen oxides and 1 p/btu of sulfur dioxides, burning oil and coal produces respectively 164,000 and 208,000 p/btu of carbon dioxide, 448 and 457 p/btu of nitrogen oxides and 1,122 and 2,591 p/btu of sulfur dioxides, see IEA (1998).

38 According to Barbier and Rauscher (1994) and Swallow (1990) habitat destruction is one of the obstacles to the long-run viability of more than 50 per cent of those species currently threatened by extinction.

39 Barbier and Schulz (1997), Smulders et al. (2004) and Polasky et al. (2004) illustrate the effect of trade in natural resources on biodiversity through the effect on natural habitat. Brock et al. (2007) analyse the effect of trade-induced biological invasion on biodiversity.

40 Here the discussion will be restricted to identical countries. In general however, the literature takes into account the fact that countries differ in size, productivity and tastes and shows that in these cases, the effect of trade opening on biodiversity is not clear and will depend on multiple factors such as the sectors in which the countries will specialize, the relative size of the species habitat across countries or differences in the eco-systems across countries.

41 This description of "species-habitat area" curve comes from MacArthur and Wilson (1967) and is widely used in ecological theory.

42 See Polasky et al. (2004).

43 The welfare effects of trade depend on how biodiversity affects the utility of consumers. Consider, for example, that a certain species provides services to the population. The impact of trade on welfare will depend on whether the species has to be located in the same country of the consumer (e.g. species of sedges, which are primarily used to filter water in wetland ecosystems) to provide a positive effect on its utility, or whether the location of the species is not relevant (e.g. species such as chimpanzees for which people care that the worldwide population does not become extinct).

44 However, results can be extended to other natural resources such as forestry and hunting of wild animals.

45 When countries have market power and tastes are identical the price effect will offset the biological externality and an efficient level of harvesting will be reached.

46 Resource concentration is a sufficient, but not necessary condition for concentrated trade patterns. The "new trade theory" allows for extreme concentration even where endowments are similar across countries. Moreover, even if it was the geographical distribution of factor endowments that led to these trade patterns, extreme trade concentration could be the result of geographically concentrated capital, or skilled labour. For the sake of the arguments put forth in this section, it suffices to note that trade in resources is a predominant share of production and export activities in a few abundant countries, regardless of the underlying reason.

47 The term was coined in 1977 by *The Economist* to describe the decline of the manufacturing sector in the Netherlands after the discovery of a large natural gas field in 1959.

48 See Corden and Neary (1982) and Corden (1984).

49 It might be the case that the natural resource sector does not employ a factor that is mobile across sectors, and is effectively an enclave in the economy. In this situation there is only a spending effect, because there is no intersectoral reallocation of productive resources.

50 Figure 16 is from Sachs and Warner (1995).

51 A few caveats are in order. First, the existence of external economies in the manufacturing sector has not yet been determined. Sachs and Warner (1995) themselves state that "the links of these Dutch Disease effects to the loss of production externalities, however, remains speculative and as yet unproven". Second, the presence of external economies justifies government subsidization of the growth-driving sector. The lower growth path BCD of Figure 16 may then be due to government failure rather than to the resource boom *per se*. Third, the same growth path BCD could be due to resource depletion, which – as shown among others by Nordhaus (1992) and Boyce and Emery (2006) – is a drag on economic growth when it is not offset by technological progress. Fourth, Alexeev and Conrad (2009), who study the effect of oil abundance on GDP levels, have not determined any resource extracting economy to be on part CD of Figure 16. They are all on part BC, and it is not known whether CD will happen.

52 By the Rybczynski theorem, the non-traded, capital intensive sector expands and the traded sector contracts; the resulting increase in the relative supply of non-traded goods causes a depreciation of the real exchange rate. Other cases are discussed in Van der Ploeg (2006).

53 Collier et al. (2009) notice that this is a theoretical possibility. In practice, however, even in the presence of under-employed resources, supply responses are dampened, producing higher wages and a higher price of domestic output as a whole relative to the price of foreign goods, therefore a real appreciation of the currency.

54 Brunstad and Dyrstad (1992) find that occupational groups in areas close to the booming sector which did not experience positive demand effects experienced a decrease in their real wages as a result of the petroleum boom.

55 Sachs and Warner (1995) also show that resource-intensive economies had a higher ratio of output of services to output of manufactures. This is consistent with the prediction of the Dutch disease models that the ratio of non-traded to (non-resource) traded output will be higher in resource intensive economies, to the extent that services proxy the non-traded sector and manufactures proxy the non-resource traded sector.

56 When there is more political competition, on the other hand, the government would try to retain its power and thereby it might be forced to spend more on provision of public goods to promote growth. Bhattacharyya and Hodler (2009) make a similar point by arguing that the relationship between natural resource abundance and corruption depends on the quality of the democratic institutions: resource abundance is positively associated with corruption only in countries with low net democracy score.

57 There is a potential endogeneity concern, namely reverse causality from economic growth to resource endowment. Sachs and Warner (1995) argue that the relationship is robust to the introduction of an alternative measure of natural resource abundance – arable land area to population – which is relatively less endogenous than the ratio of natural resource exports to GDP.

58 For the period 1970-98, they estimate a growth regression including institutional quality and natural resource abundance in the set of explanatory variables. Institutions are instrumented with variables that do not affect growth between 1970 and 1998 – namely mortality rates of colonial settlers, as in Acemoglu et al. (2001) and fraction of the population speaking English and European languages, as in Hall and Jones (1999). The first-stage regression results allow one to test the indirect effect of natural resources on growth via their impact on institutional quality.

59 The inclusion of levels, rather than growth rates, of per capita GDP is justified by observing that if a country has a higher per capita GDP than another, it must have experienced faster growth over the long term than the other.

60 For similar reasons, conflict is more likely for capital-intensive resources than for labour-intensive ones (Dube and Vargas, 2006).

61 Since they induce rent-seeking, point-source resources will also tend to deteriorate institutions (and therefore growth), beyond their effect on the likelihood of conflict. This is confirmed by the empirical literature. For instance, Isham et al. (2003) show that export concentration in point-source natural resources and plantation crops is strongly linked to weak public institutions and governance indicators which, in turn, generate lower capacity to respond to shocks and, ultimately, lower economic growth – as compared with more diffuse natural resources such as agricultural products. Therefore, it seems that the type of natural resource exports is a crucial determinant of whether natural resources become a curse or a blessing (for a study based on panel data econometric modeling, see Murshed, 2004).

62 Secessionist conflict refers to war started with the aim of splitting up a region of the country and founding an autonomous state, while centrist conflict is about gaining the control of the whole country.

63 Fisman and Miguel (2008) propose shifting some amount of international development assistance away from long-term investment and toward short-term emergency aid for countries hard-hit by a collapse in prices of labour-intensive commodities such as coffee. This aid would kick in as soon as prices fall, potentially avoiding the occurrence of violent conflict.

64 See also Ross (2004).

65 An earlier comparative analysis by Davis (1995) also found no evidence of a resource curse; the observed mineral economies had done well in a number of development indicators against non-mineral economies over the same period, even outperformed them in some cases.

66 A related idea, explored in Rodriguez and Sachs (1999), is that with constant or declining resource production and exogenous growth, GDP per capita asymptotically approaches that of a non-mineral economy from above, thus exhibiting negative growth rate during the transition to steady state.

67 According to Kilian (2009a), this interpretation is however not entirely consistent with a wide range of evidence that indicates a central role for oil demand shocks in all previous oil price shock episodes since 1972, except the oil price shock triggered by the outbreak of the Iran-Iraq War in late 1980.

68 This is associated with the idea of a "random walk", which is a term loosely used in the finance literature to characterize a price series where all subsequent price changes represent random departures from previous prices. It implies that experts in the field cannot systematically outperform uninformed investors, except through luck.

69 The idea of "herding" in financial markets may be traced back to Keynes's Beauty Contest where he described the behaviour of market participants using an analogy based on a fictional newspaper contest. He argued that investors in equity markets anticipate what average opinion expects average opinion to be, rather than focusing on things fundamental to the market (Keynes, 1936).

70 These are investors who distribute their wealth across key commodity futures according to popular indices, such as Standard & Poor's or Goldman Sachs Commodity Index.

71 Commodities provide diversification to an investment portfolio for at least two reasons. First, commodities are subject to factors, such as weather conditions or miners' strikes, that have little or nothing to do with expectations about stock or bond markets. Second, if there were, for instance, widely held beliefs about rising inflation, bond prices would fall as interest rates rise and stock markets might be negatively affected as well. However, since commodity investments reflect expectations about further price increases over "real" products, their prices should be expected to rise along with expectations about higher inflation (Greer, 2005).

72 In other words, the real interest rate could be negative.

73 It has been argued that as speculators drive commodity futures prices higher, the effects are felt in spot markets and the real economy, since spot market participants typically base their supply and demand decisions, at least in part, on expected price changes in the future (Masters, 2008; Hamilton, 2008).

74 'Swap dealers" who provide trades, which cater to the needs of commercial entities, account for the balance.

75 The speech can be accessed at: http://www.pbc.gov.cn/english/detail.asp?col=6500&id=178

76 More precisely, Hausmann and Rigobon (2003) show that a 1 standard deviation shock to the price of oil represents an income shock equivalent to 6 per cent of GDP.

77 Hausmann and Rigobon (2003) make the following example: Assuming an economy where oil accounts for 30 per cent of national income and has a standard deviation of about 30 per cent per year and given a constant relative risk aversion (CRRA) utility function with a relatively high risk aversion coefficient of 3, a typical consumer would be willing to sacrifice 4.05 per cent of national income in order to make oil revenues perfectly certain.

78 Since the oil producers' ability to absorb infusions of capital is likely to be limited, they inevitably invest the revenue that cannot be invested domestically in oil-importing economies. A good example is the sovereign wealth funds maintained by many oil-producing countries (Kilian, 2009c). Because of this transfer of financial wealth from oil exporters to oil importers, positive oil demand shocks or negative oil supply shocks should be associated with a temporary capital gain in oil importing countries. This is the so-called "valuation channel" of transmission of oil price shocks across countries. Another, real channel of transmission of oil price shocks across countries is the "trade channel", which works through changes in the quantities and prices of goods exported and imported, and is reflected in the response of the trade balance. Kilian (2009c) explains that supply disruptions, by increasing the price of oil, cause a surplus in the oil trade balance and a deficit in the non-oil trade balance (net exports of non-oil products) of the exporter. By construction, the response in the importing economy will be the mirror image of that of the exporting economy. Demand shocks – associated for instance with productivity improvements in the oil-importing country that raise demand not only for crude oil, but for all other industrial commodities as well – have two opposing effects. On the one hand, they raise the price of oil, causing a surplus of the oil trade balance and a deficit in the non-oil trade balance of the exporter. On the other hand, they represent a short-run stimulus for the oil-importing economy, which will tend to cause a non-oil trade surplus for the exporter. Empirical research by Kilian (2009b) and Kilian and Park (2009) on the US economy (net oil importer) suggests that the latter effect dominates in the short run, while the former effect dominates after one year.

79 See Section C.4 for a discussion of other channels of the natural resource curse.

80 See, among others, Aghion et al. (2009) and Ramey and Ramey (1995).

81 The authors develop a theoretical model showing that volatility in natural resource revenues, induced by volatility in primary commodity prices, curbs growth in economies with poorly functioning financial systems. This prediction is similar to Hausmann and Rigobon (2003).

82 Blanchard and Gali (2007). Since the late 1980s, however, the effects of real oil price shocks on oil importing countries have been significantly smaller. This is discussed in Box 12.

83 This occurs through four mechanisms: (i) the discretionary income effect, that refers to the reduction in income available for non-essential spending brought about by higher energy prices, as consumers have less money to spend after paying their energy bills; (ii) the uncertainty effect, that refers to the postponement of irreversible purchases of consumer durables, as changing energy prices may create uncertainty about the future path of the price of energy; (iii) the precautionary saving effect, that refers to the increase in the uncertainty-related component of savings, and the consequent fall in consumption, in response to energy price shocks; (iv) the operating costs effect, that refers to the delayed or foregone purchasing of energy-intensive durables, whose consumption will tend to decline even more than consumption on other goods.

84 See Hamilton (2008) and Kilian and Park (2009).

D. Trade policy and natural resources

This section looks at the ways government policy responds to the unique features of natural resources. It examines how the unequal distribution of natural resources give importing and exporting countries incentives to use restrictive trade and domestic measures to "capture" monopoly rents. It analyzes how governments can use trade restrictions and domestic measures to strengthen property rights or reduce the exploitation of the natural resource. Where the consumption or extraction of a natural resource affects the environment, it considers the steps governments could take to make producers and consumers take account of the social costs of their activities. However, the use of trade and domestic policies will have consequences for trade partners through changes to their terms of trade. In some instances, the availability of large resource rents may make government policies hostage to vested interests involved in the extraction and trade of natural resources. Finally, this section will consider how regional trade cooperation can assist in mitigating or resolving these potential frictions in natural resources.

Contents

This section is divided into two parts. The first part reports data on trade policy and other relevant domestic measures employed in natural resource sectors. The second part focuses on the effects of such trade and domestic policies. These measures can shift rents internationally or change the terms of trade (i.e. the price of exports relative to imports). However, trade and domestic policies may also affect the conservation of natural resources and the environmental externalities associated with their extraction and use. Addressing these different effects separately can be useful for analytical reasons. Clearly, governments may use these policies for diverse reasons.

1. Trade and other policy instruments in the natural resource sectors

There is a wide array of policy measures that impact on natural resources trade, including export taxes, quotas and prohibitions, applied and bound most-favoured nation (MFN) tariffs, non-tariff measures as well as national consumption taxes and subsidies. What makes the picture more complex is that the distinction between trade and domestic policies can be especially blurred in the case of natural resource markets.

Some countries have such an abundance of natural resources – and their domestic markets are so small – that nearly all production ends up being exported. Other countries have such a scarcity of natural resources that they have to depend on imports for all, or nearly all, of their supply. In this context, economic theory suggests that domestic measures that restrict production in the exporting country – or, alternatively, restrict consumption in the importing country – have a disproportionate impact on exports or imports and become *de facto* trade instruments.

(a) Import tariffs

The following section examines the prevalence of restrictions placed on natural resource imports. First, it looks at the level of tariff protection on natural resources, and whether it is higher than on other merchandise trade. Second, it examines the pattern of bound tariff rates in the natural resources sector. And third it looks at the extent of tariff escalation on processed and semi-processed natural resource products.

(i) Level of tariff protection

To measure the level of tariff protection in the natural resources sector, recent data (year 2007) on applied MFN tariffs in fisheries, forestry, fuels and mining were obtained from the WTO's Integrated Database (IDB) and the International Trade Centre for 146 countries. The calculations include *ad valorem* equivalents of non-*ad valorem* duties. Based on this information, (simple) average tariff rates were calculated for all countries, and for two further groupings, developed and developing countries.[1]

The results, which are summarized in Table 7, show that tariff protection in the natural resources sector is generally lower than for overall merchandise trade (the detailed information by sector and by country appears in Annex Table 1). This conclusion applies to both developed and developing countries. The only possible exception is fisheries where, for developing countries, the rate of tariff protection is higher than for all merchandise imports. In terms of specific natural resource sectors, tariff protection is lowest in mining and fuels and highest in fisheries.

Table 8 summarizes available information on bound tariff rates in the natural resource sectors for a smaller group of 119 countries (detailed information on bound rates and binding coverage for these natural resource sectors by country are also included in Annex Table 1). Bound rates – the agreed upper limit for a tariff – are typically higher than the rates actually applied by countries, with the amount of "water" between the two being greater for developing countries than developed. Fisheries has the highest average bound rate while the fuels sector has the lowest. Binding coverage – the proportion of tariff lines bound – is highest in forestry and lowest in fisheries. With the possible exception of fuels, binding coverage is almost universal for developed countries.

Table 7: **Simple average applied tariff rates in natural resource sectors, 2007**

Sector	Developed countries	Developing and least-developed countries	All countries
Fishery	2.2	15.1	14.2
Forestry	0.6	6.5	6.1
Fuels	0.5	6.2	5.8
Mining	0.8	6.0	5.7
All merchandize imports	5.4	10.7	10.3

Source: WTO Integrated Database and International Trade Centre.

Table 8: **Bound rates in natural resource sectors, 2007**

	Average Bound Rate				Binding Coverage			
	Fishery	Forestry	Mining	Fuels	Fishery	Forestry	Mining	Fuels
All	31.4	26.5	28.6	25.3	65.0	74.0	72.6	68.9
Developed	2.5	1.2	1.6	1.5	98.3	98.6	99.9	90.1
Developing and least-developed	34.2	28.9	30.9	27.5	62.4	72.1	70.5	67.2

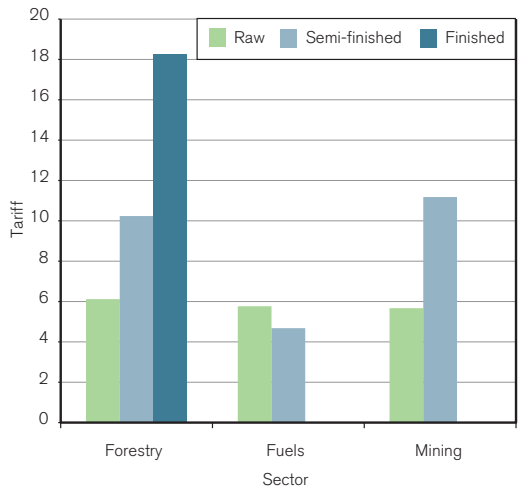
Source: WTO Integrated Database and International Trade Centre.

(ii) Tariff escalation

One suggested reason why resource-rich countries apply export taxes is to redress the structure of protection they face in export markets, where tariff rates tend to rise with the stage of processing. This issue has been examined in previous WTO reports in terms of its application to manufactured goods (World Trade Organization (WTO), 2001) and to non-oil commodities. In the case of non-oil commodities, although tariff protection was found to rise with the degree of processing, the degree of escalation differed, sometimes markedly, across countries (World Trade Organization (WTO), 2003). Tariff escalation was also found in manufactured goods although it differed greatly across countries. Moreover, certain product categories, such as textiles and clothing, and leather and leather products, were characterized by a higher degree of tariff escalation than other industrial sectors (World Trade Organization (WTO), 2001).

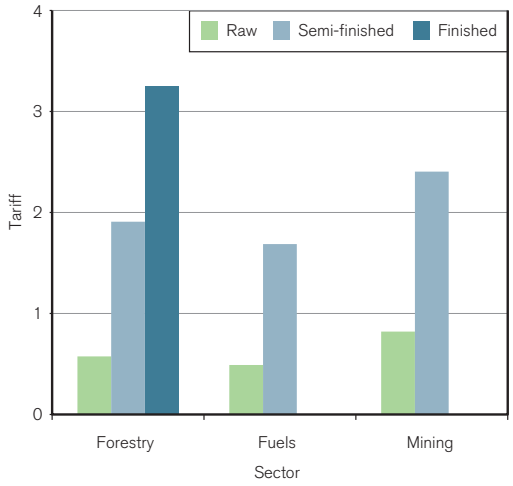
The pattern of tariff protection for natural resources in their raw state and in their more finished or processed state is shown in Figure 26 (more detailed information is available in Annex Table 2).[2] Tariff escalation appears to be present in some natural resources, such as forestry and mining, but not in others, such as fuels. For instance, in their raw state, the average tariff on forestry products is 6.1 per cent. But in their more processed form, it rises to 10.2 per cent in the case of cork, wood and paper products,

Figure 26: **Structure of tariff protection, by stage of processing**



Source: WTO Integrated Database and International Trade Centre.

Figure 27: **Structure of tariff protection in developed countries, by stage of processing**



Source: WTO Integrated Database and International Trade Centre.

and to 18.3 per cent in the case of wooden furniture. However, no escalation is discernible in fuels; in fact, there may even be de-escalation in that sector given that the average tariff rate on petrochemicals is less than the rate on fuels.

Further insight into the issue can perhaps be gleaned if one focuses on the structure of tariff protection in developed countries. The results shown in Figure 27 show that tariff escalation is now present in all three sectors – which is particularly significant given that developed countries remain the biggest markets for developing country exporters of natural resources.

(b) Non-tariff measures

The non-tariff measures that are examined include para-tariff measures, price control measures, finance measures, automatic licensing measures, quantity control measures, monopolistic measures and technical measures (see Box 14 for a discussion of the limitations of this data). They correspond to UNCTAD's classification of trade control measures.[3]

An analysis of these measures in the fisheries, forestry and fuels sectors leads to two main conclusions (see Table 9). First, the frequency of such measures is greater on fisheries imports than in either the imports of forestry or fuels – a finding which is consistent with the relatively high level of tariff protection in fisheries noted above. Second, the type of non-tariff measures

Box 14: Data limitations – non-tariff measures

Data on non-tariff measures were obtained from UNCTAD's TRAINS (Trade Analysis and Information System) database. There are several features of the non-tariff measures (NTMs) data worth noting. First, a large part of the NTM data is dated – for example, only 15 countries have data for 2008 – so it has been necessary to include data from various periods to build a large enough sample. If countries with information no earlier than 2000 are included, a total of 58 countries are available for analysis. However, the number of countries reporting NTMs in a specific natural resources sector is generally less than 58 (45 for fisheries, 37 for forestry and 44 for fuels).

Second, the NTM database reports all tariff lines covered by a particular non-tariff measure. However, the level at which the tariff lines are reported is not uniform – some are reported at the two-digit, others at the four-digit, six-digit and still others at the national tariff line level.

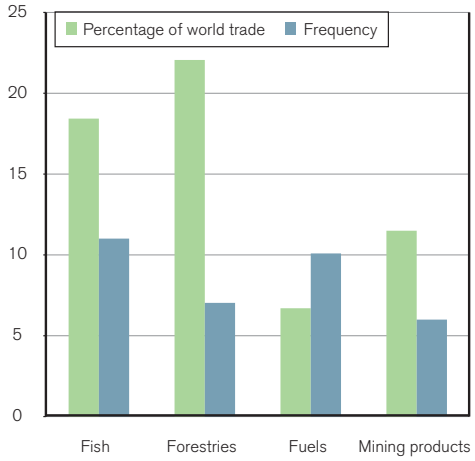
Third, while the count of tariff lines covered by NTMs provides valuable information about the extent of non-tariff measures and the types of measures applied, this approach does not allow us to determine the restrictiveness of the various measures. So a natural resources sector could have a large number of lines where non-tariff measures are applied, but the measures may have only limited effects on trade. On the other hand, another sector could have only a small number of tariff lines affected by non-tariff measures, but those measures may impose far more significant costs on producers or exporters.

employed appear to be similar across the three sectors – i.e. (i) technical regulations (product characteristic requirements, labelling requirements, testing, inspection and quarantine requirements, etc.); (ii) non-automatic licensing (licence combined with or replaced by special import authorization, prior authorization for sensitive product categories, etc.); and (iii) import prohibitions.

(c) Export taxes

Available evidence suggests that there is a strong incidence of export taxes on natural resources relative to other sectors. According to the WTO's Trade Policy Reviews (TPRs), export taxes on natural resources appear twice as likely as export taxes in other sectors. In fact, natural resource sectors account for fully one-third of all export taxes – although they represent less than a quarter of total tradable sectors. In terms of the percentage of trade covered, estimations based on Harmonized System (HS) two-digit information (see Box 15 for a description of the data limitations) suggests that 11 per cent of world trade in natural resources is

Figure 28: **Export taxes by natural resource – upper bound estimates** (frequency and percentage of world trade)



Note: Authors' calculations are based on HS two-digit data. Frequencies are calculated as the ratio of the number of export taxes/(number of HS two-digit sectors*number of countries).
Source: Trade data are from Comtrade, year 2007; information on export taxes is derived from TPRs (1995-2009).

Table 9: **Number of tariff lines affected by non-tariff measures, by type**

NTM Code	Description	Fishery	Forestry	Fuels
2400	Decreed customs valuation	5	1	0
3100	Administrative pricing	2	2	26
3300	Variable charges	0	0	2
3400	Anti-dumping measures	24	11	7
3500	Countervailing measures	1	0	0
4100	Advance payment requirements	0	3	0
4300	Restrictive official foreign exchange allocation	0	0	1
4500	Regulations concerning terms of payment for imports	210	62	1
5100	Automatic licence	0	66	0
5200	Import monitoring	4	1	2
6100	Non-automatic licensing	2,361	1,435	472
6200	Quotas	0	16	3
6300	Prohibitions	208	178	113
7100	Single channel for imports	2	0	273
8100	Technical regulations	5,954	1,393	400
8200	Pre-shipment inspection	1	0	0
8300	Special customs formalities	130	20	77
	TOTAL	8,902	3,188	1,377

Source: UNCTAD TRAINS.

Box 15: Data limitations - export taxes and quantitative restrictions

Information on export taxes has been collected from the WTO's Trade Policy Reviews (TPRs) published between 1995 and 2009. This is the only source of information that allows, at least to a certain extent, a cross-country comparison of the incidence of export taxes. However, two main limitations related to the use of TPRs should be kept in mind. The first one is that available information for different countries may refer to different time periods. This is because the frequency at which WTO members are reviewed depends on their shares in world trade,[4] meaning that some countries and customs territories are reviewed more often than others. In order to get the widest possible coverage of export taxes information, the latest TPRs available for each WTO member have been used.

The second limitation is that at the product level, data are highly aggregated. The degree of detail at which information on product level export taxes is reported in TPRs varies significantly across countries. In order to allow for a comparison across products and WTO members without losing too much information, we collected data at the HS 2002 two-digit classification level. This enabled us to analyse the intensity of use of export taxes and to provide estimates of the trade coverage of export taxes. It is important, however, to note that these statistics are likely to represent upper bound estimates,[5] because any time an export tax on a certain product was reported, including when the information was available at the six-digit level, the whole two-digit sector was considered to be covered by an export tax.

TPRs also provide information on other forms of export restrictions. Using this information, recent work by the OECD (2009c) highlights the tendency of countries to adopt quantitative restrictions mainly for conserving exhaustible resources, protecting the environment and controlling weapon and arms trade. The study also reports that export restrictions for forestry, fisheries, mineral products, metals and precious stones tend to be used to maintain adequate supplies of essential products or to promote downstream industry.

An additional source of information for quantitative restrictions is WTO notifications. A decision by the Council for Trade in Goods on 1 December 1995 (G/L/59) creates a procedure for WTO members to submit biannual notifications of their export quantitative restrictions.[6] However, from 1996 to 2006 only ten WTO members have notified quantitative restrictions on their exports.

covered by export taxes, while just 5 per cent of total world trade is covered by export taxes. One consequence of the extensive use of export taxes and other export restrictions in natural resources is the use of FDI as a way to circumvent the measures. A discussion of "export restriction-jumping" FDI is provided in Box 16.

The extent to which trade in natural resources is affected by export taxes varies by sector. As shown in Figure 28, between 15 to 25 per cent of world trade in fish and forestry, and between 5 to 10 per cent of world trade in fuels and mining, is estimated to be covered by export taxes. The figure also shows that the share of

Box 16: Investments in natural resources – a case of "export restriction-jumping" FDI?

The use of export restrictions on natural resources can lead importing countries to take alternative measures to try and secure access to scarce supplies.

A first way to "jump" export restrictions is through acquisition of or mergers with foreign firms involved in the natural resources sector (oil firms, mining firms, etc.). Specifically, firms in importing countries may choose to invest in the natural resource sector in the exporting country – for instance by relocating some parts of the down-stream production process – as a way to avoid (or "jump") the export restrictions on the natural resource.

Direct investments in natural resources, such as land, in foreign countries may – in part – have similar motivations. This phenomenon has attracted significant attention recently. These investments frequently take the form of long-term leases, outright purchases, or contract farming. In many cases, the acquired land is to be devoted to raising crops for food or for biofuel. Investors tend to be from countries where arable land and water is particularly scarce or from economies with a growing demand for food, energy and raw materials (von Braun and Meinzen-Dick, 2009). The investments are frequently made in countries in Africa (such as Ethiopia, Mozambique, Sudan) and in South East Asia (Cambodia, Indonesia, Philippines), but also in more developed resource-rich countries such as Ukraine and Russia.[7]

There is some available information on the amount of these investments. The value of cross-border mergers and acquisitions in the natural resources sector (mining, quarrying and petroleum) reached more than US$ 83 billion in 2008, representing about one-eighth of the total value of cross-border mergers and acquisitions that year (United Nations Conference on Trade and Development (UNCTAD), 2009).[8] If one uses flows of foreign direct investment (FDI) to agricultural production in developing countries as a proxy for investments in land, this amount tripled to about US$ 3 billion annually between 1990 and 2007 (United Nations Conference on Trade and Development (UNCTAD), 2009).

There are benefits and risks involved in both types of investments.

Because of the capital-intensive nature of the natural resources sector, mergers and acquisitions provide a way of financing the large outlays required for operations. Since exploration for natural resources can be very risky, mergers and acquisitions provide an opportunity for sharing risk. Finally, this form of investment can benefit the firms involved by allowing them to share technologies and reduce their costs through rationalization of their business operations (e.g. eliminating duplicate operations). However, there are also important challenges posed by these types of investments to governments which have jurisdiction over the firms. One is the possibility that the acquisition or the merger results in a combined firm with significant market power. A second challenge involves the case where the acquiring firm may be partly or wholly state-owned or is a sovereign fund. This can raise concerns about the possible blurring of the lines between the commercial and political interests of the acquiring firm.

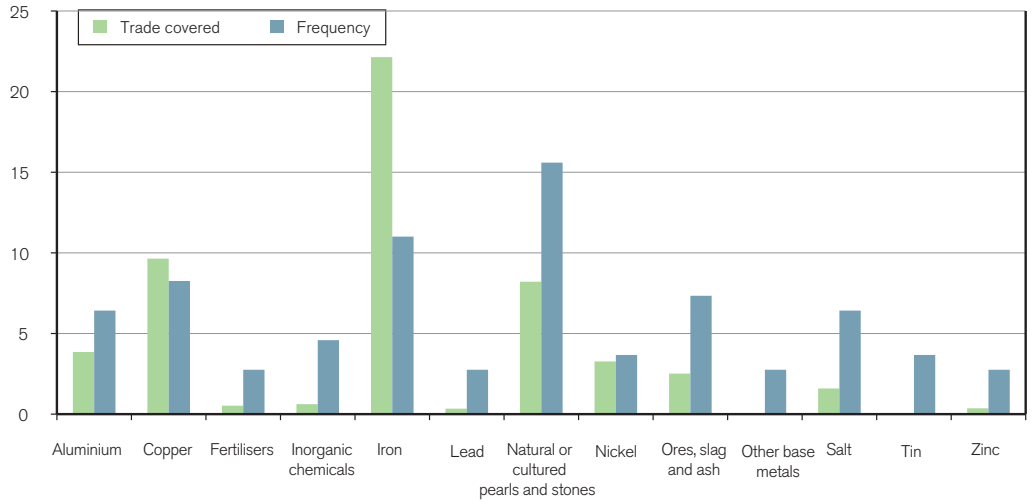
Foreign investments in land can increase land productivity, particularly if the investments are accompanied by new technology and expenditures on complementary inputs, such as irrigation, drainage and even roads. Foreign investment can also help to expand the global supply of natural resources by expanding land use, extraction and production. Furthermore, foreign investment can create other benefits that can be "captured" by the local economy in the form of increased rural employment and economic activity. However, such investments also involve costs. The investment may displace local inhabitants who initially had access to the land. Since the destination of these investments is usually poor countries, property rights may not be well defined. The owners may either not have formal rights to the land or they may be unable to have their rights recognized. In the face of a large investor, they can easily be displaced. Other costs that have been raised in the context of these investments include adverse effects on the ecological sustainability of land and water resources.

A significant share of these investments in the natural resources area have been made because growing global demand has pushed countries and firms to take whatever measures were needed to secure hard-to-get supplies. However, it is likely that some of these investments have also been prompted by export restrictions imposed by major producers when natural resource and food prices were high ("export-restriction jumping investments"). These export restrictions may exacerbate conditions of already stretched supplies and lower the confidence in the functioning of international markets, encouraging countries short in land, water and other natural resources to find alternative means of securing supplies. In this sense, the investments can be seen as "second-best" responses – efforts by consuming countries to get around trade restrictions – that would otherwise not have been made if markets provided greater certainty of access. What is more, there may be no assurance that host-country governments will automatically allow the outputs from the investments to be freely exported if a serious crisis were to erupt.

world trade in natural resources covered by export taxes tends to be higher than the percentage of lines covered by export taxes, thus suggesting that export taxes tend to be used by major exporters of the commodity.

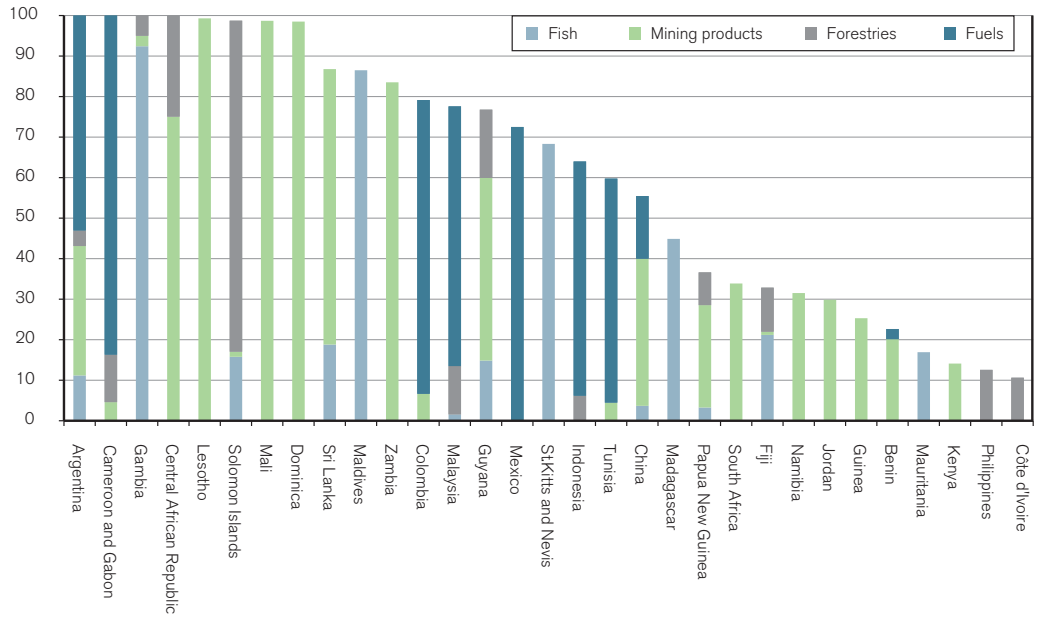
A closer look at the use of export taxes in the mining sector shows that the incidence of these taxes varies significantly across product sub-headings, with iron, copper, natural or cultured pearls and stones being most frequently subject to export taxes (see Figure 29). Data for forestry show that export taxes are mainly on wood products, rather than cork or pulp wood.

Figure 29: **Export taxes on mining products by subheading – upper bound estimates** (frequency and percentage of world trade)



Note: Authors' calculations are based on HS two-digit data. Frequencies are calculated as the ratio of the number of export taxes/(number of HS two-digit sectors*number of countries).
Source: Trade data are from UN Comtrade, year 2007; information on export taxes is derived from TPRs (1995-2009).

Figure 30: **Natural resources exports covered by export taxes – upper bound estimates for selected countries** (frequency and percentage of world trade)



Note: Author's calculations are based on HS two-digit data. Frequencies are calculated as the ration of the number of export taxes/(number of HS two-digit sectors*number of countries).
Source: Trade data are from UN Comtrade database, year 2007; information on export taxes is derived from TPRs (1995-2009).

Unfortunately, given the high level of aggregation of the database, it is impossible to distinguish across different types of fuel, fish or wood.

The analysis of export data at the country level reveals that for some countries, export taxes on natural resources cover a large percentage of their total exports in natural resources. Figure 30 shows some of the main users of export taxes in terms of the share of natural resource exports covered by export taxes. Notwithstanding the limitations regarding the cross-country comparability data (see Box 15),[9] the figure shows that for some countries export taxes cover a large share of their exports in natural resources.

(d) Other export restrictions

There appears to be a strong incidence of quantitative export restriction (prohibitions, quotas, automatic and non-automatic licensing, etc.) applied to natural resources relative to other sectors – as outlined in Table 10, which summarizes available information on such restrictions on natural resource sectors notified to the WTO.[10] Clearly, export restrictions on natural resource products represented a large share of notified export restrictions – some 2,577 entries out of a total of 7,328. These restrictions fall fairly equally under Article XI and under Article XX[11] of GATT; there is also an equal propensity to use either non automatic-licensing or quota-type restrictions across sectors. Unfortunately, the entries identified in the notifications on quantitative restrictions are at different levels of disaggregation (some at chapter level, others at eight-digit level), making it impossible to draw inferences on the relative degree of restrictiveness of such quantitative measures across sectors.[12]

(e) Consumption taxes

According to the theory, the uneven geographical distribution of natural resources – resulting in resource-abundant countries exporting most of their production and resource-scarce countries importing most of their consumption needs – means that domestic measures, such as consumption taxes, can function as *de facto*

Table 10: **Export restrictions on natural resources notified to the WTO**

Natural Resource Sector	Countries (Number) [a]	Measures (Number of entries)				Justification by the Member imposing the measure		
		Automatic Licensing	Non Automatic Licensing	Quota	Prohibition	GATT Art. XI	GATT Art. XX	Other
Fish	2	0	10	0	8	0	18	0
Forestry	6	0	173	122	18	107	165	0
Fuels	2	0	201	236	7	172	172	74
Mining products	7	94	1,001	746	60	618	823	353
TOTAL	10	94	1,385	1,104	93	897	1,178	427

[a] Total number of countries may not correspond to the sum obtained across sub-sectors because the same may appear in different sub-groupings.
Note: Other justifications denotes notifications made under Art. III, Art. XVII or Art. XXI of the GATT or Protocol of Accession.
Source: Authors' calculations based on WTO Secretariat data.

Table 11: **Taxes on fuels in OECD countries, 2008** (per cent)

Countries	Percentage of taxes in low sulphur fuel oil prices in industry	Percentage of taxes in automotive diesel prices for commercial use	Percentage of taxes in automotive diesel prices for non-commercial use	Percentage of taxes in premium unleaded (95 ron) gasoline prices	Percentage of taxes in natural gas prices in households	Percentage of taxes in light fuel oil prices in industry	Percentage of taxes in heavy fuel oil for electricity generation
Australia	..	..	33.0	34.6	..	..	..
Austria	14.7	44.9	47.8	56.8	26.6	16.6	3.4
Belgium	3.5	30.7	42.7	58.6	..	2.9	..
Canada	..	21.5	..	27.6	..	8.5	..
Czech Republic	5.4	37.3	47.3	55.0	16.0	4.2	6.3
Denmark	11.5	36.0	48.8	59.8	..	4.2	..
Finland	14.5	35.1	46.8	62.1	24.2	12.6	..
France	4.6	40.3	50.1	61.1	15.0	8.7	..
Germany	6.2	42.0	51.3	62.6	..	9.6	6.4
Greece	4.3	28.9	40.3	47.5	8.3	18.2	..
Hungary	6.4	34.2	45.2	53.0	16.7	..	..
Ireland	..	35.0	46.3	54.8	11.9	6.8	3.8
Italy	7.1	37.7	48.1	57.5	..	37.2	..
Japan	4.8	30.9	27.0	..	..	7.2	..
Korea	11.7	..	38.8	..	19.5	16.6	..
Luxembourg	..	..	..	..	..	..	..
Mexico	..	-	13.0	13.0	13.0	-	..
Netherlands	8.1	38.2	48.1	61.3	37.8	..	..
New Zealand	..	0.3	11.4	38.6	..	-	..
Norway	..	39.7	51.8	60.9	x	19.5	..
Poland	3.9	33.1	45.2	56.4	18.0	10.0	5.1
Portugal	2.8	40.6	45.5	59.0	4.8	..	..
Slovak Republic	-	41.4	50.8	56.0	16.0	-	..
Spain	3.4	31.0	40.5	49.5	13.8	12.1	..
Sweden	48.5	38.9	51.1	62.0	..	10.3	..
Switzerland	6.0	44.0	45.3	48.6	9.8	3.4	..
Turkey	..	46.0	46.0	59.7	15.3	..	31.7
United Kingdom	..	50.5	57.9	61.9	4.8	..	47.9
United States	..	13.8	13.8	15.0	..	4.9	4.7

Legend: x – not applicable; .. - not available; - - nil.
Note: Taxes refer to excise tax, consumption tax, goods and service tax (GST), and VAT.
Source: International Energy Agency (IEA) (2009).

trade instruments in importing countries. Gathering information on domestic measures that restrict consumption is, therefore, important as these measures are likely to have an impact on the volume of imports and on the terms of trade. One major drawback to this information-gathering exercise is that only consumption taxes on fuels are available.

Nevertheless, an analysis of these data shows that consumption taxes are high when compared with the rate of tariff protection on fuels. In the case of OECD countries, for example, import tariffs on fuels averaged only about 5.8 per cent (see Table 7), whereas the tax on gasoline and diesel for motor vehicles ranges between 30 and 60 per cent, dwarfing the size of import tariffs. Consumption taxes on fuel used by industry appear to be lower while fuel for electricity generation seems to be taxed the least (roughly in the same order of magnitude as import tariffs).

Information on fuel taxes for non-OECD countries is available from a relatively old study by Mahler (1994). It reveals a pattern consistent with that seen in OECD countries – namely, domestic taxes on fuels are several orders of magnitude greater than the tariffs on fuels (see Table 12). One important point to note about the data in the Mahler paper is that only those taxes that are explicitly levied on petroleum products, expressed

Table 12: **Fuel taxes in non-OECD countries, 1991** (per cent)

Regions	Premium gasoline	Regular gasoline	Automotive diesel	Heavy fuel oil
Africa	79	86	53	48
Asia	37	53	21	4
Eastern Europe	115	125	82	n. a.
Middle East	23	23	6	1
Western Hemisphere	70	62	36	25

Source: Mahler (1994).

Box 17: Data limitations – subsidies

The 2006 *World Trade Report* conducted a comprehensive examination of the type, amount and incidence of subsidies provided by WTO members (World Trade Organization (WTO), 2006). One conclusion was that comprehensive information on subsidies is hard to obtain, either because governments do not systematically provide the information or because multiple data sources use different definitions and classification systems. National subsidy reports provide quantitative information that may be detailed but do not guarantee cross-country comparability. Data from international sources, including from the WTO, allow for cross-country comparisons but only exist at a highly aggregated level, or are available for a limited number of sectors.

as a percentage of before tax petroleum prices, are used. However, some countries will have many implicit tax rates or subsidies which will affect the price level. These will ultimately increase (decrease) the tax rates.

(f) Subsidies

Several natural resource sectors – mining, coal, forestry and fisheries – figure very prominently in the notifications made by WTO members under the Agreement on Subsidies and Countervailing Measures (SCM). While the SCM notifications serve as an important means of informing other WTO members that subsidies are being provided, they are less useful for quantifying the subsidies involved. Members frequently indicate that no information on the value of the subsidy is available, or if values are provided, the notifications are often unclear about the measurements that have been used. For these reasons, the following discussion focuses on other studies (besides WTO notifications) of fisheries subsidies where more information is available (see Box 17) for a short discussion of the data limitations on subsidies). Note, however, that the figures reported in these studies may not always correspond to the term "subsidies" as used in the SCM Agreement.

(i) Fisheries subsidies

Probably one of the first attempts to estimate fisheries subsidies was carried out by the UN Food and Agriculture Organization (FAO) (1992). Employing 1989 data, the FAO study estimated an annual deficit of US$ 54 billion between global fishing revenues and costs, suggesting that the difference might be made up by subsidies. Using the definition of subsidy underlying the SCM Agreement, a subsequent study by Milazzo (1998) came up with a somewhat lower estimate of US$ 14 to 20 billion a year in global fisheries subsidies, with the subsidies constituting between 30 and 35 per cent of the value of the catch.[13] The most recent work on this issue is by Sumaila et al. (2009) which suggests that global fisheries subsidies for 2003 were between US$ 25 and 29 billion. All told, these various studies suggest that global fisheries subsidies are in the order of tens of billions of dollars annually and make up a substantial portion of the value of the fish catch.

Beyond these studies, there is also data from the OECD on government financial transfers (GFTs) to the fisheries sector, defined as "the monetary value of government interventions associated with fisheries policies" and covering all transfers from central, regional and local governments in OECD countries.[14] From 1996 to 2006, these transfers averaged about US$ 6.1 billion annually, ranging from a low of US$ 4.2 billion in 1998 to a peak of over US$ 7 billion in 2006.[15] Japan and the United States were the two biggest spenders, contributing 28 and 30 per cent respectively of total OECD transfers in 2006 (see Table 13). The OECD estimates that over the past decade, the transfers represented around 18 per cent of the value of the total catch of OECD countries from capture fisheries (Organization for Economic Co-operation and Development (OECD), 2009b). Capture fisheries refers to the sum (or range) of all activities to harvest a given fish resource.

Data on developing countries' fisheries subsidies is more difficult to obtain and tends to be scattered across different studies or reports. However, based on the study by Sumaila et al. (2009) cited above, 32 per cent of total fisheries subsidies were accounted for by developing countries in 2003. The estimates by country are shown in Table 14.

Table 13: **Government financial transfers by OECD countries to fisheries, 2006** (USD millions)

Country	Amount	Country	Amount
Australia	90.0	Korea, Rep. of	752.2
Belgium	7.8	Mexico	89.1
Canada	591.0	Netherlands	21.3
Denmark	113.2	New Zealand	38.6
Finland	23.4	Norway	159.5
France	113.8	Portugal	29.3
Germany	30.7	Spain	425.4
Greece	79.6	Sweden	41.5
Iceland	52.4	Turkey	133.9
Ireland	29.4	United Kingdom	114.7
Italy	119.2	United States	2,128.8
Japan	1,985.1	**OECD**	**7,169.9**

Source: Organization for Economic Co-operation and Development (OECD), 2009b.

Table 14: **Fisheries subsidies in year 2003: developing countries and customs territories** (USD millions)

Country	Total Amount	Country	Total Amount
Albania	1.3	Libya	5.1
Algeria	6.7	Madagascar	12.9
Angola	74.5	Malaysia	317.2
Antigua and Barbuda	4.1	Maldives	65.2
Argentina	366.8	Marshall Islands	72.1
Bahamas	14.3	Mauritania	26.0
Bahrain	11.9	Mauritius	2.2
Bangladesh	62.8	Micronesia	170.1
Barbados	0.9	Morocco	91.7
Belize	7.9	Mozambique	21.5
Benin	6.6	Myanmar	157.8
Brazil	413.4	Namibia	122.5
Brunei Darussalam	0.8	Nauru	0.2
Cambodia	7.4	Nicaragua	14.8
Cameroon	9.4	Nigeria	31.0
Cape Verde	11.2	Oman	79.5
Chile	93.7	Pakistan	136.7
China	4,139.5	Palau	1.5
Colombia	15.4	Panama	50.1
Comoros	0.7	Papua New Guinea	662.0
Congo	1.8	Peru	205.5
Costa Rica	17.1	Philippines	918.8
Cote d'Ivoire	12.3	Qatar	3.8
Cuba	13.9	Russian Federation	1,481.8
Cyprus	1.4	Saint Lucia	4.0
Djibouti	0.6	Samoa (Western)	7.3
Dominican Rep.	7.5	Sao Tome & Principe	0.7
Dominica	7.3	Saudi Arabia	33.3
Ecuador	47.4	Senegal	70.5
Egypt	15.8	Seychelles	28.6
El Salvador	9.5	Sierra Leone	13.7
Equatorial Guinea	0.3	Singapore	0.3
Eritrea	2.0	Solomon Islands	35.0
Fiji	39.8	Somalia	4.3
Gabon	12.6	South Africa	69.6
Gambia	12.1	Sri Lanka	132.4
Georgia	1.0	St. Kitts & Nevis	1.1
Ghana	32.9	St. Vincent & Grenadines	5.3
Grenada	5.4	Sudan	1.3
Guatemala	8.9	Suriname	15.8
Guinea-Bissau	4.4	Syria	0.8
Guinea	28.9	Taipei, Chinese	360.5
Guyana	54.5	Tanzania	10.0
Haiti	4.4	Thailand	552.6
Honduras	11.9	Togo	1.5
Hong Kong, China	8.6	Tonga	7.2
India	1,070.2	Trinidad & Tobago	11.5
Indonesia	989.7	Tunisia	26.5
Iran	243.1	Turkey	97.1
Israel	1.2	UAE	10.6
Jamaica	10.7	Ukraine	49.7
Jordan	0.1	Uruguay	11.1
Kenya	4.8	Vanuatu	144.0
Kiribati	23.5	Bolivarian Rep. of Venezuela	64.8
Korea, Rep. of	893.9	Vietnam	697.4
Kuwait	1.0	Yemen	117.6
Liberia	0.6		

Source: Sumaila et al. (2009).

Given that not all fisheries subsidies are intended to expand fishing capacity and some are intended to assist conservation efforts, an exclusive focus on the total amount of subsidies may give a false impression of the extent to which the payments exacerbate the exploitation of fisheries stocks or distort trade.

Kahn et al. (2006) have attempted to disentangle the effects of different subsidy programmes and to account for the amounts involved. They estimated that the amount of non-fuel subsidies that contributed to an increase in fishing capacity globally was about US$ 16 billion. Included under this category are: programmes on boat construction, renewal and modernization programmes; support for fishing port construction and renovation; marketing support, processing and storage infrastructure programmes and the like. To this category must be added the US$ 4.2 to 8.5 billion worth of fuel subsidies estimated by Sumaila et al. (2006).

In contrast to these subsidies, Kahn et al. (2006) estimated that US$ 7 billion of subsidies were devoted to fisheries management and conservation. In this category, they included expenditures on monitoring, control and surveillance; stock assessment and resource surveys; and fisheries research and development. Finally, they identified another US$ 3 billion of subsidies that, in their view, have the potential to lead to either investment or disinvestment in the fisheries resource.[16] Notable among the programmes that they classified under this heading are vessel buy-back programmes (see the discussion in Box 22).

Based on data for the last decade, the pattern of support in OECD countries appears to show a larger proportion of the Government financial transfers (GFTs) were devoted to fisheries management, research and enforcement (38 per cent of total GFTs in OECD countries). The remainder went to infrastructure expenditure (39 per cent), vessel decommissioning schemes (7 per cent), income support (5 per cent), access agreements (3 per cent), vessel construction and modernization (3 per cent) and other cost reducing transfers and direct payments general services (5 per cent).

2. Trade policy, resource distribution and exhaustibility

What are the trade and domestic policies that governments adopt to deal with the uneven geographical distribution of finite natural resources, and how do these policies affect other economies? Since natural resources are often concentrated in a few countries, producers and exporters of these resources benefit from market power and can earn large (at times monopoly) rents. These may provide both the importing and the exporting countries with an incentive to appropriate part or whole of these rents by imposing trade restrictions, such as import tariffs, export taxes and export quotas, or providing subsidies.

The following analysis will focus mainly on the "rent-shifting" effects of trade policy measures. However, a critical issue in the analysis of the impact of these policies when applied to finite natural resources is that they involve dynamic considerations. As discussed in Section C, optimal extraction of exhaustible natural resources is an inter-temporal decision involving calculations of optimal extraction paths over time. A government incentive to adopt certain trade policy measures may depend not just on market conditions today but on strategic considerations regarding the availability of – and demand for – the resources in the future. These dynamics introduce important complexities into economic models, including the issue of whether a government can credibly commit to a certain announced trade policy time path. For this reason, the existing economic literature has analysed these issues only in relation to specific circumstances and policy measures.

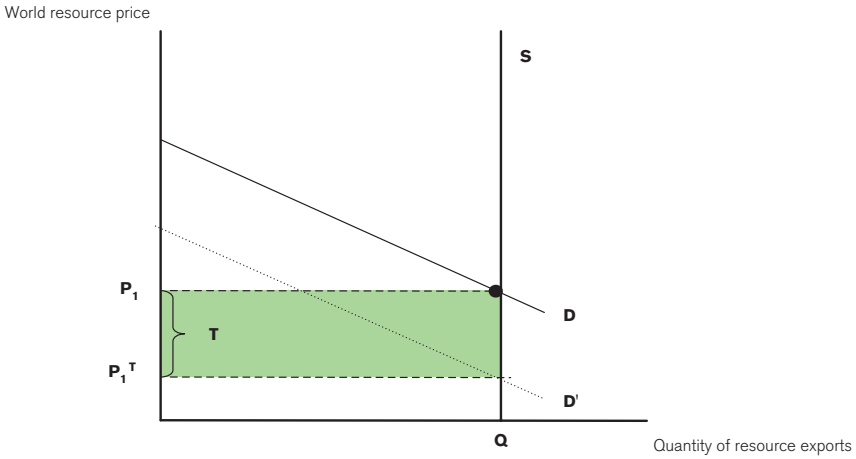
(a) Rent-shifting effect of tariffs (and consumption taxes)

Economists stress the importance of rent-shifting to explain the use of import tariffs on natural resources. In other words, tariffs are strategically set by resource-importing countries to extract rents from resource-exporting countries. This argument is particularly relevant in natural resources relative to other types of products for two reasons: first, because resource revenues largely consist of pure rents; and second, because import tariffs on natural resources cannot generally be justified as import substitution strategies. Since deposits of exhaustible natural resources, such as oil and minerals, tend to be concentrated in relatively few locations and cannot be relocated from one country to another, obviously the rationale for imposing import tariffs cannot be to increase domestic production.

Two other arguments have been advanced to justify the use of import tariffs. One is an insurance argument that relates to the fact that the supply of natural resources available is unknown and that as a consequence their supply may be subject to random interruptions. Several studies show that import tariffs can be optimal if supplies are subject to such interruptions. This is because the higher domestic price will reflect the premium that consumers pay for the vulnerability and uncertainty of imports (Nordhaus, 1974; Plummer, 1982). The other argument is a strategic one – that import tariffs can be optimal to counteract the monopoly power of the resource-rich country. Based on the evidence that the natural resource exporters may be monopolists and that importers may enjoy monopsony power, various studies have examined the optimality of import taxation (Bergstrom et al. 1981; Bergstrom, 1982; Newbery, 1984).[17]

Regardless of the motivations, the imposition of import tariffs will affect the geographical distribution of the rents associated with extraction. Consider the case of oil, which is available in a finite amount and costs relatively little to extract after the initial investment has been made. These high fixed and low variable costs mean that its supply curve is inelastic – that is, it is not

Figure 31: **The effect of a tariff on natural resources** (static model)



sensitive to price variations. In these circumstances, if the importing country introduces a tariff, the exporting country will have to lower the exporting price (by as much as the size of the tariff) in order to be able to sell the total amount of the resource. Therefore, the burden of the tariff will fall on the exporter.

Figure 31 provides a graphical representation of the impact of an import tariff on natural resources in a simple static model, where all available resource is exhausted in a given period. Suppose that Q is the total amount available of a certain natural resource, say oil, and S is its supply curve. Suppose also that the world consists of an importing and an exporting country and that all resource extracted is exported. In these circumstances, for a given demand curve D, the free trade price for the resource is P_1. Suppose then that the importing country imposes a tariff T. The demand curve shifts to D' and the new equilibrium will be at the export price P_1^T. Consumers will continue to pay the price P_1 – the price at which they demand the quantity Q- while the exporter will receive the price P_1^T. The shaded area in the figure represents the tariff revenue collected by the government of the importing country – with the difference between P_1 and P_1^T being the tariff T, and it also reflects the reduction in rent suffered by the exporting country.

Under the circumstances defined above, a consumption tax would have exactly the same effects as an import tariff. That is, in the same way that a tariff for a given export price increases domestic prices, so too does a consumption tax raise domestic prices. If supply is inelastic – and in the absence of a domestic industry consuming the resource – the exporting country will have to pay the burden of the tax. It is because of their similar effects that much of the economic literature on natural resources refers to consumption taxes or tariffs as equivalent measures.

How much of the exporter's rent can importers appropriate? The broad conclusion in the literature on rent-extracting tariffs (or the equivalent consumption taxes) is that the higher the tariff imposed by the importing country, the higher the share of the rent that it can appropriate. In fact, the entire rent can eventually be extracted by imposing a high enough tax or tariff rate. This argument also holds when the exporter is a monopolist (Bergstrom, 1982).

There are, however, a number of factors that determine the size of the rent that can be moved from the exporting to the importing country. One is the size of the importing country relative to the exporting country. The optimal tariff tends to be higher the larger the importing country – and it approaches a confiscatory level when the importing country is very large compared with the exporting country (Brander and Djajic, 1983). Another determining factor is the number of importing countries. In general, the share of the exporter's rent that can be appropriated decreases with the number of importing countries (Rubio, 2006).

Finally, the size of the rent that can be appropriated by the importer also depends on whether the resource-rich country faces a domestic demand for the resource, for example, from a local processing industry. If the supplying nation can transform the natural resource into final goods within its own economy, then it can respond to the imposition of the tariff by restricting exports. With consumption no longer taking place in the importing country alone, the amount of resource supplied to the importing country is no longer fixed, thus limiting the importing country's ability to reap the entire rent (Brander and Djajic, 1983).

A key issue determining the effects of an import tariff is its time pattern. When this is taken into account, a general result of natural resource economics is that the effect of a tariff on the price and output path chosen by the industry (be it a competitive industry or a cartel) will depend on whether the tariff remains constant, decreases or increases over time. In particular, economic theory shows that if a government can pre-commit and chooses a constant (in terms of its present value) tariff over time, the extraction path will be unaffected by the tariff (Bergstrom, 1982).[18]

Figure 32: **The effect of a tariff on natural resources** (two-period model)

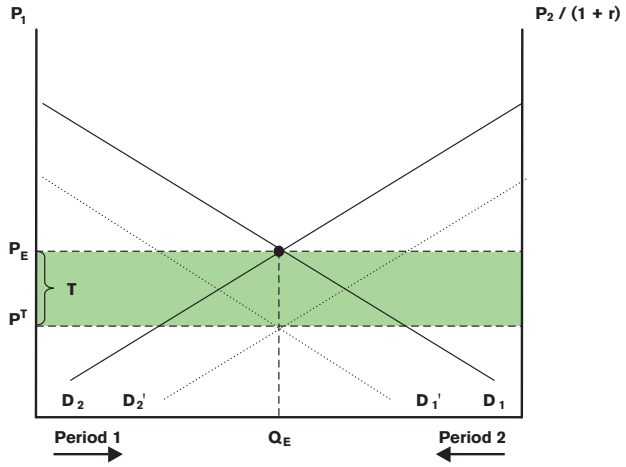


Figure 32 elucidates this case in a two-period framework.[19] In the figure, the curves D_1 and D_2 represent the demand curves in period 1 and period 2, respectively. Q_E is the quantity of resource exports at which the first-period price equals the discounted second-period price (that is, the exporting country is indifferent between extracting and selling the resource now or in the future), and P_E is therefore the equilibrium price. When the importing country imposes a tariff (constant in present value terms over the two periods), the demand curves shift downwards to D_1' and D_2' and the equilibrium shifts from E to E'. The quantities of the resource extracted in the two periods are unaffected by the policy. The world (export) price falls to P^T, but consumers in the importing country will continue to pay P_E (the export price augmented by the tariff). In other words, the government of the importing country will appropriate part of the rent of the exporter country (the shaded area in the graph) without affecting the output path.

Overall, the critical issue is whether countries can credibly commit themselves to a certain announced time path of import tariffs. Natural resource economics has shown that optimal tariff paths may be time inconsistent – i.e. some time in the future, as the tariff plan set at the beginning of the period unfolds, the importer will want to deviate from the original tariff path. This applies, for example, to a dominant oil importer facing a competitive supply of oil and other small, competitive buyers. In these circumstances the optimal tariff path would simply increase at the rate of interest, as this would maintain the price path consistent with the Hotelling rule (see Section C.1). At some date in the future, however, the domestic price in the dominant oil importer country will become so high that demand for oil falls to zero, while the oil price in the rest of the world, where oil is imported free of tariffs, will be lower. At this point, the dominant importer will find it attractive to deviate from the previous tariff plan, by reducing the tariff and importing more oil. The original tariff plan is thus dynamically inconsistent (Newbery, 1981).[20]

There are two broad solutions put forward to this time inconsistency problem. The first one involves reinforcing the credibility of certain trade policy announcements by binding them in international agreements such as the General Agreement on Tariffs and Trade (GATT) and other WTO agreements. The second involves the use of futures markets and the storage of resources (Maskin and Newbery, 1990).

(b) Export taxes

As noted above, one interesting feature of natural resources trade is the extensive use of export taxes.[21] The following discussion looks at the various motivations for export taxes, and the structure of markets that influence their operation and impacts.

To understand the effect of an export tax on exhaustible natural resources, it is important to distinguish between situations when there is a local demand for the resource and when there is not. Assume that the economy is characterized by three agents: the government, the oil-producing company and consumers. When all production is exported, an export tax imposed by the exporting country only has distributional effects: rents move from the extracting company to the government of the exporting country in the form of export tax revenue. There is no terms-of-trade effect in these cases. The reason for this is simple. Suppose that the initial conditions are those described in Figure 31. The supply curve of a certain resource – for example, oil – is fixed at a certain level and all production is exported.[22] In these conditions the export price will be determined by the level of the demand.

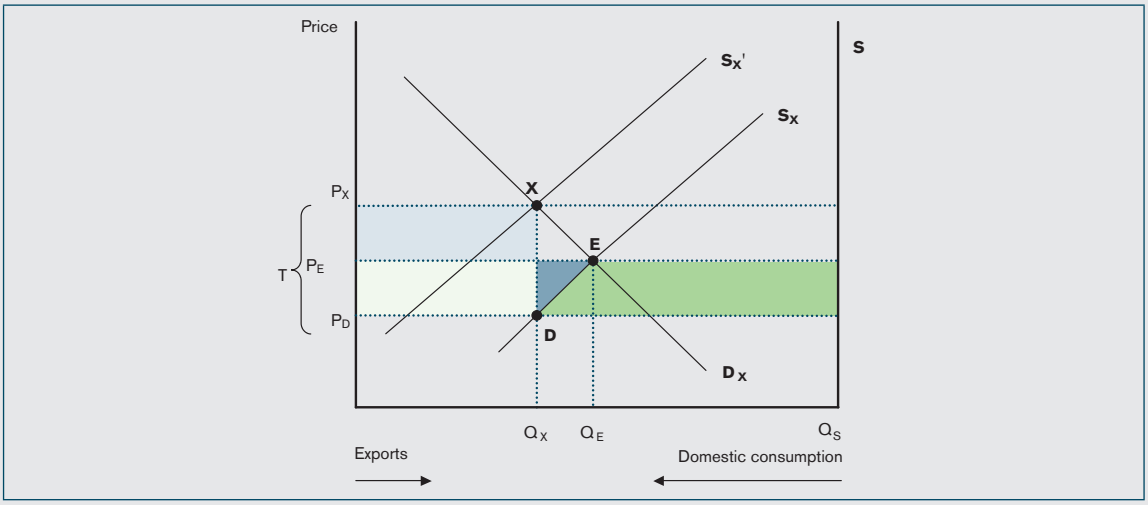
If the government of the exporting country introduces a tax on exports, the oil-producing company will not be able to pass the burden of the tax onto foreign consumers by increasing the export price, because at a higher price part of the resources remain unsold. Therefore, the export price will not change, while the net price received by the oil-producing company will be reduced by the amount of the tax, say T. For an export tax equal to T, the shaded area in Figure 31 will represent the rent loss of the oil-producing company and the export tax revenue of the government of the oil-rich country.

In contrast, when part of the natural resource production is consumed domestically, an export tax is equivalent to a subsidy on domestic consumption in terms of its price and quantity effects. Since natural resources are highly concentrated geographically, it is often the case that the trade policy of the resource-rich country is able to affect the world price of the resource. In economic terms, these conditions define a so-called "large" country. When a large exporting country applies an export tax on the natural resource, the domestic price will fall and the world price will rise. Part of the rent associated with production will shift from the producer company to the government and to the consumers in the exporting country.

In addition, there will be a terms-of-trade gain for the exporting country and a terms-of-trade loss for the importing country (see Box 18). Domestic consumers will consume too much of the resource, while foreign consumers will consume too little. In the exporting country, consumers' efficiency loss may be compensated by the terms-of-trade gain. Therefore, as for any other good, there is an optimal export tax for natural resources.[23] However, the exporting country will gain at the expense of the importing country and global welfare will be reduced.

In the long run, however, export taxes may not be effective in maintaining high export prices of natural resources. One reason is that sustained high world prices provide an incentive for importing countries to invest in new resource-saving technologies that reduce their natural resource requirements per unit of output. Sustained high prices may also make available additional resources for exploitation – by creating incentives to exploit resources that would not be economical to exploit at normal (free trade) prices or to undertake exploration for new reserves. All of this creates higher demand uncertainty for the exported natural resource, because the discovery of a new substitutable resource would suddenly shift demand away from the taxed commodity. In deciding whether or

Box 18: **Welfare effects of an export tax: the case of a large country**



Suppose that Q_S is the total amount of a certain resource – for example, oil – and that its overall supply curve S is inelastic. In the presence of a domestic demand for oil, the export supply will be a positively sloped line, indicated in the chart by S_X. Suppose as well that the curve D_X represents the export demand – i.e. the demand for the resource in the foreign country. At the equilibrium price P_E, the quantity Q_E is exported while the rest, Q_S - Q_E, is consumed domestically.[24] In free trade, export price and domestic price coincide.

If the government of the resource-rich country introduces an export tax, the export supply curve will shift upwards to S_X'. This is because for a certain price paid by the importing country, only a fraction is perceived by the producing company, because the amount T is paid to the domestic government. In particular, the export tax will create a wedge between the domestic and the foreign price of the commodity. In the new equilibrium, the foreign importers will pay P_X and will consume the quantity Q_X, while domestic consumers will pay P_D (equal to P_X –T) and will consume Q_S – Q_X. The shaded area below the price P_E is the producers' surplus loss, generated by the lower price (net of the tax) perceived by the producer. The area P_XP_DDX represents the tax revenue accruing to the government of the exporting country. Of this, the light blue area indicates the terms-of-trade gain enjoyed by the exporting country (or equivalently, the terms-of-trade loss suffered by the importing country) due to the higher export price for the resource. The green shaded area is the consumers' surplus gain occurring to domestic consumers, consequence of the reduction of the domestic price.

Finally, the dark-blue shaded area is the dead-weight loss. The export tax may be overall welfare improving for the exporting country if the dead-weight loss is more than offset by the terms-of-trade gain. Clearly, this occurs at the expense of the importing country that will suffer from a terms-of-trade loss and, because of the dead-weight-losses, the world as a whole will be worse off.

not to apply an export tax, natural resource-rich countries have to trade-off the short-run terms-of-trade gains against the possible negative long-run effects of higher demand uncertainty.

Furthermore, export taxes on natural resources also have distributional consequences within the exporting country. By reducing the domestic price of the resource, they implicitly subsidize the resource-consuming sector and reduce the income of the resource-producing sector. For this reason, they can be used for social or re-distributional objectives – for example, an export tax might be applied to natural gas products in response to government concerns about escalating heating costs for the poor. However, export taxes are a second-best policy response to distributional problems compared with a direct subsidy or an income tax.

Overall welfare considerations should also take into account the fact that export taxes may generate production inefficiencies in the resource-using sector. For example, they may distort investment incentives and encourage export-tax jumping FDI (see Box 16). In addition, because of the implicit subsidies, they may encourage the processing sector to produce a good for which it does not have a comparative advantage. In this respect, an export tax has an effect similar to that of a dual pricing scheme,[25] whereby prices in the export market are determined by market mechanisms while prices in the domestic market are fixed by a government at a lower price than abroad.

Besides terms-of-trade and income distribution motives, governments may also impose export taxes on natural resources for a variety of other economic objectives, including to smooth out the volatility of export earnings and to stabilize income, to promote export diversification and to respond to tariff escalation (see Box 19). Export taxes on natural resources have also often been used for non-economic reasons, such as conservation and environmental protection (Korinek and Kim, 2009)[26] – subjects that will be discussed in sub-section 4.

(c) Export quotas

In general, the exhaustibility of natural resources implies a trade-off between extraction today and extraction in the future. For a country that exports everything it produces, establishing an export quota will generally result in higher future rates of extraction.

Box 19: **Export taxes as a tool to address resource volatility, dominance and tariff escalation problems**

Export taxes as income stabilization policy

One distinguishing feature of natural resources trade is high price volatility. Another is that natural resources often represent a disproportionate share of resource-rich countries' GDP and exports. These two features together make some countries particularly prone to income stabilization problems. A recent study (Borensztein et al., 2009) shows that 40 countries characterized by a heavy dependence on the export of one single commodity experienced export income variability twice as large as non-commodity GDP variability between 2002 and 2007.[27]

Income stabilization, and in particular export revenue stabilization, is commonly viewed as an important policy goal. Stabilization schemes, international commodity agreements and buffer stocks are all examples of policies that have been aimed at reducing instability. Although neither economic theory nor empirical evidence provide clear conclusions about the relationship between export-earning instability and economic growth (see Section C.5), it seems likely that reduced income volatility is economically beneficial for countries because it leads to lower consumption volatility and higher welfare when consumers are risk averse.

Three motives justify the use of an export tax in these circumstances. First, it softens the impact of rapidly rising world prices in the domestic market (recall that the impact of an export tax is to lower domestic prices), thus protecting local consumers. Second, it increases government revenue, thus easing fiscal imbalances. Third, it taxes the windfall gains of exporters, thus promoting a fairer distribution of income.[28]

However, the use of an export tax to stabilize income is not without hazards. First, a flat export tax that did not differentiate between price rises and falls would not be effective in smoothing the transmission of world price shocks to the domestic economy. What is needed instead is a progressive export tax system – whereby a high tax rate is imposed when world commodity prices rise, but the tax rate is reduced or removed when prices fall. This would capture part of the gains from increasing commodity prices but avoid the adverse impact of falling prices on producers' incomes.

Second, a progressive export tax system can reduce the transmission of price fluctuations and act as an income stabilizer only if governments are willing to adjust their expenditure patterns accordingly in order to balance demand over time. Volatility of world prices can result in fluctuations in tax revenue. In order to stabilize income in the domestic economy, governments need to save during periods of high tax revenue and spend more during periods of low tax revenue. If government has a higher propensity than consumers to spend, then the income multiplier[29] will rise as the export tax rises, with the result that even a progressive export tax system would fail to stabilize the economy.

Third, political and social institutions need to be flexible enough to adjust to changing conditions. The external factors that first prompted an export tax can evaporate quickly, but many governments may lack the political and institutional flexibility needed to make rapid policy adjustments – leaving export taxes in place long after the underlying economic conditions have changed.

Finally, export taxes may trigger a self-reinforcing spiral of rising prices. When export taxes are introduced by several exporting countries or by a major exporter, the fall in the international supply of the commodity subject to export restrictions may further increase export prices (World Trade Organization (WTO), 2009).

In general, export taxes are a second-best option. Indeed, natural resource economists tend to argue that the development of efficient stock exchanges and financial markets is a more effective – and lower cost – way of addressing income instability problems. In particular, some economists urge governments to accumulate foreign assets in commodity stabilization funds as precautions against possible instability (Arrau and Claessens, 1992; Deaton, 1991; Durdu et al., 2009). However, this strategy may be less viable in countries characterized by weak governance, as the funds are vulnerable to misuse. Moreover, the accumulation of precautionary reserves comes at the cost of lower domestic consumption and welfare. Alternatively, commodity exporters may ensure against the risk of export income volatility by hedging the risk with derivative instruments (Borensztein et al., 2009; Caballero and Panageas, 2008).

Export taxes as export diversification policy

Concerns about the effects of resource price volatility run in two directions – on the one hand, fears of possible welfare losses associated with deteriorating terms-of-trade, and on the other hand, fears of de-industrialization associated with improving terms of trade (the so-called Dutch disease).[30] For example, Roemer (1985) notes that the most common response to rising mineral prices – and the threat of Dutch disease – is to tax the booming mineral export sector and to subsidize the lagging domestic manufacturing sector. By taxing exports, the government effectively redistributes income from the booming sector to the shrinking sector.[31]

As discussed in Section C.4, a natural resource boom need not lead to Dutch disease. The shrinkage of the non-competitive sector is the efficient response to the expansion (and increased earnings) of the competitive sector, in this case natural resources extraction, because it allows the country to enjoy higher wealth. Other factors are responsible for the Dutch disease, such as pre-existing distortions or positive spillovers associated with production in the manufacturing sector (van Wijnbergen, 1984; Sachs and Warner, 1995). In these cases, the first-best policy response would be the removal of the distortion or the provision of incentives to take account of the spillovers. Trade policy can only be justified as a second-best policy option (i.e. because it does not directly address the cause of the problem) when the first-best option is not viable.

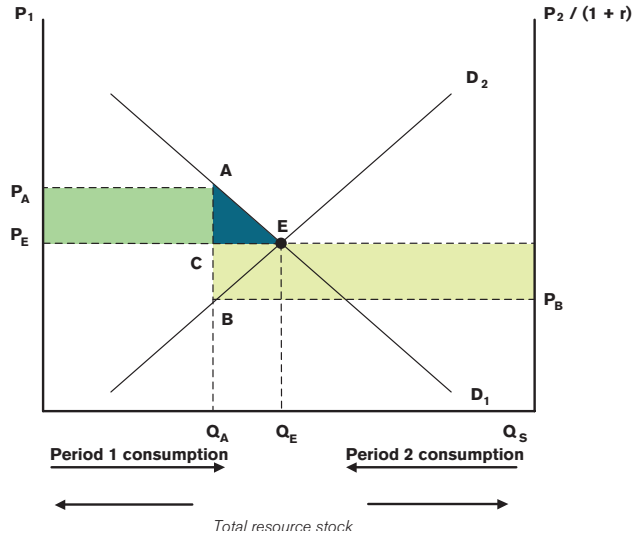
Export taxes have not only been used to avoid de-industrialization, but also to promote infant industries.[32] Since natural resources are used as inputs in most higher-value added industries, export taxes can work as an indirect subsidy to manufacturing by reducing the price of resource inputs. By shifting supply from the export to the domestic market, export taxes lower the domestic price of natural resources to below world market prices, thus giving the domestic downstream industry a competitive edge against foreign competition.

However, traditional economic models support infant-industry types of policies only in specific circumstances. According to many economists, the argument that new domestic industries may not be able to compete with well-established foreign firms because they lack sufficient experience – and that if protected, they may eventually acquire the experience and a comparative advantage – is not *per se* a sufficient argument to justify government intervention from an economic efficiency point of view. This is because well-functioning financial markets will recognize the potential comparative advantage of the new industry, and will lend it sufficient resources in the initial phase of its development, on the assumption that their investment will be repaid as soon as the industry develops its comparative advantage (Baldwin, 1969). Government intervention can only be justified in the presence of some form of market failure, such as imperfect financial markets. Trade-restrictive measures represent a second-best policy option (the first-best option would be to reform financial markets).

Export taxes as response to tariff escalation

While tariffs on natural resources tend to be very low, evidence suggests that tariff levels tend to increase as commodities become more processed.[33] To the extent that developed countries' imports are crucial to the growth of high value-added industries in developing countries, tariff escalation may increase poorer countries' reliance on unprocessed primary commodities and hinder their ability to diversify their economies and develop a domestic manufacturing sector. In this situation, the removal of tariff escalation would be the first-best policy (i.e. the least distortionary) to achieve diversification. However, export taxes would be a second-best policy – because by reducing the domestic price of a resource, they would favour the local processing industry and offset the distortionary effects of tariff escalation.

Figure 33: **The effect of a quota in period 1**



Consider a simple case where all available resources will be consumed in two periods (see Figure 33).[34] If an export quota is introduced in period 1 at the level denoted by Q_A, then the price in period 1 will increase and equal P_A. In period 2, the supply of the natural resource will be higher (equal to the segment Qs-Q_A) and the price will be lower, P_B, than in the absence of a first-period quota.

What are the welfare effects of an export quota? In the exporting country, the effect of an export quota is to shift rents from the second to the first period, and, in principle, the loss in the second period may even be larger than the gain in the first period. The figure below clarifies this point. If a quota Q_A is imposed, the price of the resource will increase and there will be a terms-of-trade gain in period 1 (the green area). However, since a larger amount of resources will be available in the second period, the price in period 2 will fall below the level that would have prevailed without the quota and there will be a terms-of-trade loss (the yellow area).

At the world level, the price wedge between the two periods implies a real income loss, given by the area ABE. Of this, the area ACE is the loss in consumer surplus caused by higher price in the first-period, which is not compensated by the terms-of-trade gain. The BCE is the second-period terms-of-trade loss that is not compensated by the gain in consumer surplus resulting from lower second-period price.

Two points are worth noting. First, the price of the resource can be kept higher over the two periods (and therefore a terms-of-trade argument for the imposition of a quota exists) only if a government can credibly commit that it will leave some of the resources unexploited in the ground. Second, when all resources are exported, an export quota is equivalent to a production quota. The trade-off between extraction today and extraction in the future also holds in this case.

Several reasons may justify the introduction of quantitative restrictions on the extraction rate of a resource relative to the optimal one that might otherwise be chosen by the competitive producer. In the case of natural resources, uncertainty about the future plays an important role in decisions about extraction, and this uncertainty may take different forms. There is uncertainty of supply, due to the fact that reserves of some natural resources are at least partially unknown. In addition, there is uncertainty on the demand side, as substitutes for resources may be developed and become available at some unknown point in the future. Risk-aversion plays an important role in determining the optimal extraction paths in this case. For example, if a government is more risk-adverse than the private producer and wants to avoid running out of a resource, it may consider it optimal to introduce a quota to move towards a more conservative extraction path (Devarajan and Fisher, 1981; Weinstein and Zeckhauser, 1975; Arrow and Chang, 1978; Hoel, 1978).

Another important reason for restricting production in one period relative to the future is the existence of externality – which will be discussed in more detail below. In addition, export quotas, like export taxes may be introduced as a second-best policy measure to further certain development objectives, as noted above.

Finally, export quotas can also be rationalized by a terms-of-trade argument. When there is domestic demand for the resource, an export quota (like an export tax) will create a wedge between domestic and foreign prices and work as a beggar-thy-neighbour policy. The resource-exporting country gains in terms of trade, but the policy generates overall efficiency losses.

(d) Subsidies

Although available information suggests that subsidies to natural resource sectors are significant (World Trade Organization (WTO), 2006), no comprehensive cross-country data exist to allow a comprehensive comparison

of subsidy policies across the main producers and consumers of non-renewable natural resources.[35]

A production subsidy in a resource-exporting country is essentially a simple transfer from the government to the producing company. Provided that supply is linked to available resource stocks (the situation described in Figure 31), a production subsidy will not affect consumer prices, but will simply increase the price per unit of output for the production company. From an economic perspective, production subsidies in an exporting country are justified when there is a market failure and when insufficient resources flow to the extraction activity. In the case of a natural resources sector that represents, or may potentially represent, a large share of a country's economy, one can imagine that the development of an extraction company could have positive externalities for the rest of the economy, and thus the case for public subsidies could exist.

A consumption subsidy acts like an export tax when provided by the natural resource-exporting country, and similar rationales apply. To the extent that the two measures differ, an export tax represents rent-shifting from the producing company to the government and consumers, whereas a consumption subsidy represents a transfer from government to consumers and the producing company.[36]

In contrast, a consumption subsidy provided by the importing country works in the opposite direction to an import tariff, in that it is a simple transfer to the exporting country – suggesting that there may be mainly an income distribution rationale behind it.

Production and exports can also be affected by exploration subsidies. Since available natural resource endowments are partially unknown, and companies must invest in exploration to discover new deposits, governments may choose to support this activity through exploration subsidies – that is, incentives for companies to invest in exploration. By increasing the amount of proven resources, more intensive exploration activity can increase production and exports of non-renewable resources. In the situation illustrated in Figure 31, this is equivalent to shifting the supply curve to the right.

The economic literature highlights a number of factors that may cause market failures in terms of exploration activity and hence justify public intervention.[37] One is the spillover of geological information. Because exploration is expensive and uncertain – and because producers can benefit from information that spills over from exploration attempts in adjacent territories – producers might have an incentive to wait for their neighbours to drill first, resulting in socially inefficient levels of exploration (Stiglitz, 1975; Peterson, 1975). A government subsidy to encourage exploration could result in the discovery of new resources that might otherwise have gone undeveloped.

Exploration by the government itself – or subsidies to encourage private exploration – may make sense for two other reasons. First, there may be positive spillovers to the rest of the economy from successful exploration that raise the overall benefits for the government relative to private actors – thus justifying government interventions. Second, a principle-agent problem exists in exploration that may induce a sub-optimal exploration rate. The problem arises because of sunk (i.e. non-recoverable) costs of exploration (Collier and Venables, 2009). The reduction of this initial sunk cost through the provision of a subsidy is a way to address the problem.

The market may also fail to deliver a socially optimal level of exploration because of the so-called "tragedy of the commons".[38] If an explorer that discovers a mineral or an oil deposit may exclude others from the exploitation of the natural resource, he will have an incentive to explore and capture the benefits of a discovery as quickly as possible before others do. This "race" may result in over-exploration, as each discovery reduces the amount of resources available to all (Hotelling, 1931). As will be discussed in more detail below, there are a range of policy instruments available to address the problem of the commons – from rules and regulations to taxes and subsidies. One way to reduce over-exploration is to create an incentive to invest in other activities, for example by providing subsidies to encourage research into substitute or renewable resources (e.g. subsidies to encourage research into biofuels or solar energy as a way of offsetting the development of new oil deposits).

3. Trade policy and exhaustibility: The problem of open access

As explained in Section C, free trade in natural resources between two countries may not always be mutually beneficial when open access problems exist. What policies should governments adopt to address this problem? And are some approaches more efficient and effective than others?

(a) Trade policy instruments

The following analysis assumes that the exporting and importing countries are "large" economies capable of affecting world prices (the result would essentially be the same for "small" economies except for the terms-of-trade effect). Moreover, the discussion focuses on comparing the long run effect of policies rather than on the transition, i.e. steady-state equilibria.[39]

An export tax applied by a resource-exporting country with open access problems will reduce the level of extraction in the natural resources sector. It raises the welfare of the resource exporter in two ways: by improving its terms of trade and by increasing its long-run stock of natural resources. However, the use of an export tax has a beggar-thy-neighbour effect because the increase in welfare of the exporting country comes at the expense of the welfare of its trading partner. The importing country will suffer a terms-of-trade decline and its steady state natural resources stock will be lower.

Box 20: **Export restrictions in the tropical lumber industry**

The world's forests are endangered by decades of over-logging – primarily triggered by land conversion, notably into agriculture (Robalino and Herrera, 2009). Since the 1970s, many developing countries have resorted to taxes or bans on exports of logs for the purposes both of conserving their use and promoting greater domestic value-added processing. Jeffrey (1992) noted the use of (high) export taxes in Western Africa (Cameroon, Ivory Cost, Ghana), South East Asia (Indonesia and Malaysia) and Latin America. One justification for the use of these measures was to correct the effect of high tariff escalation imposed by some developed countries against processed woods, deemed to depress prices for tropical timber on international markets. Furthermore, export measures served industrial policy and development objectives by providing assistance to downstream industries in correcting the bias introduced against their exports by tariff escalation in importing countries, and by "capturing" some of the economic rent associated with the countries' perceived market power in these sectors.

Export measures have often been combined with domestic policy measures (government control of land and of logging concessions and licences, obligations by concessionaires to undertake further processing of timber) to encourage domestic processing industries. A number of WTO trade policy reviews have documented how high export duties on logs and export promotion measures (including concessionary credit, insurance and guarantees, exemptions and duty drawback on machinery) have played a central role in Indonesia and Malaysia's industrial policies. In 20 years, Indonesia – whose government had linked the granting of logging concessions to the establishment by the applicant company of a wood/plywood processor near the territory of the concession – fulfilled by the late 1990s its objective of becoming the world's largest plywood manufacturer and exporter, while expanding wood furniture industries. Malaysia also became the second-largest exporter of wood products. Undoubtedly, export policy contributed to generate employment, raise export receipts and to boost the economy generally.

However, some economists have argued that the scale at which these policies were conducted raises questions about efficient resource allocation and resource sustainability, even though sustainability may have been one of the two governments' objectives at the outset. Anderson (1997) as well as Varangis et al. (1993) argued that impediments to trade reduced the value of sustainable forestry. Although poor implementation of domestic policies regulating the production of domestic timber (inadequate logging supervision, lack of tenure rights, inadequate stumpage fees, non-transparent allocation of logging concessions) were mainly responsible for unsustainable logging, "trade policies are inefficient instruments for correcting domestic distortions and, in the case of tropical timber trade, may affect the environment perversely. Export and import restrictions ultimately depress the value of an already under-price resource – the forest."

Policy cases conducted by the World Bank (1998) identified some of the drawbacks associated with prohibitive export taxes in forestry (500 to 5,000 per cent in Indonesia in 1998) and requirements on concessionaires to establish wood-processing factors, resulting in domestic logs and timber prices being one-fifth of the international price, the proliferation of wood-processing mills (3,000 in Indonesia), wastage ratio superior to the international average, and finally the diversion of wood to relatively less remunerative and efficient downstream processing industries (plywood) than alternative industries (higher-value added furniture).

In the early part of this decade, the Indonesian and Malaysian governments corrected some of the identified drawbacks, notably by reducing the amount of the export tax, weakening powerful export cartels that had obtained trade and other privileges from previous governments, and partially liberalizing log exports. However, in view of the rapidly developing demand for raw and processed wood products in Asia on the one hand, and the expansion of uncontrolled logging and smuggling of wood products in the forests of both countries, both governments decided to re-establish export bans on tropical timber.

The resulting increase in the exporting country's long-run stock of natural resources assumes that there is no domestic processing sector that could make use of the natural resource. In cases where a domestic processing sector exists, an export tax is a less effective tool for protecting natural resource stocks, since it effectively lowers the resource price that domestic processors have to pay and increases the quantity they will demand (see Box 20).

What happens when the importing country imposes a tariff on the natural resource, leaving aside for the moment the question of precisely why it would want to do that. Given the large country assumption, such a restriction will improve the terms of trade of the importing country while reducing the terms of trade of the resource-exporting country. Moreover, the long-run stock of the natural resource in the importing country will fall while the steady state stock in the exporting country will rise. Brander and Taylor (1998) show that even though the resource exporter suffers a terms-of-trade loss, it gains in the steady state because of the greater stock of natural resources which, in turn, expands its consumption possibilities.

Brander and Taylor also show that the importing country may benefit from the imposition of protection in two ways: through a terms-of-trade improvement and

through the tariff revenues it collects. It is possible that these benefits could outweigh the loss from the lower steady state level of the natural resources stock. This possibility of a net gain could explain why a resource-importing country might be willing to impose a tariff on a natural resource.

Clearly, the exporting country will prefer an export tax to a tariff, while the importing country will have the opposite preferences. In both instances, the long-run welfare of the exporting country rises. The key difference between the two instruments is that the steady state utility of the importing country falls with an export tax, whereas the effect is ambiguous with an import tariff.

(b) Domestic policy instruments

(i) Strengthened property rights

The economic literature argues that a more efficient outcome can be achieved by strengthening property rights rather than by employing trade measures. The first-best policy is to eliminate the distortion at the source, which is the absence of property rights over the stock of natural resources (Brander and Taylor, 1998). This implies that when both trading partners are able to manage the resource sector effectively, both countries can reap the benefits of trade opening without risk of resource over-exploitation.

How does strengthening property rights in the exporting country compare with imposing export taxes, as discussed above? First, strengthening property rights improves resource allocation by reducing the level of extraction below the open access equilibrium to a point that would maximize rent (see Section C.3). Second, given the reduction in resource extraction, strengthened property rights will also produce a terms-of-trade gain for the exporting country. But unlike an export tax, strengthened property rights would fully correct the underlying distortion arising from open access problems – i.e. too much effort or labour devoted to harvesting the natural resource.

However, seeing this problem in terms of perfect property rights versus open access is probably unhelpful, given that property rights regimes typically lie between these two extremes. While strengthened property rights is the first-best solution, it is important to understand the limitations that regulators (whether national governments or local communities) face when trying to enforce rules governing access to natural resources or to monitor compliance (Copeland and Taylor 2009).

Ostrom (1990) has studied many successful examples of community efforts to manage common pool resources from around the world – ranging from freshwater basins in the United States to irrigation systems in the Philippines, and to mountain pastures in Switzerland (see Box 21). In each case, these are neither completely open access resources nor perfectly managed resource systems. Nor are they completely privatized or fully state-controlled systems. They operate using an assortment of rules for sharing the resource, for monitoring compliance with the norms and for adjudicating disputes. Frequently, agreement among the members of the community cover not only how the resource is to be shared but also how provision is to be made for maintaining, repairing or investing in the natural resource system. What is striking about these examples is their longevity, with some local institutions being centuries old. While it is not possible to claim that these local solutions achieve an economic optimum, the durability of the institutions nevertheless testifies to a certain level of success in managing natural resources.

Ostrom identifies a number of "design" principles that characterize these long-standing arrangements. The individuals who have rights to the resource and the boundaries of the resource itself are clearly identified. The rules governing the harvesting of the resource and the obligations to provide for maintenance repair or investments are tailored to local conditions. The individuals who are subject to the rules can participate in modifying those rules. Those who monitor compliance with the rules are accountable to the harvesters or are themselves harvesters. Sanctions are calibrated to the degree of seriousness of the offence. Low-cost venues for resolving disputes are available. Higher authorities at the regional or national levels do not challenge the right of local communities to devise their own rules or institutions.

The more complex the common pool resource system is, the more widely layered or multi-levelled are the rules.

Box 21: **Alpine meadows**

One of the successful examples of local community efforts to manage natural resources can be found in Törbel in the Swiss canton of Valais. Since at least 1224, historical records document that villagers have been managing several types of communal properties, including alpine meadows where cows are allowed to do their summer grazing. The communal meadows have co-existed with private ownership of lands for at least 500 years. For Ostrom, this indicated that communal ownership was not simply a vestige from the medieval ages, but a rationally chosen way to manage the meadows. Access to the meadows is strictly limited and regulations dating back to 1517 further set out these limitations: no citizen could send more cows to the Alp than he could feed during the winter. This "wintering" rule was strictly imposed, with officials in charge of enforcement given the right to collect half of all the fines levied on those caught violating it. Although yields are low, the meadows have conserved their productivity for hundreds of years. Villagers help to preserve this productivity by contributing labour to weed and manure the grazing areas, and by constructing and maintaining mountain roads.

Source: Ostrom (1990).

While Ostrom is able to offer exemplary cases of success, she also documents quite a large number of unsuccessful efforts at managing common pool resources. In her estimation, they failed because they lacked a sufficient number of the design principles. However, Ostrom is careful to offer the qualification that these design principles are not necessarily pre-conditions for success. The difficulty of providing an economically concise analysis or explanation for why these institutions work suggests that there is more than a touch of fortuity involved in the most successful cases.

Furthermore, the difficulty of achieving an ideal property rights regime may be particularly acute in developing countries. Institutional and socio-political limitations make it unlikely that poor developing countries will be able to implement such policies effectively in the near future (Lopez, 1998). This opens the door to the use of alternative policy instruments such as trade measures, which were discussed before, and domestic taxes and quotas.

In connection with this, it will be helpful to examine other domestic measures that have been used in the natural resources sector. The two reviewed here are a production quota or limit on harvest, and a tax on harvest. In addition, because subsidies in some renewable natural resource sectors, such as fisheries, have been particularly important, their impact is also examined

(ii) Tax on production or harvest

Brander and Taylor (1998) rank a production tax in the same order of efficiency as property rights, i.e. they are first-best instruments,[40] if the tax is set at a level that makes the harvester internalize the reduction in productivity that he inflicts on other harvesters. This is shown in Figure 34 which depicts the situation after trade opening, meaning that the revenue curve reflects world market or post-trade liberalization prices. The application of a production tax (at a rate equal to AB/AE**) shifts the revenue curve inward to the dashed curve (i.e. lowers the revenue from harvesting the resource) so that labour allocation under open access now becomes equal to the optimal level of effort E**.[41]

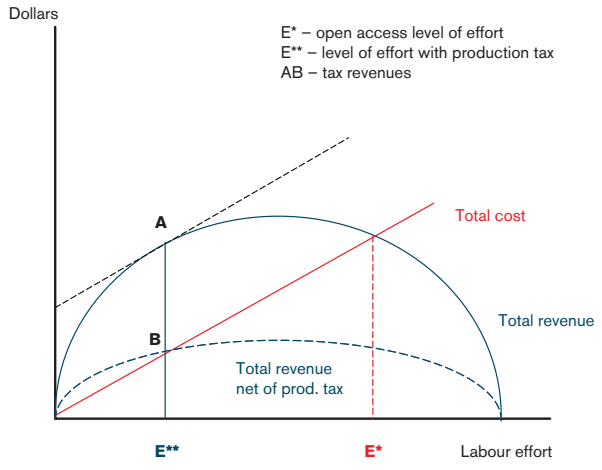
Note that E** is the allocation of labour that would result from the actions of an owner whose objective was to maximize the rent from the resource (marginal revenue equals marginal cost). The difference in this case is that the line segment AB represents tax revenue collected by the government instead of rent.

(iii) Quantitative limit on the harvest of natural resources

The view about the efficacy of production taxes is not shared by everyone. Chichilnisky (1994) claims that taxing the harvest of the natural resource can even exacerbate the rate of its extraction. However, it turns out that her result requires additional assumptions to be made about the consumption preferences of those working in the natural resources sector. The outcome she describes occurs because she assumes workers who harvest the natural resource have a demand for consumption goods produced in the non-resources sector that is not affected by price changes. Thus, faced with a reduction in their revenue as a result of the application of the production tax, they must harvest more of the resource so that they can purchase the same amount of the consumption good. On top of this, there will be an additional welfare loss from the increased harvesting because of the decline in the resource-exporting country's terms of trade.

Ferreira (2007) argues that the use of a production tax by the resource-exporting country will not be sufficient to prevent it from suffering a welfare loss. Her explanation for this is that unlike a quantitative restriction on harvesting, a tax on harvests does not fix the amount harvested since the allocation of labour responds to changes in relative prices. The movement from autarky to free trade increases the price of the natural resource in the country with poor property rights. Workers involved in the natural resources sector will increase their effort so that they can harvest and sell more of the resource at the higher price. A production tax will reduce but not eliminate the incentive for workers to allocate more of their labour to harvest the natural resource.

Figure 34: **Effect of a production tax**



Ferreira (2007) argues that a production quota on harvests is preferable. As long as there is some quantitative restriction in place to limit harvesting of the natural resource, free trade can be optimal for the exporting country. Furthermore, a government does not need exact information on the optimal level of harvest to set a quantitative restriction that will increase welfare. So long as the quantitative restriction on the amount harvested is binding, trade opening will not put additional stress on the stock of the natural resources sector and hence welfare will increase for the resource-exporting country. This is because a country that liberalizes usually experiences gains from two sources: increases in consumer surplus (because liberalization reduces the price paid by consumers for import-competing products) and increases in producer surplus (because factors of production are more efficiently utilized).

In a situation where the natural resources sector is characterized by open access, trade opening results in more effort or labour being allocated to the natural resources sector, leading to losses in producer surplus (rent dissipation) that dominates the gain in consumer surplus. However, if a quantitative limit is set on the harvest of the natural resource, so that no reallocation of labour to the natural resources sector takes place, the gains in consumer welfare will be sufficient to produce an overall increase in the country's welfare.

The argument about the superiority of a production quota to a production tax is surprising since at whatever level a production quota is set, there is always a way to set a production tax so that it achieves the same result when implemented. Using Figure 34 to illustrate this point, note that the optimal labour allocation E^{**} can be attained either by a production quota that fixes the harvest at the amount AE^{**} (assuming that the world price is normalized to one) or a production tax equal to AB/AE^{**}. Weitzman's (1974) classic article on prices and quantities shows that, when there is complete certainty about benefits and costs, price instruments are equivalent to quantitative controls. It is only when the regulator faces uncertainty about the structure of benefits and costs that the two instruments will not be equivalent in their welfare effects.[42]

Nevertheless, the result from Ferreira (2007) may have important practical policy implications if uncertainty is allowed and due to the fact that many poor but resource-rich countries do not have the monitoring and enforcement capability to implement a first-best property rights regime. A simple quota on the amount of resources that can be harvested, however, may be feasible for poor countries. Furthermore, the quota need not even be set at the optimal amount of harvest, and yet trade opening will be welfare improving for the resource-exporting country.

(iv) Subsidies

While it is widely recognized that important renewable resources are over-exploited, and that corrective measures need to be implemented to restore their productivity, this recognition has not stopped governments from providing various forms of financial support to producers. One notable example is fishing subsidies. The reasons for such support are varied. Since fish is an important food source, subsidies could be rationalized as a measure to ensure food security. Fishing communities may be located in struggling regions of a country and so subsidies often help jobs remain in those areas. Finally, subsidies may also be provided in order to reduce fishing efforts and conserve fish stocks (see Box 22 on the buy-back of fishing vessels).

Economic theory suggests that subsidies that reduce the cost of harvesting (e.g. subsidies for fuel used in fishing boats or subsidies for fleet modernization, or subsidies that are paid on the basis of harvest) will worsen the exploitation of stocks that already suffer from open access. The increase in revenue or the reduction in cost made possible by the subsidy raises rent in the natural resources sector and thereby attracts more entry. This infusion of entrants continues until rent is totally dissipated.

Despite the increased effort, the effect of the subsidies on harvest or output is ambiguous. It is only when the natural resources system is in the upward sloping portion of the supply curve that the subsidy results in more output or harvest. If the natural resources system is in the backward-bending portion of the supply curve, the subsidy will result in reduced harvest or output. To recall the explanation in Section C.3, the supply curve of the natural resource under open access is backward-bending because too much effort is involved in harvesting. Hence, when the price rises, drawing additional labour to the natural resources sector, those additional workers reduce instead of increase total harvest. By the same token, the subsidy aggravates the crowding in the natural resources sector and reduces, instead of increases, total harvest.

When the resources are subject to some form of management, whether subsidies worsen the exploitation of the natural resources stock or not may depend on the nature of the management system. If management of the resource takes the form of the individual transferable quota (ITQ) system, which has become popular in fisheries, where a total catch (the "total allowable catch") is determined at the outset and individual quotas are assigned to harvesters, the subsidy will not increase the exploitation of the resource if the total allowable catch is left unchanged and is effectively monitored and enforced. Instead, the subsidy simply stays with the harvesters or ITQ owners as increased rents.

What is the effect of subsidies on international trade? The interesting case is where the initial free trade equilibrium occurs in the backward-bending portion of the supply curve of the country with open access problems. Some have argued that given the severity of the open access problem in fisheries, this is the likely situation for that sector (Asche and Smith, 2009).

Box 22: **Are there good subsidies? The case of vessel buy-back schemes**

An example of a potentially "good" subsidy is a buy-back programme where fishermen are compensated to remove their fishing vessel and thereby reduce fishing efforts. However, opponents of the notion that there are good subsidies claim that all transfers will eventually be transformed into increased effort. Hence, the entry of new vessels or increased capacity in the remaining fleet will make up for the reduction in effort implied by the removal of one vessel.

Buy-back programmes are a common tool to reduce capacity in fisheries, particularly in developed countries. However some developing countries also have such programmes in place. Fishing vessels have little alternative value and it is therefore difficult for the fishermen to withdraw a vessel. Buy-back programmes provide the means to change this.

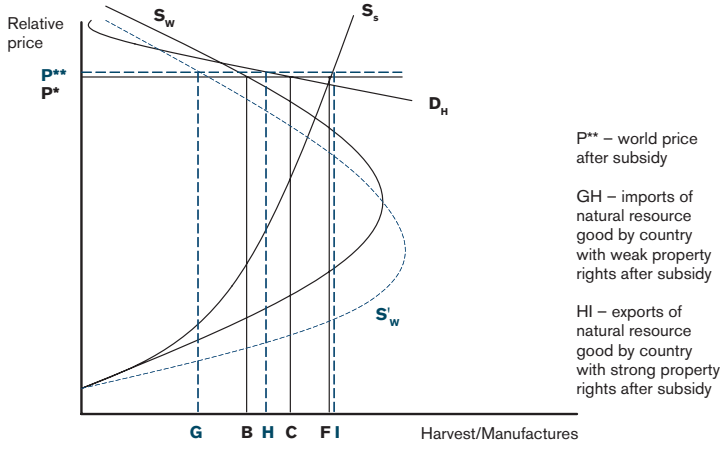
Groves and Squires (2007) give eight categories of reasons why vessel buy-backs are used as a management tool: (1) increasing economic efficiency, (2) modernizing fleets and adjusting fleet structure, (3) facilitating transition between management regimes, (4) providing alternatives when rights-based management forms are not an alternative, (5) providing disaster or crises relief, (6) addressing compensation and distribution issues, (7) helping conserve or rebuild over-exploited stocks, and (8) protecting ecological public goods and biodiversity. They recognize that a buy-back programme often targets several different and even conflicting objectives and that the programme is the outcome of a policy process that in most cases will target improved, not optimal, management as the objective.

How well a buy-back programme works depends to a large extent on its objectives, design and implementation. Groves and Squires (2007) and Hannesson (2007) show that buy-back programmes in fisheries without access restrictions cannot achieve its objective (with the possible exception of transferring revenue to a group of fishermen). In fact, if the programme is poorly designed and lacks restrictions on access or capacity expansion for the remaining vessels, a buy-back programme can reduce the size of the fisheries stock. A recent OECD report (2009d) based on case studies of a number of decommissioning schemes in OECD and non-OECD countries reaches similar conclusions. It recognizes that vessel buy-backs, as part of a package of transitional assistance and management changes, can accelerate the transition to a rationalized fisheries system. However, decommissioning schemes used on their own do not provide a long-term solution to the problems in fisheries with poorly developed or enforced use and access rights. Unless complementary measures are taken to effectively manage the fisheries stock, short-term gains from the buy-back are likely to be eroded as remaining fishermen expand their efforts, previously inactive vessels and licences are activated, or as new entrants join the fishery.

Sources: Asche and Smith (2009) and Organization for Economic Co-operation and Development (OECD) (2009d).

Figure 35 below shows the free-trade equilibrium occurring in the backward-bending portion of the supply curve. The structure of demand is the same in both countries and is given by D_H. The country with weak property rights imports the natural resource from the country with strong property rights. The world price is given by P^* with imports given by BC which is equal to exports CF. A subsidy by the country with weak property rights increases effort (shown as the shift in the supply curve to S'_W). However, since the subsidizing country is already in the backward-bending portion of its supply curve, this additional effort actually reduces its harvest and the steady state stock of the natural resource. As a consequence, at the initial world price P^*, the country

Figure 35: **Effect of a subsidy on trade**



providing the subsidy demands a greater amount of imports than before. This leads to a new equilibrium with a higher world price P^{**} and higher imports (equal to GH) for the subsidy-providing country.

Thus, it turns out that a subsidy by the importing country to its natural resources sector increases its imports and also leads to a deterioration in its terms of trade. While the subsidy worsens the state of its natural resources sector, the measure does not steal trade opportunities from its trade partners. By the same token, it can be shown that a subsidy that reduces capacity in the importing country will have the opposite effect to that described above. By reducing harvesting capacity, the subsidy-providing country improves production efficiency to such an extent that its harvest actually increases, its imports are reduced and there is an improvement in its terms of trade.

In summary, the economic literature on trade in renewable natural resources implies that free trade may not benefit both countries, particularly if the resource exporter suffers from a problem of open access. Since the inefficiency that plagues exhaustible natural resources is domestic in origin, trade policy will not be the first-best policy instrument. The economic inefficiency will be better addressed at source through stronger property rights or through a production tax/quota. However, institutional limitations, particularly in poor and developing countries, may make it unlikely that they will be able to implement resource management policies effectively, which might justify the use of trade instruments such as an export tax.[43]

4. Natural resources externalities and environmental policy

The following discussion looks at a set of policy instruments that governments could use to deal with the environmental externalities deriving from the extraction and use of exhaustible resources. First, it focuses on fossil fuel resources – and more specifically, on the optimal time pattern of consumption environmental taxes[44] to limit negative externalities such as pollution and habitat destruction. It is important to note that since most energy resources are unevenly distributed geographically, it is very likely that countries importing those resources are not producing them. Thus, analysing the effects of a consumption tax would be equivalent to analysing the effects of an import tariff.

Second, the effects of trade policy instruments such as import tariffs on renewable natural resources are considered. The effectiveness of these instruments is analysed in the context of common pool problems and environmental externalities such as habitat destruction. Finally, policy instruments such as eco-label schemes and environmental standards are discussed as alternative policy instruments to deal with negative effects on biodiversity.

As noted earlier, policy instruments such as export taxes can also be used to address environmental externalities. The ensuing discussion, however, focuses on those measures referred to most commonly in the specialized literature.

(a) Fossil fuels and the optimal pattern of consumption taxes (and import tariffs)

The optimal level of a consumption environmental tax – also known as Pigouvian tax – should reflect the costs of the environmental damage generated by the extraction or use of exhaustible resources such as fossil fuels. In addition, the efficient implementation of Pigouvian taxes should take into account the link between environmental damage and resource depletion. More specifically, when damage to the environment derives from the use of a non-renewable resource, policy-makers wishing to impose a tax on consumption should focus on the time path of the tax rather than just its level. Doing the contrary would be inefficient. In fact, as illustrated in Section D.2, imposing a constant *ad valorem* Pigouvian tax[45] on a non-renewable resource will not change the path of production and consumption of such a resource and hence will not reduce the resulting pollution.

The following section focuses on taxes on the carbon content of fuels.[46] Conclusions related to this particular policy instrument are also valid for taxes on energy consumption. The literature[47] shows that in the presence of flow environmental externalities (i.e. the environmental damage caused by the current extraction or use of the resource),[48] a falling *ad valorem* Pigouvian tax would be an optimal policy to delay depletion and hence to slow the accumulation of CO_2 emissions.[49] In the short run, the introduction of a Pigouvian tax will increase the consumer price of the resource in each period and will consequently reduce its total demand. A shift from present consumption towards future consumption is welfare enhancing since it reduces both the absolute amount of emissions and the present value of the environmental damage. As the marginal environmental damage decreases with decreasing consumption of the resource, the tax rate falls as time passes.

When stock externalities are considered (i.e. when environmental damage is a function of cumulative emissions), there is no general rule that can determine the optimal pattern of a carbon tax. The direction of the movement of a carbon tax will in fact depend on the effects and the interaction among different factors such as the natural rate of decay and the initial stock of carbon emissions and at what rate today's consumers discount future environmental damage in relation to the present. However, studies such as Ulph and Ulph (1994) show that for a special and very plausible case in which the stock of the pollutant decays over time, *ad valorem* carbon taxes should initially be rising when the initial stock of pollution is small and be falling towards the end of the resource's life. The previous theoretical result is in line with some empirical evidence showing that in the European Union and the United States, tax rates on fuels such as gasoline have increased substantially over time.[50]

How would the optimal path of a carbon tax change if the trans-boundary effects of environmental externalities are taken into account? In the context of

carbon emissions, for instance, it is likely that the actions taken by resource users in a certain country are not entirely contained within national borders, but spill over into other countries independently of international trade. Some economic models, for instance Amundsen and Schöb (1999), show that in the presence of cross-border effects, an agreement to increase taxes uniformly higher than the Pigouvian level would provide an efficient allocation of the natural resource over time. However, reaching an agreement is costly: although all countries could benefit from coordination, a single country always has an incentive to deviate from the coordinated tax scheme since its best policy would be to impose the lower Pigouvian tax. Hence, to overcome this "prisoner's dilemma" situation, coordination requires binding and enforceable agreements.

Finally, once the right policy instrument is announced, the speed of introduction of such a policy can be crucial to its success. In fact, in studies such as Long (1975) and Konrad et al. (1994) it has been shown that in order for the policy to be beneficial for the environment, any proposed tax needs to be introduced quickly. This is because announcing the imposition of coordinated taxes acts like an expropriation threat to the resource-owning countries. They have the incentive to increase present extraction prior to the date when the tax is imposed in order to reduce future losses.

In practice, the level of taxes imposed by governments deviates from the optimal Pigouvian tax level. The reasons for this are twofold. First, the difficulty of estimating the environmental damage costs generated by the use of fossil fuels makes countries implement more workable approaches, such as that introduced by Baumol and Oates (1971), where the tax rate is set to influence the behaviour of taxpayers in order to achieve a predetermined set of objectives for environmental quality. Second, different studies[51] show that the level of taxes today deviates from the optimal Pigouvian tax level due to the strategic interaction between consumers and producers of resources. This is because, as explored in Section D.2, the imposition of taxes also serves to capture resource rents from resource-exporting countries. For example, the fact that petroleum-producer and petroleum-consumer countries are two separate groups with different interests might make this latter group use carbon taxes not only with the objective of making consumers take account of the environmental damage derived from the consumption of an exhaustible resource, but also to appropriate rents.

(b) Renewable resources, biodiversity and environmental policy

(i) Import tariffs

In Section D.3 it was shown that when property rights with respect to resource harvesting are not well enforced, trade opening might have a negative impact on resource conservation. Therefore, trade policies such as tariffs imposed by the resource-importing country will reduce foreign demand for the resource commodity, mitigating – to some extent – the over-harvesting problem. In what follows, the analysis of trade policy instruments is performed taking into account not only the open access problem related to renewable resources but also the resulting environmental damage. More specifically, the following questions will be considered: is the imposition of a tariff still optimal when a negative externality such as habitat destruction is taken into account? Are there alternative instruments that could be used to deal with habitat destruction?

The effect of a tariff on biodiversity depends on the principal causes of habitat destruction. The destruction can be a direct result of over-harvesting – for instance, excessive timber extraction implies habitat loss due to declining soil fertility. In such a situation, the imposition of a tariff will be an optimal policy since it decreases the amount of the resource harvested and hence will also reduce habitat loss. If, however, the expansion of other economic activities takes place at the expense of habitat conservation, through land conversion (cross-industry externalities), then imposing a tariff will not always be the best policy. In fact, the work of Smulders et al. (2004) shows that when there is a negative relationship between economic activity and habitat conservation, the introduction of a marginal tariff on resource imports will have an ambiguous effect on both the importer's and exporter's stock of the resource.

To better illustrate the logic behind this result, consider an economy with two countries, home and foreign, and three sectors – harvesting, agriculture and manufacturing. The production of each good requires labour as well as a sector-specific input, and labour can shift freely between the three sectors within each country. While the development of the manufacturing sector does not necessarily have a negative impact on habitat conservation, an expansion of the agricultural sector will have two opposite effects on the stock of a renewable resource. On the one hand, it will reduce it through land conversion and hence habitat destruction. On the other hand, less labour will be available for harvesting which will have a positive effect on the resource stock.

Suppose now that the home country imposes a tariff on the harvested good. The effect of a tariff on the foreign country's resource stock is ambiguous and depends on the intensity of its direct effect on harvesting, through a decrease in demand, with respect to its indirect effect on other economic activities. More specifically, the introduction of a tariff on the harvested good will decrease its exports and hence will reduce harvesting. In addition, a decrease in harvesting will make labour resources shift to the manufacturing and agricultural sectors and the expansion of the latter will be at the expense of habitat conservation. The natural resources stock will therefore increase (decrease) – if the negative effect on habitat conservation through land conversion is smaller (larger) – than the direct positive effect due to a decrease in harvesting.

The analysis of the importer country can be divided into short- and long-run effects. In the short run, a tariff on the harvested good will reallocate labour away from the

agricultural sector to more harvesting and hence the size of the habitat will increase.[52] However, the price of agricultural products relative to harvesting products will decrease and their relative demand will rise. In the long run, because of a reduction in the overall resource stock, the costs of harvesting will increase and labour will shift back to the agricultural and manufacturing sectors. The more demand shifts to manufactured goods, instead of agriculture, the more likely it is that the resource stock will increase.

(ii) Eco-labels and environmental standards

An important implication of the above discussion is that when there are certain interdependencies between an exhaustible resource and economic activity, the introduction of a tariff might have a negative impact on habitat conservation. Are there some alternative policy instruments that governments could implement to efficiently address environmental problems such as biodiversity loss due to habitat destruction?[53]

First, governments may enforce environmental mandatory standards.[54] These are a set of quality conditions that are to be adhered to by each producer. Standards, also known in the literature as command-and-control systems, are especially attractive from the perspective of effectiveness. This is because the government directly dictates a clear quantity target (restriction) that has to be followed by market participants.[55] Second, governments (or non-governmental agencies) can provide eco-label schemes.[56] An eco-label is a certification scheme with the intention to provide information to consumers, helping them to identify green and environmentally friendly products. A typical eco-label scheme lists environmental criteria, and awards the eco-label to products that meet such criteria.[57] Examples of eco-labels run by non-governmental agencies, in the context of trade in renewable resources, are the sustainable seafood eco-label by the Marine Stewardship Council and sustainable timber eco-labels monitored by the Forest Stewardship Council. An example of a government-run eco-label is the Blue Angel label in Germany, which is awarded, among other criteria, to goods that protect resources.

Models such as Greaker's (2002) and Rege's (2000) show that an eco-label scheme may be able to achieve similar environmental goals as environmental standards and can even be more efficient. However, one important condition must be fulfilled for an eco-label to achieve policy objectives, which is that consumers must prefer environmentally friendly goods. Only if consumers see an additional benefit in consuming the higher-priced environmental quality goods (a so-called warm glow effect), will they respond to eco-labels by switching towards eco-labelled goods. Indeed, there is some literature documenting that consumers are willing to pay more for greener products.[58]

To illustrate the extent to which eco-label schemes might be more effective than environmental minimum standards, a comparison of the two previous policy instruments is performed in a simple model of trade with one domestic and one foreign firm which produce an identical good and compete on price in the domestic market. Depending on how much each firm cares for the environment, they will decide whether to produce a low or a high environmental quality good. From the consumers' side, there is a warm glow effect that makes them have a higher willingness to pay for high environmental quality goods. However, their personal tastes are negatively affected by transportation costs, as goods get more expensive for consumers that live further away from the importing location. In the absence of regulation, consumers will not have the possibility to distinguish whether firms produce environmentally friendly goods or not. In other words, consumers can only be sure about the environmental quality if the producer is regulated by an environmental standard or if an eco-label can be observed.[59]

Consider first the case where the domestic government imposes a mandatory environmental standard and assume that only the domestic firm is obliged to produce high environmental quality goods.[60] Since consumers in the home country will have no information to distinguish the quality of the goods imported from the foreign firm, it will have no incentive to produce environmentally friendly goods and will continue to produce low environmental quality goods, which are cheaper. In equilibrium, both high and low environmental quality goods are going to be sold in the domestic market. More specifically, since the share of consumers buying the high (low) quality good is increasing (decreasing) in the warm glow effect but decreasing (increasing) in the transportation costs, then the total demand for the environmentally friendly good will depend on the relative strength of the transportation costs effect over the warm glow effect.

What does the equilibrium look like if the government decides on an eco-label scheme instead of imposing a minimum environmental standard? In such a situation, both the domestic and the foreign firm can decide if they want to adopt the eco-label.[61] More precisely, if the average willingness to pay for an eco-label is higher than the per-unit abatement cost borne by the firm, both firms will adopt the eco-label and a higher overall environmental quality will be reached than with environmental standards.

5. The political economy of trade policy in natural resource sectors

The discussion so far has used the simplest assumption about the motivation of government – that it seeks to maximize economic efficiency or national welfare. However, policy-makers often take into account the instances of special interest groups that try to influence the outcome of the political decision-making process to benefit their members.[62] These considerations naturally apply to the extraction and trade of natural resources. If governments are influenced by the activities of lobby groups and other vested interests trying to "capture"

the relevant regulations in their favour, the rate of extraction of a renewable resource – or the rate of depletion of a non-renewable resource – is likely to differ from the social optimum, reflecting the outcome of the interaction between lobbies and the government.

(a) Examples of policies affected by political economy considerations

Systematic evidence on the influence of interest groups on policy formation is obviously hard to find, but it is not difficult to see how political economy considerations explain the use of some trade-related policies. A first example concerns subsidies to renewable natural resources. As explained in Section D.4, subsidies that reduce the cost of harvesting these resources worsen the exploitation of stocks that already suffer from open access. According to Ascher (1999), these policies can be implemented by policy-makers to capture part of those resources directly, or to grant them to groups who will reciprocate with political support and contributions.

Becker (1983) further notes that resource-related subsidies can be used by governments as a politically easy way to redistribute income. This is because the efficiency losses are small, they are usually far from the electorate and difficult to quantify, and the losses will only be incurred by future generations or by the poor.[63] A second example concerns export taxes. It has been argued in this report that restricting exports of a primary resource encourages downstream processing by providing, in effect, an input subsidy to processors. Since they redistribute rents from upstream to downstream producers, they are likely to be opposed by the former, and supported by the latter.[64] The use of export taxes on natural resources might therefore reflect a relatively higher weight of producers in downstream industries relative to natural resource producers in the political economy competition.[65]

A third example concerns the effects of "Dutch disease". The appreciation of the real exchange rate associated with it is likely to induce protectionist lobbying pressures by the lagging sector. Hillman's classical contribution (Hillman, 1982) shows that, although declining industries will inexorably decline even when they benefit from politically motivated protection, the government can slow down their rate of decline by offering more generous protection. This provides a rationale for lobbying in favour of more protection by declining industries. Freund and Ozden (2008) further show that, irrespective of the extent of lobbying, there will be a deviation from free trade that tends to favour loss-making industries. It has been documented that in South America and sub-Saharan Africa it was quite common for mineral rents to be used for the protection of the non-boom tradable (NBT) sectors through subsidies and protectionist strategies.[66] However, the inadequate performance of the weakened NBT sectors during post-boom downswings required levels of subsidy from the mining tradable sectors that were unsustainable. As shown by Freund and Ozden (2008), protection following a downswing is likely to be persistent.[67]

Sachs and Warner (1995) provide an empirical test for the hypothesis that high resource wealth is negatively correlated with lack of openness to trade as a consequence of governments trying to address the Dutch disease effects of resource abundance. They postulate a U-shaped relation between openness and resource intensity. In their logic, Dutch disease effects provoke a protectionist response, but only in countries with intermediate levels of resource intensity. For the most highly resource-endowed economies, however, the natural resources base is so vast that there is no strong pressure to develop an extensive industrial sector. Therefore, openness to trade would tend to be high. The overall effect would therefore be a U-shaped relationship between openness and resource abundance.[68] They find empirical evidence in favour of this prediction. In particular, almost all countries in the sample are in the downward-sloping segment of the relationship: higher primary exports tend to promote economic closure. Extremely resource-rich countries, such as Saudi Arabia and Malaysia, are in the upward-sloping part on the relationship, with a long tradition of open trade.

(b) Corruption, trade opening and resource utilization

The influence of special interest groups on policies that affect resource utilization raises two questions: is corruption associated with higher resource utilization? [69] And are the effects of trade policies on resource utilization dependent on corruption?

The answer to the first question is unambiguously positive. A number of studies in environmental economics consistently find that corruption is closely associated with environmental degradation. In a theoretical framework where the government uses a Pigouvian tax as a policy instrument to take account of pollution caused by resource utilization (i.e. pollution tax), Damania et al. (2003) show that an increase in corruption implies that the government places a greater relative weight on bribes, and thus on firm profits. The pollution tax consequently falls as corruption increases, deviating from the welfare-maximizing tax rate. Similarly, Lopez and Mitra (2000) investigate the impact of corruption on the empirical relationship between income and pollution – the Environmental Kuznets Curve (EKC). They show that corruption increases the income level at which the EKC begins to decline. The positive correlation between corruption and environmental degradation can easily be recast in terms of a positive correlation between corruption and resource extraction.[70]

Barbier et al. (2005) show that the rate of utilization of a renewable resource (in their model, the conversion of forest into agricultural land) increases with corruption (or intensified lobbying pressure). In their theoretical model, the rate of utilization is determined by the interaction between a government issuing extraction quotas, and resource-using firms seeking to influence the government's decisions through political

contributions.[71] An increase in corruption implies that the government places a greater weight on bribes, relative to social welfare, issuing more conversion quotas. This creates a positive correlation between utilization and corruption. Their empirical analysis on a sample of tropical countries[72] confirms this prediction.

Turning to the second question, the effect of trade opening on resource utilization is ambiguous, even in the presence of high corruption. Consider first the case in which there is no corruption. As shown by Barbier et al. (2005), greater dependency on resource exports (which may be caused by trade opening) is not necessarily linked to a higher cumulative level of resource use. Since greater exports are accompanied by higher levels of imports (to keep trade balanced), this lowers the demand for domestically produced output and land conversion pressures are thus reduced. The impact is therefore ambiguous.[73]

Barbier et al. (2005) further consider the effect of changes in terms of trade, defined as the ratio of export to import prices, on the conversion of forest into agricultural land. They find that a rise in the terms of trade of a country has a direct and negative impact on agricultural land expansion. The policy implication is that the imposition of policies that reduce the terms of trade of countries' economies could lead to more, rather than less, cumulative agricultural land expansion. Moreover, any reduction in terms of trade may deprive countries of the foreign exchange earnings that could be employed to diversify their economy, moving away from a path of dependence on resource-based exports.

Consider now the case in which there is corruption. The results of Damania et al. (2003) suggest that the effect of trade opening on resource utilization will vary not only according to the degree of corruption (low or high), but also according to the nature of trade policy in place before liberalization (protective or anti-protective).[74] The effects are summarized in Table 15.

The pollution tax (or similarly a conservation policy) increases with trade opening when the initial conditions are protective trade policy (import tariff or export subsidy) and high corruption – or when the initial conditions are anti-protective trade policy (import subsidy or export tax) and low corruption. Consider the case of protective trade policy and high corruption. Liberalization reduces output of the protected sector. This reduces bribes offered and leads to a higher pollution tax, or lower level of resource utilization. On the other hand, the welfare motive for increasing the pollution tax is weaker, causing a reduction in the tax (decrease in resource conservation). Since corruption is high, the first effect dominates, leading to an increase in pollution tax (increase in conservation).[75] The other case in which the pollution tax (or conservation of a natural resource) increases with trade opening is when trade policy is anti-protective and corruption is low. Intuitively, liberalization increases output of the protected sector (which creates more bribes and leads to a lower pollution tax, or higher level of resource utilization) and induces the government to increase the pollution tax (increase resource conservation) to improve welfare. Since corruption is low, this second channel dominates, leading to an increase in pollution tax (increase in conservation).[76]

It is interesting in this context to analyse possible feedbacks between trade openness and corruption. Rodrik et al. (2004) show that trade integration has a positive effect on institutional quality.[77] A number of studies further show that a strong rule of law reduces corruption. Damania et al. (2004), for instance, find that a strong rule of law, as defined by Rodrik et al. (2004),[78] is associated with a low level of corruption.[79] These results together imply that more trade reduces corruption. Since, as argued above, the rate of resource utilization increases with corruption, it can be argued that trade can have an indirect, beneficial effect on the management and conservation of natural resources via its effect on corruption.[80]

(c) Trade sanctions and exploitation of renewable resources

Some renewable resources such as tropical forests may confer significant cross-border external benefits, through their role as stores of carbon, genetic material, habitat for endangered species, etc. This has prompted calls for the use of various trade-based policies, so-called "trade sanctions", to coerce nations to reduce the level of resource exploitation. The literature on this, however, has shown that trade sanctions are not appropriate to cover the complexity of long-run ecological effects. The sanctions make harvesting less profitable in the short run, but in the long run specific management policies are necessary.[81]

Moreover, it has been shown that trade sanctions can have perverse effects if resource exploitation in the exporting country is determined in a political economy setting. Using a model where the government issues licences defining the maximum allowable harvest – while an industry group lobbies the government for greater access to the resource by offering political contributions – Damania (2000) shows that trade sanctions may lead to lower stocks of the renewable resource in equilibrium. When sanctions are imposed, the profits from harvesting decline and political contributions fall. A government that values political donations sufficiently will adopt policies to mitigate the decline in profits and contributions. It does this by increasing the harvest rate. Thus, resource stocks decline in response to trade sanctions.

Table 15: **Effect of trade liberalization on pollution taxes** (rate of conservation)

		Corruption	
		High	Low
Trade policy	Protective	Increases	Decreases
	Anti-protective	Decreases	Increases

In the light of this result, Damania and Barbier (2001) and Barbier and Rauscher (1994) argue in favour of international transfers[82] as the first-best management tool of a natural resource whose depletion creates cross-border externalities. In particular, if for low levels of the resource stock, the increase in transfers is high enough, transfers will always induce the government to increase equilibrium stocks. The profits from harvesting and the political contributions paid to the government are high when the resource stock is low. In this situation, a high rate of increase in transfers can reduce the influence of the lobbyist on policy decisions and induce resource conservation. Damania and Barbier (2001) further argue that if resource exploitation creates significant cross-border externalities, such transfers may be viewed as a means of internalizing externalities and promoting more efficient resource usage.

These insights qualify the result highlighted in Section D.4 that a tariff by the importing country favours conservation of renewable resources.[83]

6. National resource abundance and regional integration

This section takes a closer look at the issue of regional integration in the context of natural resources trade. It first reviews the concept of regional integration, discussing its nuances and stages of progression. Subsequently, it analyses issues that may provide incentives or disincentives for regional integration agreements. These issues, which assume salience in the context of natural resource abundance, relate to both economic efficiency and political economy. They range from standard issues of trade creation, trade diversion and asymmetric shocks to the relatively unconventional issues of export diversification and remote locations. Finally, this section analyses the potential impact of regional integration on the sustainable management of natural resources.

(a) Regional integration

In general, regional integration refers to a process by which countries enter into an agreement to enhance regional cooperation. The motivation can be economic or political, and the degree of integration can vary significantly. The most basic approaches involve framework agreements, which outline principles for dialogue on trade and related issues, usually between two countries.[84] More formal economic integration can be classified into four stages (Machlup, 1977). First, there are free or preferential trade agreements (FTAs/PTAs) whereby member countries eliminate tariffs and quotas on almost all goods and services traded between them. Customs unions augment FTAs by incorporating a common external tariff for member countries vis-à-vis the rest of the world. Third, a common market extends customs unions to include free movement of factors of production (capital and labour) and common policies on product regulation. Fourth, there are economic and monetary unions which consist of a common currency.

Furthermore, the literature classifies regional integration schemes as either "shallow" or "deep" (Lawrence,1996; Hoekman, 1998). The former involves the removal of barriers to trade in goods, i.e. forming a free-trade area or a customs union. The latter moves beyond this form of simple economic integration. It entails the removal of internal barriers that distort the allocation of international production within the region – e.g. fair treatment of foreign direct investment (FDI) and the protection of intellectual property. The minimum requirement of any "deep integration" agreement is the provision of national treatment to business activities of other trading partners (i.e. the principle of giving others the same treatment as one's own nationals).

Usually, however, "deep integration" requires countries to harmonize a variety of policies (fiscal and industrial) and adopt common standards in many fields (e.g. labour and health). For example, the Canada-US Free Trade Agreement (FTA) included both national treatment as well as restrictions on expropriation and a move towards harmonizing corporate income taxes (United Nations Conference on Trade and Development (UNCTAD), 1992). Similarly, India and Singapore have a Comprehensive Economic Cooperation Agreement, which includes an FTA in goods and services, a bilateral agreement on investment promotion and protection, an agreement on double taxation avoidance and a more liberal air services agreement (Narayan, 2005).

(b) Resource abundance and its implications

To understand the incentives for a resource-abundant country to enter into a regional integration agreement, issues of trade creation and trade diversion, potential responses to asymmetric shocks, diversification of production and export structures, and the importance of a remote location are analysed.

(i) Trade creation and trade diversion

A central exception to the MFN principle of equal treatment of all members in the GATT/WTO is for customs unions and free trade areas. There are two arguments that explain the rationale behind this exception. First, such agreements can contribute to the growth of world trade. Second, regional trade liberalization, enabled by these preferential agreements, can serve as a building block to further liberalization at the multilateral level. (Viner, 1950) introduced the concepts of trade creation and trade diversion in the economic analysis of preferential trade agreements. With a focus on the production effects, he defined trade creation as the displacement of domestic production by lower-cost imports from more efficient producers in other member countries. In contrast, he defined trade diversion as the shift in the flow of imports from a more cost-efficient non-member to a higher-cost member.[85]

For trade in natural resources, the issue of trade creation and trade diversion is somewhat different, even unique. This is because, relative to manufactured goods,

tariff and non-tariff barriers on natural resource commodities such as oil, natural gas, metals and minerals tend to be low (Carbaugh, 2007).[86] Hence, an analysis of potential trade creation and trade diversion effects when two resource-abundant countries enter into a preferential trade agreement will be a function of the extent of specialization – whether both have complete specialization in the production and export of resource-intensive goods (Case I), or whether the relatively resource-poor country has a small, developing manufacturing sector as well (Case II).

Case I

Consider that both member states of a regional trade agreement are natural resource abundant with complete specialization in the production and export of resource-intensive goods. First, if the two countries are abundant in different natural resources, tariffs imposed on these resource commodities within the free trade area are unlikely to constitute a major barrier to trade within this area (Fouquin et al., 2006). For instance, in a study on resource-abundant countries in Central Asia, Venables (2009) shows that tariff barriers to intra-regional trade are low. Hence, trade creation effects for resource-abundant countries are likely to be small.

Second, if the two resource-abundant countries are abundant in the same natural resource, they will have few incentives to trade with each other, with or without tariffs, as there is very little product differentiation in the same resource commodity. Hence, once again, trade creation effects are likely to be negligible. This is especially true of south-south trade as partners do not appear to be major export markets for natural resources (Fouquin et al., 2006). However, there are exceptions. Take the case of Indonesia and Singapore, where the former exports crude oil to the latter which has a thriving refining industry (Fouquin et al., 2006). Importantly, following the arguments presented above, trade diversion effects are also unlikely to be significant.

Case II

Consider that both member states of a regional trade agreement are natural resource abundant, where one has complete specialization in the production and export of resource-intensive goods and the other has a small, developing manufacturing sector. There is commodity dominance in the entire region and a policy of import substitution vis-à-vis the rest of the world. In this situation, the resource-abundant country with a non-existent manufacturing sector will enjoy no trade creation effects but will suffer notable trade diversion effects as imports from more efficient, low-cost producers in non-member states are replaced by those from a member state. On the other hand, the member country with a small manufacturing sector in its nascent stages will benefit from privileged access to markets inside the FTA, while continuing as commodity exporter to the rest of the world. This was precisely the situation which prevailed in Latin America in the 1970s and 1980s (Fouquin et al., 2006).

(ii) Asymmetric shocks

Countries in a regional integration agreement may suffer from "asymmetric shocks", including demand shocks, arising from disparate growth rates, or supply shocks, induced by sector-specific factors where the importance of different sectors may vary across resource-abundant and resource-scarce countries. Hence, the success of any regional integration agreement will depend on the mechanisms that exist to address these potential stresses. Unlike other factors of production, natural resources are immobile. Hence, an uneven allocation of resources across a group of countries may defy the tendency towards the law of one price, and aggravate the impact of commodity price shocks in integration agreements (Fouquin et al., 2006). For instance, resource-rich and resource-poor countries would be exporters and importers of the same resource commodity, crude oil for example. A price hike would involve the latter bearing a huge cost, and the former reaping a huge gain.

In fact, the two oil price shocks of the 1970s led to the collapse of many south-south regional integration schemes, as it widened the differences between net oil importers and net oil exporters. Commodity importers decided to focus on extra-regional trade agreements and commodity exporters abandoned domestic reforms after the windfall gains, thereby creating volatility in these regional integration schemes (Fouquin et al., 2006). A possible solution to such asymmetric shocks may be deep regional integration, which requires some burden sharing. However, resource-rich commodity exporters may be reluctant to share resource revenue owing to political economy constraints. Hence, resource-abundant countries tend to participate in shallow integration schemes, such as free trade agreements (FTAs), and avoid deeper integration schemes whose common policies might require resource revenue sharing (Fouquin et al., 2006).

(iii) Diversification of production and export structure

Resource-abundant countries have neither been driving forces for establishing regional integration schemes nor facilitators of deeper integration once they are part of such schemes. Integration into world markets has been faster for countries producing and exporting manufactured goods (Fouquin et al. 2006). This may be attributable, in part, to the natural resource curse hypothesis described earlier and the consequent desire of resource-rich countries to diversify into the production and export of manufactured goods. For instance, poorer resource-rich countries may want to develop a domestic industrial sector as they are commonly exposed to "Dutch disease" shocks. This provides a disincentive for these countries to join regional integration agreements, as trade creation would imply that goods produced by less efficient domestic firms in the industrial sector would be replaced by cheaper imports from partner countries.

In addition, to help develop their domestic commodity processing industries, resource-abundant countries may often restrict natural resource exports. There is evidence of such restrictions when resource-abundant countries are part of regional integration schemes, ostensibly justified on environmental grounds (i.e. to reduce the over-exploitation of natural resources) (Fouquin et al., 2006).

On the other hand, regional integration may actually help resource-abundant countries to diversify their export basket and break into the chain of global manufacturing production. This may be the case when natural resource endowments are concentrated in a region, but unevenly distributed between countries within this region. Africa, whose abundant resources are dispersed over several small countries, is an example of this situation, which has potential implications for economic efficiency. This is because the impact of resource revenues is likely to be subject to diminishing returns. Hence, while a country may have sufficient foreign exchange for vital imports, it may be constrained by other inputs such as labour, thereby implying that it will be unable to diversify into manufacturing production and achieve economies of scale.

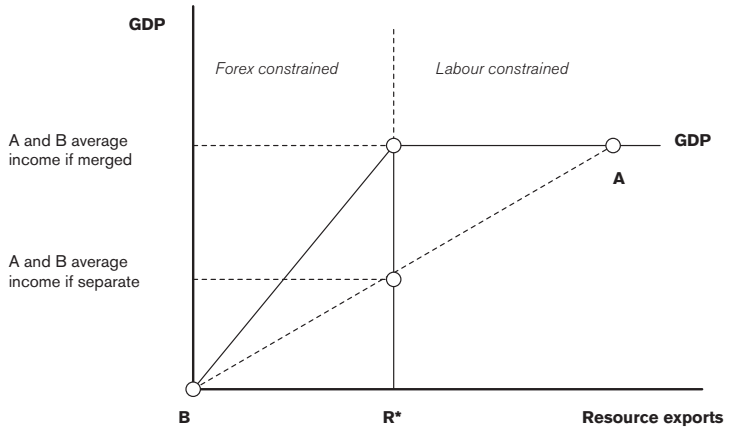
Consider the following model constructed by Collier and Venables (2008). Both countries consume and produce a single non-tradable good, which uses foreign exchange (to import oil or equipment) and domestic labour in fixed proportions. Moreover, the supply of labour is fixed and resource revenues are the only source of foreign exchange. In figure 36, if resource exports are less than threshold level R^*, then production is foreign exchange constrained, and real income is given by the upwards sloping section of the line (with slope equal to the foreign exchange content per unit GDP). If natural resource earnings are greater than the same threshold level R^*, then the economy is labour constrained, implying that further resource earnings beyond this point are simply accumulated as foreign assets. This reflects the fact that the resource-abundant country encounters diminishing returns in its ability to use resource revenues as it reaches full employment, i.e. no more labour is available to produce further income. Importantly, this argument may extend beyond labour to a range of inelastically supplied non-tradable goods and services. For example, a resource boom often leads to inflation in the construction sector as supply bottlenecks are encountered.

For analytical simplicity, assume that one economy has no resource revenue, i.e. at point B, and the other has resource revenue and is at point A. Their average income is the midpoint between A and B. It can be seen that integration of the two economies would increase overall income substantially, thereby implying that there will be large efficiency gains. This extreme case suggests that all the gains from trade accrue to the resource-scarce country. However, in general, regional integration will result in gains for both countries. The resource-poor country can increase its foreign exchange earnings to import inputs and capital equipment by gaining duty-free access to the market of its resource-rich partner country. On the other hand, the resource-rich country can import labour or goods that were previously supply constrained, thereby inhibiting economies of scale and successful diversification into manufacturing production.

While regional integration can enable resource-rich economies, specializing in the production and export of primary commodities, to diversify and become successful exporters of manufactured goods, any such successful diversification may depend on the kind of natural resources which are abundant in that country. For instance, in an empirical study of 73 countries from 1962 to 2000, Fuentes and Alvarez (2006) show that mineral-abundant countries are unlikely to ever become net exporters of relatively capital-intensive goods. This is because of the combination of capital scarcity, mineral abundance and high world prices for primary mineral commodities.

Most mineral-abundant countries are characterized by a relatively low capital-labour ratio and a capital-intensive mining sector. Given this situation, a relatively high price

Figure 36: **Overall income gain from regional integration**



Source: Collier and Venables (2008)

for the mining good implies that it is always produced, thereby taking up the extra capital accumulated by these countries. Hence, even if regional integration enables a mineral-abundant country to consistently accumulate capital, increasing its capital-labour ratio, it is unable to diversify successfully into the production and export of manufactured goods. As an exception to the norm, Fuentes and Alvarez (2006) reveal that after capital accumulation, a few mineral-abundant countries do gain comparative advantage in machinery and chemicals. Similarly, Nina and Andersen (2005) examine the case of Bolivia, a mineral-abundant country, and analyse the impact of its integration with MERCOSUR on its export pattern. They show that while regional integration has stimulated a diversion of trade away from the traditional US and EU markets towards MERCOSUR countries, the composition of exports has only moderately diversified.

(iv) Remote location and uneven distribution of natural resources in a region

Remote, landlocked countries have few opportunities for integration with the world economy due to high costs of trade. Critically short of the foreign exchange needed to finance essential imports, they have little chance of economic development via exports of manufactured goods. Yet, in many regions of the world, these countries have resource-rich neighbours that can be potential export markets. Given a comparative advantage in producing and exporting resource-intensive goods, these resource-rich countries may be concerned about the "resource curse" but may face difficulties in diversifying their production and export structure because of a shortage of labour or other goods and services. Greater integration with their relatively resource-poor neighbours may help relax these constraints. So while remoteness and resource dependence make it difficult to export non-resource based goods outside a region, there are potential opportunities for a mutually beneficial integration within a region – e.g. in Central Asia and the Great Lakes Region in Africa (see Box 23).

Venables (2009) presents a highly stylized model to investigate the issue. Consider two countries, "A" and "B", each endowed with a fixed supply of natural resources and a fixed quantity of labour. Moreover, assume that these natural resources are the only exports to the rest of the world (outside the region). Furthermore, assume that the value of these natural resource exports

Box 23: The case of Central Asia and the Great Lakes Region in Africa

Regional integration in Asia is usually focused on the development of global production networks through exports of manufactured goods. However, unlike East and South Asia, there is a group of countries in Central Asia with somewhat different characteristics. They are landlocked and, in some cases, rich in natural resources. At the same time, this region is seeking to develop regional integration agreements as well. Countries in the region are members of the Commonwealth of Independent States (CIS) Free Trade Agreement; Kazakhstan, the Kyrgyz Republic, Tajikistan and Uzbekistan are also members of the Eurasian Economic Community.

The integration process is being driven forward by the Central Asian Regional Economic Cooperation (CAREC), which seeks to promote cross-border activities – particularly in the areas of transport, trade policy and trade facilitation, and in energy. It currently has eight members: Afghanistan, Azerbaijan, China, Kazakhstan, the Kyrgyz Republic, Mongolia, Tajikistan and Uzbekistan.

The remoteness of the Central Asian region can be calculated in various ways. The World Bank's "Doing Business" database ranks six CAREC members in the bottom 10 of 181 countries for its measure of transport costs (World Bank, 2004). Remoteness can also be assessed by calculating measures of market access from trade data and gravity modelling. For example, Mayer (2008) reveals that, in a ranking of 196 countries, six countries in the region rank among the lowest, with their market potential being six times less than Malaysia's or the Republic of Korea's, and 90 times less than Belgium's, the top-ranked country.

Another way of seeing the impact of remoteness is to look at relative prices of commodities within the region. Evidence indicates the extremely high prices of tradable goods, such as machinery and equipment, clothing and footwear, transport and communications relative to non-traded goods – in particular, services such as education, health and utilities (World Bank, 2008). Similarly, resource abundance in the region, albeit uneven across its constituent countries, is also apparent. For Azerbaijan and Kazakhstan, hydro-carbon and minerals account for more than 50 per cent of exports, while oil and gas account for more than 25 per cent of fiscal revenue. Moreover, these countries have had major resource booms and their exports nearly quadrupled in value between 1999 and 2004. In contrast, Afghanistan, Tajikistan and Uzbekistan have much lower levels of natural resources wealth, and the exports of the Kyrgyz Republic, Tajikistan and Uzbekistan increased by less than 50 per cent from 1999 to 2004 (Venables, 2009).

The East and Central regions of Africa, together known as the Region of the Great Lakes, is another area which combines remote, landlocked countries with natural resource-abundant countries. For instance, in this region, Burundi, Rwanda and Uganda are landlocked while the Democratic Republic of the Congo is resource rich (Collier and Goderis, 2008). Current initiatives for regional integration in the region include the Common Market for Eastern and Southern Africa. In addition, there are proposals for deeper integration in the East African Community.

is the only difference between the two countries, i.e. it is the only source of comparative advantage. In particular, assume 'A' has more of these exports than 'B', thereby implying that the former is resource rich while the latter is relatively resource poor. In addition, both countries produce and consume from a continuum of sectors that use imported inputs and labour to produce non-resource (manufactured) goods. Each of these goods can be produced domestically, imported from the rest of the world, and may also be traded intra-regionally.

Given that country "A" has a comparative advantage in natural resource exports, the resource-poor country "B" will have a comparative advantage in producing the non-resource (manufactured) goods, i.e. "B" can produce those goods at a relatively lower price. This implies that the resource-poor country, "B", will import from the rest of the world but not from country "A", while the resource-rich country, "A", will import from "B" and the rest of the world. The need to distinguish between "globally traded" and "regionally traded" goods, where the distinction is set by real trade costs, and barriers to trade, is important for two reasons. First, the changing sets of goods produced domestically, imported from the region, or imported from the rest of the world are indicative of the trade-creating and trade-diverting effects of regional integration. Second, although the countries are price-takers in world markets, regional integration may change the price of regionally traded goods, thereby affecting the distribution of real income between them.

Using this stylized model, Venables (2009) shows that regional integration brings large overall efficiency gains for these remote, landlocked countries. However, it turns out that the gains from integration are unevenly distributed, as integration with a resource-rich economy is extremely valuable for the resource-poor country but not vice-versa. Remote and landlocked developing countries have very limited export potential with the rest of the world, but need foreign exchange to purchase inputs for production as well as consumption goods. Regional integration implies a reduction in tariffs on imports from country "B" in country "A". This enables country "B" to earn foreign exchange via their exports to the resource-rich partner country "A". Furthermore, this extra foreign exchange accruing to country "B" raises income, thereby bidding up the prices of these regionally traded goods, increasing wages and creating a terms-of-trade gain for the resource-poor country.

On the other hand, resource-rich economies lose (or at best experience very modest gains) from regional integration. First, a terms-of-trade gain for the resource-poor country is necessarily a terms-of-trade loss for the resource-rich economy. In addition, regional integration results in an increase in the share of imports coming from the partner country, "B", which from the viewpoint of country "A", is largely trade diversion, i.e. goods that were being imported from more efficient producers in the rest of the world are now imported from the partner. In contrast, multilateral trade liberalization will be beneficial for the remote resource-rich country as lower tariffs on more cost-efficient imports from non-member countries will entail trade creation, but no trade diversion.

Moreover, external trade liberalization implies a reduction in tariffs on imports from the rest of the world. Since intra-regional trade takes the form of exports of manufactured goods from the resource-poor "B" to the resource-rich "A", this reduction in the price of imports from the rest of the world is a terms-of-trade gain for the resource-rich economy, "A". Hence, while trade is a way for the resource-rich economy to relax the constraint causing diminishing returns in the use of its resource revenues, these gains come from non-preferential opening.

The analysis points to the potential for conflicting interests between resource-poor countries seeking preferential regional integration, and resource-rich countries seeking non-preferential trade opening. The way to overcome this obstacle is to look for other policy measures that can accompany a non-preferential opening. One possibility is the use of resource wealth to develop regional infrastructure. This helps maintain the competitive position of the resource-poor country while external liberalization takes place. Other ways of spreading the benefits of unevenly distributed resource wealth include labour mobility and monetary policy measures.

In sum, there appears to be a two-way relationship between natural resources and regional integration. Regional integration affects the potential development of resource-rich countries differently, relative to resource-poor countries (producing manufactured goods), in terms of economic efficiency, welfare and political economy. However, this effect is often contingent upon the location of the countries concerned and the kind of natural resource in which they are abundant. Hence, relative resource abundance in these different contexts, in turn, may shape the incentives for countries to engage in regional integration.

(c) Sustainable management of natural resources

(i) Regional and bilateral free trade agreements

Concerns about over-exploitation of natural resources and any other potential negative impact that trade may have on the environment are addressed in many regional and bilateral free trade agreements – whether in the preamble, in detailed chapters, in relevant provisions (such as government procurement or dispute settlement), or in accompanying environmental cooperation agreements (Robalino and Herrera, 2009). For example, the Association of Southeast Asian Nations (ASEAN) contains an agreement on trans-boundary haze pollution, which serves to improve monitoring and reporting, promote green technologies and establish a network of protected areas (Organization for Economic Co-operation and Development (OECD), 2008).

The North American Free Trade Agreement (NAFTA) recommends appropriate limits for specific pollutants, the promotion of pollution prevention techniques and a conservation of biodiversity programme that focuses on

shared and critical habitats, wildlife corridors and migratory and trans-border species (primarily birds and marine animals). An FTA between Canada and Colombia spells out that specific multilateral environmental agreements (MEAs), such as the Montreal Protocol for ozone layer depletion, will prevail in the event of an inconsistency between FTA and MEA obligations (Organization for Economic Co-operation and Development (OECD), 2009a).

Article 108 of an FTA between Chile and China includes a Memorandum of Understanding to promote cooperation in the field of environmental protection, on the basis of equality and mutual benefit. Similarly, Chapter 18 of the US-Colombia trade agreement outlines the importance of optimal use of natural resources in accordance with the objective of sustainable development (Organization for Economic Co-operation and Development (OECD), 2008). There are several other examples of bilateral free trade agreements that include relevant provisions or are accompanied by bilateral environmental cooperation agreements, where cooperation includes management of the water environment, pollution control and monitoring, and biodiversity conservation. These include three recent free trade agreements involving Canada (Canada-Colombia, Canada-Jordan, Canada-Peru) and the New Zealand-China agreement (Organization for Economic Co-operation and Development (OECD), 2009a).

(ii) Deep integration: the case of fisheries

Fisheries are an open access natural resource, i.e. much like public goods, it is difficult to exclude people from accessing the resource. At the same time, unlike public goods, fisheries are characterized by rivalry in consumption. Given the above, rapid growth in the demand for fish and fish products, accompanied by new fishing techniques and commercial structures, has led to over-exploitation of fish stocks in international waters. Over-fishing has also placed broader ecosystems, of which fish are an integral part, under threat (European Commission, 2009b).

Territories for fishing in international waters are defined by "exclusive economic zones" (EEZs) of 200 miles (see also Section E) (Asche and Smith, 2009). This was the result of a gradual process which was consolidated in the UN Convention on the Law of the Sea (UNCLOS) in 1982. As a result, most fisheries fall within the jurisdiction of individual nations, thereby giving them legal authority to bring an end to open access problems by excluding fishing vessels and by managing fishery resources for their economic benefit.

Given these developments, over-fishing typically falls under two categories: poorly managed fisheries that lie within EEZs (Worm et al., 2009); and open access problems for fisheries that remain outside a single EEZ. Regional integration is likely to affect the latter areas which consist of shared stocks (where fishing can take place within the jurisdiction of two or more countries), straddling stocks (where fish stock also moves into international waters) and highly migratory species (where fish stock is primarily in international waters) (Asche and Smith, 2009).

For shared stocks, the countries involved in most cases are likely to find a cooperative solution by sharing the quota, although side payments may often be made to obtain higher quotas. For straddling and highly migratory stocks, such as tuna, however, agreement is much more difficult to reach, as no single country can prevent over-fishing and enforce a management plan (Asche and Smith, 2009). A cooperative outcome may be facilitated by "regional fisheries management organisations" (RFMOs)[87] which were created under the 1995 United Nations Fish Stocks Agreement. These bodies consist of coastal states and relevant distant-water fishing nations. However, their effectiveness so far is questionable, partly because non-members to the RMFO can still fish freely; and partly because there are no enforcement mechanisms even among members (Bjorndal, 2009).

Some form of deep regional integration may provide an alternative solution to the over-fishing problem. Regional integration may also play an important role in the conservation of marine biodiversity, the benefits of which will accrue to both member and non-member states.

The Common Fisheries Policy (CFP) of the European Commission/European Union is one example of a potentially effective regional approach to these issues (see Box 24) (European Commission, 2009b). The CFP

Box 24: The European Union's Common Fisheries Policy

The Common Fisheries Policy (CFP) was formally created in 1983, but its origins go back to the early 1970s when fisheries were a part of the Common Agricultural Policy. In the early days, the main concern was to avoid conflict at a time when many countries around the world were extending their territorial waters, until they created exclusive economic zones (EEZs), which define territories for fishing in international waters. To avoid the disruption this new regime could have caused, EU member states agreed to grant free mutual access to each other's waters, thereby enabling the preservation of each nation's traditional fishing grounds and practices.

Hence, the CFP started out as an attempt to preserve the diversity which characterized the traditional fabric of the European fishing industry. Over the last decade, Europe, as well as the rest of the world, have seen alarming declines in fish stocks. Hence, sustainable fisheries are now firmly at the top of the international fisheries agenda, with annual EU regulations setting total allowable catches (TACs) and quotas for the most important commercial species of fish. In a recent green paper, while observing that the CFP has not worked well enough to prevent problems of over-fishing and declining catches, the European Commission (2009a) has proposed major reforms.

provides a comprehensive system of rules for the protection and preservation of vulnerable fish stock. While it is the responsibility of national inspectorates to monitor what quantity of fish is caught, inspectors of the European Commission monitor the effectiveness of national inspection systems and ensure that CFP rules are enforced effectively across the whole of the EU. In fact, the EU has played a leading role in pioneering new technologies, such as satellite vessel monitoring systems (VMS), which have made control and monitoring more efficient.[88] The EU also processes catch data reported by the member states and publishes regular reports. In addition, the CFP has the authority to close fisheries when a quota is exhausted. Finally, if a member state is gravely endangering the sustainable management of resources by not implementing rules agreed at EU level, the Commission can bring proceedings against them before the European Court of Justice.

Other natural resources such as water, forestry, fuels, minerals and metals are also characterized by similar problems of overuse and cross-border externalities. As with fisheries, the sustainable management of these resources is often facilitated by regional agreements, which may or may not be a part of trade agreements signed by the same parties. Section E provides an overview of such agreements, by resource sector.

7. Conclusions

The set of trade policy instruments commonly applied to the natural resources sector include export taxes, quotas and prohibitions; import tariffs; non-tariff measures; and subsidies. There appears to be a higher incidence of export taxes and restrictions on natural resources than on other sectors. Tariff protection in the natural resources sector is generally lower than for overall merchandise trade, with the possible exception of fisheries. There is some evidence of tariff escalation in some natural resources, namely forestry and mining. Subsidies to fisheries are widespread, provided by both developed and developing countries, and represent a hefty proportion of the value of the total catch. The available information on consumption taxes on fuels shows that they are high and dwarf the size of import tariffs.

For natural resource exporters, export taxes or restrictions can serve several purposes. They can increase the rents received by the exporting country through an improvement in its terms of trade. This is strictly a beggar-thy-neighbour effect, as the welfare of the exporter rises at the expense of a welfare loss of its trading partners. Where resource-exporting countries face problems of open access, they can also help to address the over-exploitation of the resource. They can assist countries facing volatile commodity markets to stabilize producer revenues. For countries concerned about over-dependence on the export of a few natural resources, export taxes or restrictions can assist export diversification by encouraging downstream processing activities. Finally, they can form part of a response by natural resource exporters to tariff escalation in their trade partners' markets.

For resource-importing countries, import tariffs can help "capture" some of the rents earned by exporters with market power (the beggar-thy-neighbour effect). When property rights with respect to resource harvesting are not well enforced, trade opening might have a negative impact on resource conservation. A tariff imposed by the resource-importing country will reduce foreign demand for the resource and so mitigate, to some extent, problems of over-harvesting and help to conserve the resource stock. Faced with "Dutch disease", industries that have been adversely affected by a boom in the natural resources sector can be partly sheltered by being given some degree of import protection through tariffs.

For countries facing increasing scarcities of energy resources, subsidies can help to correct sub-optimal levels of exploration arising from the inherent uncertainty and risk surrounding that activity and the large sunk costs involved. Governments can also direct subsidies towards management and conservation programmes aimed at sustaining natural resources.

The availability of large rents and the prevalence of rent-seeking behaviour in natural resource sectors can have a corrosive effect on the institutional framework. This means that policy choices purportedly aimed at improving specific outcomes – such as reducing over-exploitation or helping to conserve natural resources – may end up favouring vested interests.

In examining whether governments should choose trade policies or domestic measures (production restrictions, consumption taxes, etc.) to address natural resource problems, two broad conclusions emerge. First, trade measures are often a second-best policy to address problems associated with natural resources, as in the case of open access and environmental externalities linked with consumption or production of natural resources. The first-best policies are domestic measures – strengthened property rights or pollution taxes – that address the distortions at the source. Second, given the geographical concentration of natural resources, domestic measures are close substitutes for trade measures. Thus, production restrictions have the same effect as export restrictions and consumption taxes have the same effect as import tariffs. This suggests that governments have greater leeway to affect natural resources trade through the use of domestic measures compared with trade in other products.

Finally, the value of regional integration schemes for natural resource-abundant economies appears ambiguous. On the one hand, small trade creation effects, potentially large trade diversion effects and difficulties in addressing asymmetric shocks constitute a set of disincentives for regional integration. On the other hand, potential diversification of production and export structures, and the internalisation of cross-border externalities, provide strong incentives for regional integration.

Endnotes

1 Developed countries include: Australia, Canada, Iceland, Japan, New Zealand, Norway, Switzerland and the United States. The European Union is also included in this category. The group of developing countries also includes Least Developed Countries (LDCs).

2 Determining semi-finished or finished products that are derived from natural resources is not a straightforward process for the obvious reason that all manufactured goods are in a fundamental sense based initially on raw materials. For the purpose of this analysis, four finished products or product groups that in large part are based on the natural resource in its raw state are considered: cork, wood and paper products; wooden furniture; petrochemicals; and non-metallic mineral semi-manufactures and metal semi-manufactures.

3 For a detailed description of these measures, see http://r0.unctad.org/trains_new/tcm.shtm.

4 Annex 3 of the Marrakech Agreement states that: "The first four trading entities so identified (counting the European Communities as one) shall be subject to review every two years". Currently, the first four trading entities are the European Communities, the United States of America, Japan and China. For the other WTO members the procedure is as follows: "the next 16 shall be reviewed every four years. Other Members shall be reviewed every six years, except that a longer period may be fixed for least-developed country Members."

5 Note that export tax on re-exported goods, as well as statistical charge, guarantee fund, stamp duty, re-export tax, income tax, corporation tax, automation fee, exit duty, export development charge and consent fee were not taken into account.

6 The general rule of transparency (Article X of the GATT) applies to both duties and quantitative export restrictions, but there is no explicit obligation of notification pursuant to that article. There is a notification requirement for quantitative resetrictions under the Decision on Notification Procedures for Quantitative Restrictions adopted by the Council for Trade in Goods on 1 December 1995 (G/L/59). No export taxes have been notified under this Decision.

7 See for instance http://www.ifpri.org/sites/default/files/bp013Table01.pdf.

8 The value refers to the net sales in the industry of the acquired firm.

9 Recall that estimates are upper bounds and that the extent of the over-estimation may differ across countries. In addition, note that these data only refer to the coverage of export taxes and not to the degree of restrictiveness of the measure.

10 As discussed in Box 15, these results are based only on the ten countries that have notified quantitative restrictions to the WTO.

11 These articles define the general exceptions to the general elimination of quantitative restrictions. See Section E for a discussion on WTO rules on export restrictions.

12 For detailed information on export restrictions on strategic metals and minerals, see Korinek and Kim (2009).

13 Under the SCM Agreement, a subsidy involves a financial contribution by a government that confers a benefit specific to a firm or industry or group of firms or industries.

14 See OECD (2000).

15 Table 13 presents annual amounts of GFTs to the fisheries sector in 2006. Detailed figures covering 1996 to 2006 are presented in Annex Table 3.

16 Sumaila et al. (2009) find lower levels for capacity-enhancing subsidies in 2003. Including fuel subsidies, this category amounts to US$ 16.2 billion. Other categories of subsidies, such as those devoted to resource management, are of similar magnitude.

17 However, one shortcoming of the model used in these studies is that the monopolist supplier is assumed to be implausibly passive.

18 Note, however, that the overall output path can be tilted towards the present or away from it, when the importing and the exporting countries differ in terms of technologies or demand elasticities (Brander and Djajic, 1983).

19 See Figure 12 for a more detailed description of the equilibrium conditions in this set-up.

20 These types of strategies that depend only on the calendar time and the initial conditions are called "open loop strategies". In a theoretical model, Karp and Newbery (1992) show that it is possible instead to define time-consistent equilibria under Markov-perfect strategies, that is, in each period, each exporter chooses its current supply according to the remaining resource stock while each importer selects the tariff that maximizes instantaneous welfare, taking exporters' decisions (i.e. current aggregate supply) as given.

21 There appears to be no study that looks at the optimal path of export taxes on exhaustible resources. This sub-section therefore relies on the analysis of an export tax in a static framework to provide an understanding of its effects and the motivations behind it. For a discussion on the legal aspects of export taxes, see Section E.

22 It is interesting to note that in the case of non-renewable natural resources, especially oil, this is not an uncommon situation. In fact, many oil-exporting countries have only a minor local demand. In addition, since the marginal cost of extraction is negligible, the oil supply is likely to be price inelastic.

23 This policy may be welfare improving for the exporting country in the natural resources sector. Economic theory shows that in a partial equilibrium setting with perfect competition and constant returns to scale, the optimal export tax is the reciprocal of the elasticity of residual demand facing the exporting country (Dixit and Norman, 1980).

24 For an analysis of the impact of an export tax in a small country, see Gandolfo (1998), for example. In this set-up an export tax is welfare reducing for the country concerned.

25 See Section E.

26 For a detailed description of the economic effects of export taxes and the rationale for their use as a policy instrument in primary commodities in general, see Piermartini (2004).

27 The study defines as heavily dependent on a single commodity a country that presents a ratio of commodity exports to non-commodity GDP of above 10 per cent. In addition, it measures variability as the standard deviation of the de-trended log of commodity exports and commodity GDP.

28 A similar justification for the use of export taxes is used for the case of a large currency depreciation. There is generally strong political support for imposing an export tax at the time of a large currency depreciation. In these circumstances, exporters receive windfall gains and a tax on these gains is regarded as a means to increase government revenue, while responding to a principal of fair redistribution of income. It is worth noting that the large currency depreciation argument for taxation of exports justifies only temporary export taxes and potentially justifies taxation of all exports, including those commodities in respect of which the exporting country possesses no monopoly power.

29 The income multiplier refers to the fact that increased spending (private or public) has an impact on national income greater than the initial amount of spending.

30 See Section C.4.

31 For some evidence on the use of natural resource rents to subsidize the non-booming sector of the economy, see Sarraf and Jiwanji (2001) and Sachs and Warner (1995).

32 The infant industry argument is that new domestic industries may not be able to compete with well-established foreign firms simply because they do not have enough experience. Over time they can learn by doing, reduce their costs and be competitive in the international markets. However, due to the initial absence of expertise, if the government does not intervene (this can take the form of a trade barrier or a subsidy), the industry will never take off.

33 See sub-section D1 and the section on non-fuel commodity prices in the *World Trade Report* 2003 (World Trade Organization (WTO), 2003).

34 The same set-up has been used in Figures 12 and 32. Again, the quantity Q_S is the stock of the resource. Consumption in period 1 is measured along the horizontal axis from the left hand and in period 2 from the right. The vertical axes measure the prices in the two periods and D_1 and D_2 denote the demand curves in period 1 and 2, respectively. Under free trade, the equilibrium is at point E where, at a given price (in present value terms), demand in each period fully exhausts the stock.

35 Despite the extensive use of subsidies in non-renewable natural resources, there appears to be no study that uses a dynamic model to examine optimal subsidies for exhaustible natural resources. Therefore, any analysis of the rationale for and the effects of subsidies has to rely on traditional static models. A one-period model, where the supply curve is rigid and fixed at the level of the proven amount of a certain natural resource reserve, seems to provide a reasonable benchmark framework for the analysis (see Figure 31). However, the inter-temporal effects will depend on the time path of a subsidy.

36 This point can be illustrated by referring back to Box 16. Like an export tax, a consumption subsidy will shift the export supply curve (that is the residual supply net of the domestic demand for the resource) to the left. The new equilibrium will be in X, the world price will increase to P_X both in the foreign and domestic market, but domestic consumers will only pay part of this price, say P_D, where P_D is the world price of the resource net of the subsidy.

37 The incentive to explore will also depend on the certainty of contract conditions between the government and the exploring company as well as the allocation of extraction rights. Problems in this case arise because of the difficulty of governments to make credible commitments, thus creating time inconsistency problems (Collier and Venables, 2009).

38 See Section C.

39 See the discussion in Brander and Taylor (1997).

40 See Brander and Taylor (1998), pages 198-199.

41 This analysis abstracts from the terms-of-trade effect of an increase in the world price of the natural resource good arising from the application of the production tax.

42 Under uncertainty, and in the context of controlling a negative externality, price instruments are preferred if the marginal cost function is close to being linear or there is significant curvature in marginal benefit. Quantitative controls are preferred if the marginal cost function is highly curved and marginal benefit is constant.

43 Note, however, that the recent EU report on its own fisheries policy "Green paper on a reform of the Common Fisheries Policy" suggests developed country management systems often fall short too. See http://eur-lex.europa.eu.

44 Since the focus of this report is on trade in natural resources, instruments such as border tax adjustments or cap and trade systems will not be considered in this sub-section. Mostly, these policy instruments are not directly applied to natural resources *per se* but to final products or economic agents that use natural resources as intermediate inputs. For a description and analysis of these policy measures, see WTO-UNEP (2009).

45 The *ad valorem* Pigouvian carbon tax is defined as the specific Pigouvian carbon tax divided by the producer price for the resource, say oil. The time pattern of a specific tax will depend then on the time path of the *ad valorem* tax relative to the time path of the resource price.

46 Results on the optimal pattern of carbon taxes are also valid for the imposition of an import quota on petroleum (with a cap-and-trade scheme for consumers). Emission quotas are the main scheme for controlling carbon emissions under the Kyoto Protocol and the European Union emissions trading scheme.

47 See Ulph and Ulph (1994), Sinclair (1992), Grimaud and Rougé (2005) and (2008), Acemoglu et al. (2009) and Groth and Schou (2007).

48 See definition of flow and stock externalities in Section C.3.

49 This is true if zero extraction costs of a resource are considered.

50 Data from the Energy Prices and Taxes Report (2009) show that, for the United States, the EU and Japan the taxes on gasoline have increased respectively by 17 per cent, 40 per cent and 15 per cent.

51 See for instance Wirl (1994), Rubio and Escriche (2001), Liski and Tahvonen (2004) and Strand (2008).

52 This is true under the assumption that labour productivity of harvesting is large relative to the resource growth with respect to habitat size.

53 While not discussed here, eco-labels and environmental standards can also be applied in the context of non-renewable resources such as fossil fuels as well as on final products that use natural resources.

54 Voluntary standards set by a non-government entity also exist. An example of these voluntary standards is the ISO14000 on environmental management systems that can be applied to forestry management. For other examples on these standards, see WTO-UNEP (2009).

55 For a further analysis of this, see Nunes and Riyanto (2001).

56 Most voluntary eco-label schemes come from non-government entities. However, sometimes they are endorsed or followed by governments.

57 See definition of eco-labels in WTO-UNEP (2009), p. 120, and Greaker (2002).

58 See, for instance, Kapelianis and Strachan (1996), Pepper (2000), Teisl et al. (2002), Hemmelskamp and Brockmann (1997), Gudmundsson and Wessells (2000).

59 This is true under the assumption that there is perfect information between the government and the two firms. Rege (2000) shows that regulation may also help to reach an efficient solution in situations with a large number of firms where it is difficult for the government to detect cheating firms (firms that produce low quality but pretend to produce high quality). In addition, she shows that also a non-governmental party providing an eco-label scheme may be able to achieve similar environmental quality as governmental regulation.

60 This assumption is purely theoretical. The legal issues regarding the fact that environmental minimum standards could, in practice, be imposed on foreign firms are treated in Section E of this report.

61 In reality, instruments such as eco-labels and environmental standards are not considered by governments as mutually exclusive. For instance, an eco-label could be used to show compliance with a standard or to show if a product is exceeding the requirements set by a certain regulation.

62 The branch of economics studying how interest groups influence policy-making is called political economy. Seminal contributions include Olson (1965), Stigler (1971), Peltzman (1976) and Becker (1983). For applications to the formation of trade policies, see Hillman (1982) and Grossman and Helpman (1994).

63 For a more articulate discussion of Ascher (1999) and Becker (1983), see Deacon and Mueller (2004).

64 This abstracts from terms-of-trade effects, discussed in Box 16 above.

65 This political economy motive for trade policy is independent of the terms-of-trade considerations discussed earlier.

66 Sarraf and Jiwanji (2001). Davis (1994) notices that South Africa's trade policies have long sought to deflect its natural advantage in minerals by subsidizing manufacturing, a fact that might be attributed to the politico-economic consequences of the Dutch disease. See also Roemer (1985) and the related discussion in Section D.3.

67 Van der Ploeg (2006) argues that if the funds are used to stimulate R&D and education directly, this may be less of an issue.

68 It should be noted that Sachs and Warner's postulate is not entirely consistent with what we know about the wealthiest OPEC members. Amuzegar (2001) argues that these countries did have extreme interest in diversifying away from oil. They just had enough financial resources that they could attempt the first-best approach, subsidies and state-led efforts, rather than second-best trade policies. Sachs and Warner's explanation for the upward-sloping part of the U-shaped relation between openness and resource abundance may therefore not be correct, though the underlying statistical relationship is.

69 The weight given to special interest groups by the government may be interpreted as a measure of corruption. Throughout this section, "corruption", "special interest politics" and "political economy considerations" are therefore used interchangeably.

70 As noted in Section C.3, the use of natural resources can generate negative externalities such as environmental damage and habitat destruction, and it can also be treated as an externality itself.

71 This is the so-called "protection for sale" approach of Grossman and Helpman (1994).

72 Panel data analysis of agricultural land expansion over 1960–99 for tropical low and middle-income economies in Latin America, Asia and Africa.

73 The empirical results indicate, however, that increased resource-trade dependency leads to greater agricultural land expansion in a tropical developing economy.

74 Damania et al. (2003) consider the effect of liberalization on the optimal pollution tax. The results can, however, be applied to the rate of utilization of a natural resource. An increase in the optimal pollution tax is interpreted as an increase in the rate of conservation of the resource (reduction in the rate of utilization).

75 In the empirical analysis, Damania et al. (2003) find that there is also a significant interaction effect between corruption and trade liberalization: distorted trade policies increase the effect of corruption. Since corruption increases pollution (rate of resource conversion), this means that corruption and protection are complements in creating lax environmental policies (resource depletion). This is an instance in which protection has adverse effects on the management of natural resources.

76 There are other studies on the effect of trade openness on corruption. The conclusions are not clear-cut. Rauscher (1994) finds that trade openness may have ambiguous effects on lobbying intensity. Fredriksson (1999) finds that in a perfectly competitive sector, trade liberalization reduces (increases) both industry and environmental lobby groups' incentive to influence environmental policy if the country has a comparative disadvantage (advantage) in the polluting sector. In a related study, Bommer and Schulze (1999) argue that environmental policy is tightened by trade liberalization if the export sector is relatively pollution-intensive, but will be relaxed if the import competing sector is pollution-intensive.

77 Trade integration is measured as *de facto* nominal openness (ratio of exports plus imports over GDP). In order to control for reverse causality, institutions (rule of law) are instrumented using settler mortality as in Acemoglu et al. (2001).

78 The rule of law index of Kaufmann et al. (1999) measures the extent to which economic agents abide by the rules of society, perceptions of the effectiveness and predictability of the judiciary, and the enforceability of contracts.

79 Van Rijckeghem and Weder (2001) similarly suggest that strengthening the rule of law has beneficial effects on corruption. Measuring the quality of institutions with risk of expropriation, Mocan (2008) also finds that higher-quality institutions reduce corruption, measured as the incidence of being asked for a bribe. For a survey of the determinants of corruption, see Gunardi (2008).

80 This observation leads to interpret the results of Damania et al. (2003) with some caution. In their model, corruption is exogenously given. In a richer model where corruption endogenously decreases with trade liberalization, trade might be more likely to reduce resource utilization.

81 See Robalino and Herrera (2009).

82 Examples of such initiatives include debt-for-nature swaps and the World Bank's Global Environmental Fund (GEF). Debt-for-nature swaps usually involve a portion of national debt being converted at a discount to an environmental fund. GEF provides direct funding for environmental projects in four key categories: bio-diversity preservation, climate change, water pollution and ozone depletion. The distinguishing feature of these schemes is that the transfer is conditional upon environmental improvements being undertaken in the recipient nations.

83 Section D.5 has already discussed an exception to this result, arguing that the imposition of an import tariff by the exporter may worsen the habitat destruction externality.

84 For example, the United States has a Trade and Investment Framework Agreement (TIFA) with Saudi Arabia, whereby both countries have agreed to develop their international trade and economic relationship (Office of the United States Trade Representative (USTR), 2003).

85 This basic welfare analysis subsequently needs to take the consumption effects into account as well (Lipsey, 1957; Carbaugh, 2007).

86 The exception to this norm is agricultural commodities as several developed countries impose high tariffs on agricultural goods to protect their own farmers. However, agricultural commodities, with the exception of raw materials, are beyond the scope of this report.

87 There are nine existing RFMOs (Tarasofsky, 2007).

88 For instance, it is likely to help monitor illegally harvested fish from regulated fisheries, unreported or misreported fishing activities, and unregulated fishing by unknown vessels (Metuzals et al. 2009).

Annex Table 1: **Average applied and bound tariff rates in natural resource sectors, 2007** (per cent)

Market	Applied MFN duty					Bound duty								
	HS	Fishery	Forestry	Mining	Fuels	HS	Binding coverage[1]				Average			
							Fishery	Forestry	Mining	Fuels	Fishery	Forestry	Mining	Fuels
Afghanistan	HS02	4.3	4.2	5.0	4.2	-	-	-	-	-	-	-	-	-
Albania	HS02	0.0	0.1	2.5	8.0	HS96	100.0	100.0	100.0	100.0	0.0	0.3	2.8	9.4
Algeria	HS07	29.7	9.1	11.8	10.0	-	-	-	-	-	-	-	-	-
Angola	HS07	19.2	13.0	7.3	12.9	HS96	100.0	100.0	100.0	100.0	60.0	60.0	60.6	63.2
Antigua and Barbuda	HS96	22.5	5.0	3.9	5.8	HS96	0.0	100.0	100.0	100.0	-	50.0	50.4	53.4
Argentina	HS02	10.1	3.8	5.7	0.4	HS96	100.0	100.0	100.0	100.0	33.8	28.1	33.2	34.5
Armenia		.	.	.	.	HS96	100.0	100.0	100.0	100.0	15.0	1.0	5.5	5.0
Australia	HS07	0.0	1.3	1.0	0.3	HS96	100.0	100.0	99.6	97.4	0.6	1.4	2.1	2.7
Azerbaijan	HS02	11.1	6.2	4.4	7.3	-	-	-	-	-	-	-	-	-
Bahamas	HS02	26.1	23.7	32.7	32.2	-	-	-	-	-	-	-	-	-
Bahrain	HS07	3.2	4.7	4.8	5.0	HS96	0.0	17.0	59.5	13.2	-	35.0	35.0	35.0
Bangladesh	HS02	23.9	3.8	9.1	11.7	HS96	2.0	6.4	0.8	0.0	50.0	16.7	12.5	-
Barbados	HS02	32.9	7.4	5.6	8.4	HS96	0.0	100.0	100.0	100.0	-	70.0	71.2	79.3
Belarus	HS02	12.9	14.4	8.6	5.0	-	-	-	-	-	-	-	-	-
Belize	HS02	32.3	7.6	4.0	7.9	HS96	5.0	100.0	100.0	100.0	110.0	50.0	50.7	50.5
Benin	HS07	14.6	6.7	7.2	5.3	HS96	16.0	0.0	23.8	10.5	6.5	-	50.0	7.3
Bermuda	HS07	6.1	13.3	20.1	27.3	-	-	-	-	-	-	-	-	-
Bhutan	HS07	30.0	15.4	24.0	18.3	-	-	-	-	-	-	-	-	-
Bolivarian Rep. of Venezuela	HS02	19.3	7.0	6.5	6.6	HS96	100.0	100.0	100.0	100.0	31.7	32.9	32.9	35.0
Bolivia	HS02	10.0	8.7	8.2	7.7	HS96	100.0	100.0	100.0	100.0	40.0	40.0	40.0	40.0
Bosnia and Herzegovina	HS02	2.9	1.0	1.8	0.9	-	-	-	-	-	-	-	-	-
Botswana	HS07	4.6	0.2	1.3	2.5	HS96	0.0	100.0	98.0	2.6	-	4.3	5.7	0.0
Brazil	HS07	10.0	4.1	5.7	0.4	HS96	100.0	100.0	100.0	100.0	33.4	22.4	31.8	33.4
Brunei Darussalam	HS02	0.0	9.4	0.0	0.0	HS96	100.0	97.9	96.8	100.0	21.0	29.6	20.1	20.0
Burkina Faso	HS07	14.6	6.7	7.2	5.3	HS96	16.0	48.9	0.0	10.5	6.5	100.0	-	7.3
Burundi	HS02	8.3	9.4	5.9	7.4	HS96	5.0	0.0	0.4	0.0	6.0	-	5.0	-
Cambodia	HS02	19.2	10.2	8.9	7.3	HS96	100.0	100.0	100.0	100.0	23.8	23.1	18.6	18.0
Cameroon	HS07	24.5	21.4	11.8	10.3	HS96	0.0	0.0	0.0	-	-	-	-	-
Canada	HS07	0.8	0.1	0.7	1.9	HS96	100.0	100.0	100.0	81.6	1.1	0.1	1.9	3.6
Cape Verde	HS07	23.7	2.9	0.9	3.7	HS07	100.0	98.2	100.0	100.0	25.5	7.8	7.8	7.1
Central African Republic	HS07	24.5	21.4	11.8	10.3	HS96	0.0	0.0	42.5	100.0	-	-	34.6	30.0
Chad	HS07	24.5	21.4	11.8	10.3	HS96	0.0	0.0	0.0	-	-	-	-	-
Chile	HS02	6.0	6.0	6.0	6.0	HS96	100.0	100.0	100.0	100.0	25.0	25.0	25.0	25.0
China	HS07	10.9	0.9	3.6	5.3	HS96	100.0	100.0	100.0	100.0	10.9	1.7	3.8	5.7
Colombia	HS02	19.3	7.2	6.3	6.5	HS96	100.0	100.0	100.0	100.0	35.0	35.0	35.0	35.0

Annex Table 1: **Average applied and bound tariff rates in natural resource sectors, 2007** (per cent) continued

Market	Applied MFN duty					Bound duty								
	HS	Fishery	Forestry	Mining	Fuels	HS	Binding coverage[1]				Average			
							Fishery	Forestry	Mining	Fuels	Fishery	Forestry	Mining	Fuels
Congo	HS07	24.5	21.4	11.8	10.3	HS96	0.0	0.0	0.0	-	-	-	-	-
Congo, Dem. Rep. of	HS02	17.2	13.6	8.7	9.4	HS96	100.0	100.0	100.0	100.0	92.1	100.0	100.0	100.0
Costa Rica	HS07	8.9	1.7	1.0	4.1	HS96	100.0	100.0	100.0	100.0	46.2	36.9	45.0	45.0
Croatia	HS07	7.4	0.3	1.4	4.4	HS96	100.0	100.0	100.0	100.0	7.5	0.6	3.2	5.7
Cuba	HS02	4.6	2.1	5.0	2.6	HS96	10.0	14.9	7.9	34.2	2.8	0.0	1.8	1.4
Côte d'Ivoire	HS07	14.6	6.7	7.2	5.3	HS96	13.0	0.0	0.0	10.5	5.8	-	-	7.3
Djibouti	HS02	20.1	29.7	31.4	31.1	HS96	100.0	100.0	100.0	100.0	40.0	40.0	40.0	41.4
Dominica	HS02	29.3	5.3	3.5	6.1	HS96	0.0	100.0	100.0	100.0	-	50.0	50.0	50.0
Dominican Republic		.	.	.	.	HS96	100.0	100.0	100.0	100.0	40.0	40.0	33.7	40.0
Ecuador	HS02	19.2	6.6	5.8	5.5	HS96	100.0	100.0	100.0	100.0	29.0	15.7	16.5	15.6
Egypt	HS07	5.3	4.0	4.4	3.7	HS96	100.0	100.0	100.0	100.0	27.9	13.5	22.8	22.2
El Salvador	HS07	9.7	1.7	1.0	5.1	HS96	100.0	100.0	100.0	100.0	46.1	32.3	37.4	36.8
Equatorial Guinea	HS07	24.5	21.4	11.8	10.3	-	-	-	-	-	-	-	-	-
Ethiopia	HS02	12.6	1.0	9.2	5.8	-	-	-	-	-	-	-	-	-
European Union (27)	HS07	10.9	0.2	1.6	0.6	HS96	100.0	100.0	100.0	100.0	11.7	0.0	1.6	0.6
Fiji		.	.	.	.	HS96	0.0	0.0	3.6	0.0	-	-	40.0	-
FYR Macedonia	HS07	1.1	0.4	2.5	4.1	HS02	100.0	100.0	100.0	100.0	1.2	0.4	2.5	4.1
Gabon	HS07	24.5	21.4	11.8	10.3	HS96	100.0	100.0	100.0	100.0	15.0	15.0	15.0	15.0
Gambia	HS92	19.8	20.0	19.7	20.0	HS96	0.0	0.0	1.2	0.0	-	-	40.0	-
Georgia	HS02	0.0	0.0	2.9	0.0	HS96	100.0	100.0	100.0	100.0	0.4	6.1	7.1	12.0
Ghana	HS02	10.5	9.6	11.6	9.4	HS96	0.0	0.0	0.8	0.0	-	-	30.0	-
Grenada	HS96	28.7	7.4	5.6	7.5	HS96	100.0	100.0	100.0	100.0	50.0	50.0	50.0	50.0
Guatemala	HS07	9.7	1.8	1.0	4.7	HS96	100.0	100.0	100.0	100.0	41.1	27.6	43.4	41.3
Guinea	HS02	14.6	6.8	7.2	6.0	HS96	16.0	48.9	0.0	10.5	6.5	22.6	-	7.3
Guinea Bissau	HS07	14.6	6.7	7.2	5.3	HS96	100.0	100.0	99.2	0.0	50.0	50.0	50.0	-
Guyana		.	.	.	.	HS96	100.0	100.0	100.0	100.0	50.0	50.0	50.0	50.0
Haiti	HS96	0.9	0.0	1.3	0.2	HS96	35.0	48.9	79.0	100.0	25.7	11.3	15.8	10.4
Honduras	HS07	9.7	1.8	1.0	4.6	HS96	100.0	100.0	100.0	100.0	34.7	35.0	34.3	32.9
Hong Kong, China	HS07	0.0	0.0	0.0	0.0	HS96	100.0	95.7	75.4	10.5	0.0	0.0	0.0	0.0
Iceland	HS07	1.2	0.1	0.0	0.0	HS96	95.0	100.0	99.6	73.7	1.5	5.1	1.7	0.3
India	HS07	29.8	7.3	5.6	8.4	HS96	10.0	91.5	63.1	7.9	102.5	31.7	37.1	29.2
Indonesia	HS07	5.9	1.0	4.3	3.9	HS96	100.0	100.0	97.6	97.4	40.0	37.7	39.4	40.0
Iran, Islamic Republic of	HS02	18.0	4.7	7.3	7.6	-	-	-	-	-	-	-	-	-
Israel		.	.	.	.	HS96	51.0	97.9	87.3	78.9	4.9	5.1	6.5	4.7
Jamaica	HS07	30.1	5.2	1.4	6.7	HS96	100.0	100.0	100.0	100.0	50.0	48.1	46.2	49.6

Annex Table 1: **Average applied and bound tariff rates in natural resource sectors, 2007** (per cent) continued

Market	Applied MFN duty					Bound duty								
	HS	Fishery	Forestry	Mining	Fuels	HS	Binding coverage[1]				Average			
							Fishery	Forestry	Mining	Fuels	Fishery	Forestry	Mining	Fuels
Japan	HS07	5.5	0.5	1.2	0.8	HS96	90.0	87.2	99.6	94.7	5.0	0.6	1.2	2.5
Jordan	HS07	20.5	6.1	5.9	10.4	HS96	100.0	100.0	99.6	97.4	19.9	14.6	15.2	15.8
Kazakhstan	HS02	11.6	8.0	5.5	4.8	-	-	-	-	-	-	-	-	-
Kenya	HS02	25.0	2.8	6.3	7.3	HS96	45.0	0.0	0.0	0.0	62.0	-	-	-
Korea, Republic of	HS07	16.1	2.5	3.6	4.0	HS96	51.0	91.5	98.8	89.5	15.4	4.3	6.2	5.4
Kuwait	HS07	3.2	4.7	4.8	5.0	HS96	100.0	100.0	100.0	94.7	100.0	100.0	100.0	100.0
Kyrgyz Republic	HS02	10.0	0.0	3.6	5.0	HS96	100.0	100.0	99.6	100.0	10.0	0.6	5.9	8.5
Lao People's Democratic Republic	HS02	13.0	12.7	5.9	6.2	-	-	-	-	-	-	-	-	-
Lebanon	HS07	5.1	0.3	1.8	2.6	-	-	-	-	-	-	-	-	-
Lesotho	HS07	4.6	0.2	1.3	2.5	HS96	100.0	100.0	100.0	100.0	60.0	60.0	60.0	60.0
Macao, China	HS02	0.0	0.0	0.0	0.0	HS96	0.0	6.4	36.1	0.0	-	0.0	0.0	-
Madagascar	HS07	20.0	6.8	8.0	7.3	HS96	0.0	6.4	1.2	2.6	-	3.3	30.0	5.0
Malawi		.	.	.	.	HS96	86.0	6.4	2.4	0.0	40.0	46.7	36.7	-
Malaysia	HS02	1.9	2.3	2.4	0.3	HS96	55.0	80.9	63.1	23.7	8.2	10.0	10.3	10.6
Maldives		.	.	.	.	HS96	0.0	100.0	100.0	100.0	-	30.0	30.0	30.0
Mali	HS07	14.6	6.7	7.2	5.3	HS96	16.0	0.0	8.3	10.5	6.5	-	60.0	7.3
Mauritania	HS96	20.0	7.0	7.6	5.1	HS96	22.0	0.0	0.0	10.5	12.9	-	-	7.3
Mauritius	HS07	0.4	0.3	0.3	0.0	HS96	0.0	0.0	0.0	-	-	-	-	-
Mayotte	HS07	10.0	4.4	3.4	0.0	-	-	-	-	-	-	-	-	-
Mexico	HS02	16.8	6.4	6.6	5.4	HS96	100.0	100.0	100.0	100.0	34.8	32.3	33.6	33.5
Moldova		.	.	.	.	HS96	100.0	100.0	100.0	100.0	4.0	2.8	2.2	0.0
Mongolia	HS07	5.0	5.0	5.0	5.0	HS96	100.0	100.0	100.0	100.0	20.0	20.0	19.7	20.0
Montenegro	HS07	9.3	1.2	2.5	2.0	-	-	-	-	-	-	-	-	-
Morocco	HS02	47.8	18.8	12.2	11.2	HS96	100.0	100.0	100.0	100.0	40.0	35.4	39.3	34.5
Mozambique	HS02	19.8	6.0	4.2	4.4	HS96	0.0	0.0	0.0	-	-	-	-	-
Myanmar	HS02	8.4	8.7	3.1	0.8	HS96	0.0	0.0	17.9	21.1	-	-	20.0	25.0
Namibia	HS07	4.6	0.2	1.3	2.5	HS96	0.0	100.0	98.0	2.6	-	4.3	5.7	0.0
Nepal	HS07	10.8	7.4	9.7	11.1	HS02	100.0	100.0	100.0	90.2	21.5	15.2	22.2	18.4
New Zealand	HS07	0.4	0.6	0.8	0.2	HS96	100.0	100.0	100.0	97.4	1.3	1.7	3.5	1.1
Nicaragua	HS07	9.7	1.7	1.0	4.5	HS96	100.0	100.0	100.0	100.0	40.0	40.0	40.0	40.0
Niger	HS07	14.6	6.7	7.2	5.3	HS96	100.0	100.0	99.2	100.0	43.0	50.0	50.0	45.5
Nigeria		.	.	.	.	HS96	2.0	0.0	7.5	0.0	50.0	-	50.5	-
Norway	HS07	0.0	0.0	0.0	0.0	HS96	100.0	100.0	100.0	100.0	0.0	0.0	0.3	0.7
Oman	HS07	3.2	4.7	4.8	5.0	HS96	100.0	100.0	100.0	100.0	19.3	8.1	14.6	15.4
Pakistan	HS02	10.8	6.3	7.7	9.4	HS02	100.0	100.0	100.0	100.0	63.0	44.5	58.9	59.6

Annex Table 1: **Average applied and bound tariff rates in natural resource sectors, 2007** (per cent) continued

Market	Applied MFN duty					Bound duty								
	HS	Fishery	Forestry	Mining	Fuels	HS	Binding coverage[1]				Average			
							Fishery	Forestry	Mining	Fuels	Fishery	Forestry	Mining	Fuels
Panama	HS02	12.9	5.3	8.1	5.1	HS92	100.0	100.0	100.0	100.0	16.7	29.7	26.5	28.7
Papua New Guinea	HS02	23.1	7.8	0.0	0.0	HS96	100.0	100.0	100.0	100.0	55.0	69.4	22.6	24.3
Paraguay	HS02	10.1	3.8	5.6	0.4	HS96	100.0	100.0	100.0	100.0	35.0	32.9	34.5	33.0
Peru	HS02	12.0	9.0	8.5	6.7	HS96	100.0	100.0	100.0	100.0	30.0	30.0	30.0	30.0
Philippines	HS02	8.3	2.4	2.5	2.9	HS96	0.0	97.9	56.3	2.6	-	16.8	23.6	10.0
Qatar	HS07	3.2	4.7	4.8	5.0	HS96	100.0	100.0	100.0	100.0	15.0	15.0	17.7	15.0
Russian Federation	HS07	12.9	14.4	8.3	4.8	-	-	-	-	-	-	-	-	-
Rwanda		.	.	.	.	HS96	100.0	100.0	100.0	100.0	86.7	100.0	99.6	100.0
Saint Kitts and Nevis	HS96	11.9	4.9	2.3	6.6	HS96	0.0	100.0	100.0	100.0	-	70.0	70.0	70.1
Saint Lucia	HS96	29.8	7.3	2.2	5.7	HS96	79.0	100.0	100.0	100.0	116.3	51.6	50.4	54.5
Saint Vincent and the Grenadines	HS96	28.5	7.3	4.4	6.9	HS96	91.0	100.0	100.0	100.0	119.1	51.6	50.5	53.5
Saudi Arabia	HS07	3.2	4.7	4.8	5.0	HS02	100.0	100.0	100.0	100.0	10.6	7.8	13.2	13.6
Senegal	HS07	14.6	6.7	7.2	5.3	HS96	100.0	100.0	100.0	100.0	30.0	30.0	29.9	30.0
Serbia	HS02	8.7	1.2	3.1	2.1	-	-	-	-	-	-	-	-	-
Seychelles	HS92	89.8	4.2	0.0	0.0	-	-	-	-	-	-	-	-	-
Sierra Leone		.	.	.	.	HS96	100.0	100.0	100.0	100.0	50.0	50.0	49.8	50.0
Singapore	HS02	0.0	0.0	0.0	0.0	HS96	100.0	93.6	50.8	2.6	10.0	5.5	9.8	10.0
Solomon Islands	HS92	10.0	10.0	9.4	11.4	HS96	100.0	100.0	100.0	100.0	85.6	80.0	79.4	37.9
South Africa	HS07	4.6	0.2	1.3	2.5	HS96	0.0	100.0	98.0	2.6	-	4.3	5.7	0.0
Sri Lanka	HS07	14.7	3.8	5.3	5.8	HS96	100.0	27.7	2.4	15.8	50.0	13.5	53.3	24.2
Suriname		.	.	.	.	HS96	12.0	0.0	0.4	10.5	22.7	-	20.0	6.8
Swaziland	HS07	4.6	0.2	1.3	2.5	HS96	0.0	100.0	98.0	2.6	-	4.3	5.7	0.0
Switzerland	HS07	0.2	2.1	0.8	0.2	HS96	100.0	100.0	100.0	68.4	0.5	2.1	1.0	1.3
Taipei, Chinese	HS02	23.7	0.0	0.8	1.6	HS96	100.0	100.0	100.0	100.0	25.0	0.0	1.0	2.2
Tanzania	HS02	25.0	2.8	6.3	7.3	HS96	0.0	0.0	0.0	-	-	-	-	-
Thailand	HS07	13.5	0.9	1.2	1.3	HS96	98.0	59.6	56.7	10.5	13.7	10.7	18.6	23.0
Togo	HS07	14.6	6.7	7.2	5.3	HS96	0.0	0.0	8.7	0.0	-	-	80.0	-
Tonga		.	.	.	.	HS02	100.0	100.0	100.0	100.0	19.8	15.3	19.8	20.0
Trinidad and Tobago	HS07	30.3	5.2	1.0	6.3	HS96	100.0	100.0	100.0	100.0	50.0	41.1	41.0	47.7
Tunisia		.	.	.	.	HS96	3.0	51.1	20.6	2.6	43.0	20.9	35.7	27.0
Turkey	HS07	33.5	0.3	1.6	0.8	HS96	17.0	46.8	15.1	10.5	60.6	14.7	13.1	16.3
Uganda	HS02	25.0	2.8	6.3	7.3	HS96	9.0	8.5	0.0	0.0	50.0	50.0	-	-
Ukraine		.	.	.	.	HS02	100.0	100.0	100.0	100.0	3.3	0.6	4.0	6.7
United Arab Emirates	HS07	3.2	4.7	4.8	5.0	HS96	100.0	100.0	100.0	100.0	15.0	12.9	14.8	15.0
United States	HS07	0.9	0.1	1.2	0.3	HS96	100.0	100.0	100.0	97.4	1.0	0.0	1.2	0.4

Annex Table 1: **Average applied and bound tariff rates in natural resource sectors, 2007** (per cent) continued

Market	Applied MFN duty					Bound duty								
	HS	Fishery	Forestry	Mining	Fuels	HS	Binding coverage[1]				Average			
							Fishery	Forestry	Mining	Fuels	Fishery	Forestry	Mining	Fuels
Uruguay	HS02	10.1	3.7	5.3	0.4	HS96	100.0	100.0	100.0	100.0	35.0	25.0	33.2	35.0
Uzbekistan	HS02	5.0	8.9	14.1	10.9	-	-	-	-	-	-	-	-	-
Vanuatu	HS02	29.5	13.6	10.2	1.3	-	-	-	-	-	-	-	-	-
Viet Nam	HS02	32.2	1.4	1.9	4.2	HS02	100.0	100.0	100.0	100.0	18.4	1.5	3.2	8.2
Zambia	HS07	23.9	17.0	8.9	14.6	HS96	0.0	0.0	0.4	0.0	-	-	35.0	-
Zimbabwe	HS07	10.7	6.6	6.8	11.0	HS96	75.0	14.9	2.8	0.0	1.9	15.0	25.0	-

1 The binding coverage is calculated as the share of 6-digit subheadings containing at least one bound tariff line.
Note 1: For each country, national tariff lines are first averaged at the 6-digit level. The averages at the 6-digit level are then used to calculate the national average.
Note 2: The methodology used for calculating the ad valorem equivalents of non-ad valorem duties can be found in World Tariff Profiles 2006, pp 186-197.
Source: WTO Integrated Database and International Trade Centre.

Annex Table 2: **Applied MFN tariff rates of processed products, 2007** (per cent)

Country	Cork and paper	Petro-chemicals	Mineral-based semi-manufactures	Wooden furnitures
Afghanistan	5.3	4.5	7.7	10.0
Albania	0.1	1.2	9.4	0.0
Algeria	20.7	10.2	21.8	30.0
Angola	10.6	3.1	9.7	15.0
Antigua and Barbuda	8.9	4.2	9.5	17.5
Argentina	12.3	7.2	13.2	18.0
Australia	4.1	2.4	3.7	5.0
Azerbaijan	12.3	1.2	12.8	15.0
Bahamas	29.3	28.9	32.2	31.9
Bahrain	5.0	4.3	5.0	5.0
Bangladesh	20.1	6.2	17.8	25.0
Barbados	9.8	4.2	11.3	56.7
Belarus	14.0	8.2	13.7	31.7
Belize	10.1	1.8	9.9	27.5
Benin	12.2	5.1	17.0	20.0
Bermuda	20.7	18.7	20.7	22.3
Bhutan	19.8	10.0	21.4	50.0
Bolivarian Rep. of Venezuela	14.5	8.2	14.1	20.0
Bolivia	9.8	6.4	9.4	10.0
Bosnia and Herzegovina	6.3	2.9	7.9	10.0
Botswana	7.1	1.8	6.8	20.0
Brazil	12.4	7.1	13.4	18.0
Brunei Darussalam	3.4	0.0	0.4	5.0
Burkina Faso	12.2	5.1	17.0	20.0
Burundi	11.9	5.2	11.3	30.0
Cambodia	9.7	3.8	15.1	35.0
Cameroon	18.2	9.2	22.7	30.0
Canada	0.8	2.1	3.2	5.9
Cape Verde	9.7	0.0	11.4	50.0
Central African Republic	18.2	9.2	22.7	30.0
Chad	18.2	9.2	22.7	30.0
Chile	6.0	6.0	6.0	6.0
China	6.4	7.1	11.8	0.0
Colombia	14.5	8.0	13.6	20.0
Congo	18.2	9.2	22.7	30.0
Congo, Dem. Rep. of	15.4	7.4	15.3	20.0
Costa Rica	6.4	0.3	5.2	14.0
Croatia	1.3	1.6	6.8	4.6
Cuba	9.7	8.1	10.6	18.8
Côte d'Ivoire	12.2	5.1	17.0	20.0
Djibouti	30.5	28.4	30.0	33.0
Dominica	7.9	1.9	9.0	35.0
Ecuador	13.9	6.1	13.0	20.0
Egypt	12.5	2.2	12.7	30.0
El Salvador	6.6	0.5	5.6	15.0
Equatorial Guinea	18.2	9.2	22.7	30.0
Ethiopia	13.0	7.0	20.1	30.6
European Union (27)	1.2	4.2	3.0	0.7
FYR Macedonia	2.3	2.8	9.9	12.0
Gabon	18.2	9.2	22.7	30.0
Gambia	20.0	20.0	19.9	20.0
Georgia	0.0	0.0	1.7	0.0
Ghana	18.7	8.2	13.6	20.0
Grenada	8.9	4.2	9.5	17.5
Guatemala	6.8	0.4	5.5	15.0
Guinea	11.9	4.2	16.4	20.0
Guinea Bissau	12.2	5.1	17.0	20.0
Haiti	0.9	0.0	3.4	8.8
Honduras	6.8	0.3	5.5	15.0
Hong Kong, China	0.0	0.0	0.0	0.0

Annex Table 2: **Applied MFN tariff rates of processed products, 2007** (per cent) continued

Country	Cork and paper	Petro-chemicals	Mineral-based semi-manufactures	Wooden furnitures
Iceland	2.3	0.0	2.7	10.0
India	10.0	6.1	9.6	10.0
Indonesia	5.6	3.8	8.6	8.8
Iran, Islamic Republic of	21.7	7.0	25.3	55.0
Jamaica	5.8	0.2	6.7	17.5
Japan	1.1	2.4	1.1	0.0
Jordan	15.1	0.9	18.6	30.0
Kazakhstan	8.2	4.6	12.4	15.0
Kenya	20.8	1.1	16.0	25.0
Korea, Republic of	2.4	5.6	7.3	2.0
Kuwait	5.0	4.3	5.0	5.0
Kyrgyz Republic	0.0	1.0	5.2	2.5
Lao People's Democratic Republic	14.0	5.0	6.4	40.0
Lebanon	7.4	1.5	6.7	30.0
Lesotho	7.1	1.8	6.8	20.0
Macao, China	0.0	0.0	0.0	0.0
Madagascar	14.6	4.2	14.0	20.0
Malaysia	14.7	3.1	13.8	0.0
Mali	12.2	5.1	17.0	20.0
Mauritania	11.6	5.1	17.2	20.0
Mauritius	5.6	2.3	4.1	23.4
Mayotte	6.1	8.4	8.3	10.0
Mexico	9.7	5.4	13.0	16.6
Mongolia	5.0	5.0	5.0	5.0
Montenegro	4.5	1.5	5.8	10.0
Morocco	43.7	15.7	29.6	50.0
Mozambique	10.0	2.5	9.9	20.0
Myanmar	5.5	1.1	4.7	15.0
Namibia	7.1	1.8	6.8	20.0
Nepal	15.6	13.3	14.0	25.0
New Zealand	1.3	0.6	3.5	7.0
Nicaragua	6.5	0.3	5.4	15.0
Niger	12.2	5.1	17.0	20.0
Norway	0.0	0.0	0.0	0.0
Oman	5.0	4.3	5.0	5.0
Pakistan	20.3	8.7	19.2	25.0
Panama	7.7	0.4	9.0	15.0
Papua New Guinea	10.4	0.0	2.8	25.0
Paraguay	11.6	6.5	12.7	18.0
Peru	10.8	5.7	8.6	12.0
Philippines	7.2	3.6	7.1	15.0
Qatar	5.0	4.3	5.0	5.0
Russian Federation	14.0	8.0	13.5	32.4
Saint Kitts and Nevis	9.6	1.9	10.1	20.6
Saint Lucia	6.8	1.8	7.8	17.5
Saint Vincent and the Grenadines	8.9	1.9	9.0	17.5
Saudi Arabia	5.0	4.3	5.0	5.0
Senegal	12.2	5.1	17.0	20.0
Serbia	4.7	2.0	7.4	20.0
Seychelles	2.1	0.0	3.5	0.0
Singapore	0.0	0.0	0.0	0.0
Solomon Islands	10.1	7.4	9.3	10.0
South Africa	7.1	1.8	6.8	20.0
Sri Lanka	15.9	2.9	16.7	28.0
Swaziland	7.1	1.8	6.8	20.0
Switzerland	5.6	0.9	1.9	0.7
Taipei, Chinese	0.6	2.2	5.7	0.0
Tanzania	20.8	1.1	16.0	25.0
Thailand	7.5	3.8	11.3	20.0
Togo	12.2	5.1	17.0	20.0

Annex Table 2: **Applied MFN tariff rates of processed products, 2007** (per cent) continued

Country	Cork and paper	Petro-chemicals	Mineral-based semi-manufactures	Wooden furnitures
Trinidad and Tobago	5.8	0.2	6.7	17.5
Turkey	1.0	4.7	3.1	0.7
Uganda	20.8	1.1	16.0	25.0
United Arab Emirates	5.0	4.3	5.0	5.0
United States	0.7	2.7	2.6	0.0
Uruguay	11.0	6.0	13.2	18.0
Uzbekistan	16.4	8.6	18.5	30.0
Vanuatu	15.0	7.2	15.8	33.1
Viet Nam	19.3	2.3	19.0	36.9
Zambia	16.5	1.5	16.6	25.0
Zimbabwe	20.9	5.4	21.9	40.0

Note 1: For each country, national tariff lines are first averaged at the 6-digit level. The averages at the 6-digit level are then used to calculate the national average.
Note 2: The methodology used for calculating the *ad valorem* equivalents of non-*ad valorem* duties can be found in *World Tariff Profiles* 2006, pp 186-197.
Source: WTO Integrated Database and International Trade Centre.

Annex Table 3: **OECD government financial transfers to fishing** (USD millions)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Australia	37.4	41.2	..	..	82.3	75.9	78.0	95.6	95.6	46.3	90.0
Belgium	5.0	4.9	..	4.5	6.8	2.8	1.6	1.7	6.3	8.6	7.8
Canada	545.3	433.3	..	606.4	564.5	521.4	497.8	590.0	618.8	591.0	591.0
Denmark	85.8	82.0	90.5	27.8	16.3	..	68.8	37.7	28.5	58.1	113.2
Finland	29.0	26.2	26.9	19.2	13.9	16.5	16.0	20.2	19.4	24.8	23.4
France	158.2	140.8	..	71.7	166.1	141.8	155.3	179.7	236.8	126.2	113.8
Germany	81.6	63.2	16.5	31.3	29.8	29.0	28.2	33.9	18.3	30.9	30.7
Greece	52.3	47.0	26.9	43.0	87.3	87.0	88.3	119.0	35.5	61.0	79.6
Iceland	43.8	38.7	37.0	39.8	42.0	28.3	29.0	48.3	55.7	64.3	52.4
Ireland	112.7	98.9	..	143.2	..	..	63.6	65.0	21.4	22.1	29.4
Italy	162.6	91.8	..	200.5	217.7	231.7	159.6	149.3	170.1	119.2	119.2
Japan	3,186.4	2,945.8	2,135.9	2,537.5	2,913.1	2,574.1	2,323.6	2,310.7	2,437.9	2,165.2	1,985.1
Korea	367.8	379.0	211.9	471.6	320.4	428.3	538.7	495.3	495.3	649.4	752.2
Mexico	14.2	16.8	..	..	..	..	..	177.0	114.0	85.0	89.1
Netherlands	39.9	35.8	..	..	1.4	12.8	12.4	6.6	5.2	13.7	21.3
New Zealand	37.2	40.4	29.4	29.6	27.3	15.1	19.0	38.3	50.1	32.2	38.6
Norway	172.7	163.4	153.0	181.0	104.6	99.5	156.3	139.2	142.3	149.5	159.5
Portugal	71.8	65.1	..	28.7	25.6	25.1	24.9	26.9	26.9	32.8	29.3
Spain	246.5	344.6	296.6	399.6	364.1	376.6	301.9	353.3	256.6	433.8	425.4
Sweden	62.3	53.5	27.0	31.1	25.2	22.5	24.8	30.7	34.4	36.6	41.5
Turkey	28.7	15.1	..	1.3	26.4	17.7	16.2	16.3	59.5	98.1	133.9
United Kingdom	115.4	128.1	90.8	76.0	81.4	73.7	..	82.7	87.5	103.2	114.7
United States	891.2	1,002.6	1,041.0	1,103.1	1,037.7	1,169.6	1,130.8	1,290.4	1,064.4	..	2,128.8
OECD total	6,547.6	6,258.2	4,183.5	6,046.7	6,154.0	5,949.3	5,734.9	6,307.8	6,080.6	6,174.5	7,169.9

Source: Organization for Economic Co-operation and Development (OECD), 2009b.

E. Natural resources, international cooperation and trade regulation

This section discusses international regulation of trade in natural resources. It starts with an overview of the legal framework of the WTO and briefly addresses how natural resources fit within this. Rather than attempt an exhaustive treatment of every WTO rule that may have a bearing on trade in natural resources, this section sets out the rules that have particular relevance for this kind of trade, and considers whether, and to what extent, these rules respond to the salient characteristics of natural resource sectors. This section also presents a selection of international agreements that regulate trade in natural resources and discusses their relationship with WTO disciplines. It ends by focusing on a number of issues in this sector that appear to be of actual or potential relevance to international cooperation and to the multilateral trading system.

Contents

1. Trade in natural resources and WTO rules

(a) Trade rules and natural resources

To the extent that a natural resource may be traded, it is covered by the obligations contained in the GATT and the other WTO agreements relating to trade in goods. This is the case, for example, of extracted coal and oil, lumber that has been cut down or marine species that have been caught. Conversely, WTO rules generally do not regulate natural resources before they are extracted or harvested.

Nevertheless, in some circumstances, WTO rules may have implications for products in their "natural" state. For example, in the *US – Softwood Lumber IV* dispute, one of the issues that arose was whether the provision by provincial governments of harvesting rights for timber at less than adequate remuneration could be considered a subsidy within the meaning of the Agreement on Subsidies and Countervailing Measures (SCM Agreement). More specifically, the question was whether the term "goods" as used in Article 1.1 of the SCM Agreement could include "trees before they are harvested, that is, standing timber attached to the land (but severable from it) and incapable of being traded as such" (Appellate Body Report, *US – Softwood Lumber IV*, para. 57). Ultimately, it was decided that there was no basis to exclude "tangible items – such as standing, unfelled trees – that are not both tradable as such and subject to tariff classification" from the scope of the term "goods" in Article 1.1 (Appellate Body Report, *US – Softwood Lumber IV*, para. 67).

The issue also arose in the North American Free Trade Agreement (NAFTA) with respect to a proposal for bulk water transfers from British Columbia (Canada) to the United States through diversion of the Canadian water flow. For environmental reasons, the government of British Columbia sought to pass legislation banning large-scale transfers of water. Quantitative bans on exports are arguably contrary to provisions of the NAFTA, to which both Canada and the United States are parties. However, before the legislation could be deemed to be inconsistent with the agreement, a threshold question is whether water in its natural state is covered by NAFTA. A useful starting point is the Harmonized Commodity Description and Coding Systems (often called the "HS"), which is a multipurpose international product nomenclature developed by the World Customs Organization.

The HS comprises several thousand commodity groups and has been used by WTO members in preparing their schedules of commitments (Ehring, 2007). Sub-heading 2201 of the HS is entitled "*Waters, including natural or artificial mineral waters and aerated water*", and explicitly lists "snow" and "ice", which could support the view that ground or surface water is covered by trade rules (Horlick, 2001). A contrary position is that, because sub-heading 2201 is contained within the chapter of the HS entitled "*Beverages*", then water is only considered a product when it is destined for consumption. Because bulk transfers of ground or surface water are usually used for agricultural or industrial purposes, they would not be covered.

With a view to resolving the debate, the signatories to the NAFTA (Canada, Mexico and the United States) released a joint statement in 1993 proclaiming that "(t)he NAFTA creates no rights to the natural water resources of the parties to the Agreement". Although the legal status of this proclamation is unclear, it accords with views of those observers who consider that water does not become a good for the purposes of the NAFTA until it is removed from its natural state and transformed into a saleable commodity, such as bottled water (International Joint Commission, 1999; McRae, 2001; Cossy, 2005).

Similar issues also arise in relation to other natural resources. For example, members of the Organization of the Petroleum Exporting Countries (OPEC) have often imposed restrictions on production and asserted that such action is not inconsistent with the GATT because oil does not become subject to the disciplines of the WTO until it has been extracted. Some argue that the international law principle of sovereignty supports the proposition that nations are unrestrained in the manner in which they deal with their natural resources until they are mined, drilled or otherwise produced (Crosby, 2009). Even then, a distinction between measures affecting output and measures affecting trade bears relevance to the discussion.

A service relating to natural resources is subject to the disciplines of the General Agreement on Trade in Services (GATS) unless it is provided in the exercise of governmental authority. In practice, services relate to natural resources in many different ways, from management and protection, to exploration, exploitation, technical testing, transport, brokering and commercialization. A range of services directly concern natural resources (e.g. services incidental to mining, pipeline transportation of fuels, services incidental to agriculture, hunting and forestry, services incidental to fishing). Other services may relate to a variety of sectors, including natural resources (management consulting services, for instance).

No GATS provision specifically addresses natural resources and the application of GATS obligations depends to a large extent on WTO members' individual commitments in the sector concerned. The fact that the WTO system has different rules for trade in goods and trade in services raises complex questions in relation to the exploitation of natural resources and associated activities (see sub-section 3).

Box 25: **Historical overview of natural resources in the GATT/WTO**

The history of natural resources in the General Agreement on Tariffs and Trade (GATT) and the WTO is generally one of progressive market openness – to the point where a wide range of raw materials, from metals and minerals, to fuel and wood, today face little or no protection in most major markets. However, a number of resource-related issues remain or are becoming of major concern to some WTO members. One long-standing issue is the continued dependency of many developing countries on commodity exports, and the ways that supply fluctuations, market instability, price volatility and continued barriers to processed resources adversely affect the growth and development prospects of these countries.

Provisions for international commodity agreements (ICAs), the negotiation of the Generalized System of Preferences (GSP) granting preferential tariffs to imports from developing countries, aspects of special and differential treatment for developing countries and repeated efforts to tackle tariff escalation in successive trade negotiating rounds, were explicitly or implicitly aimed at addressing the unique challenges facing commodity-exporting countries and the perceived structural imbalances in the trading system.

Concerns about dependence on commodity exports and the adverse effects of market instability and declining prices pre-dated the creation of the GATT in 1948. The commodity price slump of the early 1920s, and more dramatically during the Great Depression of the 1930s convinced policy-makers of the need for greater international cooperation and management of commodities trade, culminating in efforts in the 1920s and 1930s to negotiate a series of ICAs aimed at stabilizing prices by controlling quantities produced and sold (typically involving the creation of buffer stocks, long-term purchase guarantees, and quantity and export restriction schemes).[1]

These agreements figured prominently in the drafting of the ill-fated Havana Charter of 1948 and the GATT itself. Article 6 of the Charter permitted exceptions to non-discrimination for ICAs, provided that they were designed to encourage the stabilization of prices, the expansion of consumption and the relief of "burdensome" surpluses. The conditions governing the acceptable operation of such agreements were clearly spelled out: they should be negotiated at public conferences open to both consumers and producers of the commodity in question; they should last for a maximum of five years; and their operations should be jointly administered by producer and consumer interests.

With the failure to ratify the Havana Charter, the GATT was tasked with conducting an annual review of trends and developments in international pricing and with endorsing international commodity agreements (both in general and in specifics). Much later, with the addition of Part IV (Trade and Development) to the GATT in 1965, contracting parties were also tasked with devising measures to stabilize and improve conditions in world markets for the primary exports of developing countries in order to enable them to attain "stable, equitable and remunerative prices", and to provide them with expanding resources for economic development.

The success of ICAs, however, was mixed at best. With the exception of coffee and, for a time, tin, few managed to reverse declining price trends for the relevant commodities. Moreover, with the exception of the Tokyo Round's Bovine Meat and Dairy Products Arrangements, both of which were focused on developed-country producers, the GATT had little direct involvement in the design and operation of ICAs (Gordon-Ashworth, 1984).

A second major effort to address developing-country dependency on raw material exports came in the 1960s and 1970s. As early as 1958, the Haberler Report, prepared by a panel of experts commissioned by the GATT, argued that the needs of producers of primary products, and particularly those of developing countries, were "different to and distinct from those of producers of manufactured goods" and suggested that "existing rules and conventions concerning commercial policy were in general unfavourable to developing countries". During this same period, the ideas of Raul Prebisch (1950) and Hans Singer (1950) were increasingly influential – especially their contention that under-development was the result of structural inequalities in the international economic system, and in particular the declining terms of trade facing commodity-dependent developing countries. This analysis held considerable sway in intellectual and policy debate, but did not go uncontested (Viner, 1953; Baldwin, 1955; Johnson, 1967).

This "dependency theory" helped provide the intellectual foundations for the first United Nations Conference on Trade and Development (UNCTAD) in 1964. A key proposal at the Conference (endorsed at the second UNCTAD meeting in New Delhi four years later) was that developed countries should grant preferential tariff treatment to imports of manufactured and semi-manufactured products originating in developing countries – the so-called "Generalized System of Preferences" (GSP) – to encourage the growth of strong and diversified manufacturing sectors in poorer countries. A year later, the new Part IV of the GATT committed developed countries to "positive efforts designed to ensure that less-developed contracting parties secure a share of the growth in international trade commensurate with the needs of their economic development". Part IV also

included the principle that developed countries would not expect developing countries to reciprocate commitments to reduce or remove tariff and other trade barriers, and that "more favourable and acceptable conditions of access to world markets" should be provided for them.

In 1971, the GATT followed UNCTAD's lead and enacted two waivers to the most-favoured nation (MFN) principle (limited to ten years) which permitted tariff preferences to be granted to developing-country exports. In 1979, the GATT established a permanent exception to the MFN obligation by way of the Enabling Clause. This exemption allowed GATT contracting parties to establish systems of trade preferences for developing countries, with the caveat that these systems had to be "generalized, non-discriminatory, and non-reciprocal". Over a dozen WTO members offer GSP schemes and current efforts to formalize duty-free and quota-free access for exports from least-developed countries (LDCs) in the Doha Round promise to expand the concept even further.

From the perspective of developing countries, these systems have been a mixed success. On the one hand, most developed countries have complied with the obligation to generalize their programmes with respect to membership, by offering benefits to a wide range of developing and least-developed countries, although over time some geographical "graduation" has been applied through the exclusion of entire countries and of products from individual national schemes.

Most schemes are not generalized with respect to products, in that they do not cover all developing-country exports (notable exceptions, until recently, being agriculture and textiles), and in particular tend to favour raw material exports over exports of processed and semi-processed resources, thus exacerbating the problem of commodity dependence that GSP schemes were meant to address. They can also lead to embedded opposition to non-discriminatory trade opening, which is seen as a threat to preference margins. Moreover, it has become increasingly understood and acknowledged that the capacity to take advantage of preferences is strongly influenced by domestic conditions and supply capacity in the economies of the putative beneficiaries.

A third concern throughout this period was the prevalence of tariff escalation – whereby higher processed grades of a commodity face escalating tariffs, discouraging higher value-added production and investment in developing countries, reinforcing primary-product exports and exacerbating poorer countries' terms-of-trade difficulties. This problem partly resulted from the efforts of industrialized countries to protect low-skill, low-technology manufacturing industries and jobs (such as textiles, apparel or footwear), but it also partly reflected the composition and mechanics of successive GATT negotiations which, at least until the launch of the Uruguay Round in 1986, tended to be dominated by industrialized countries and reflect their trade concerns and negotiated bargains (Gordon-Ashworth, 1984). The Tokyo Round (1973-79) and the Uruguay Round (1986-93) made the reduction of tariff escalation a key objective, but achieved limited success. It may well be that the Doha Round, launched in 2001 with its non-linear formula approach, will do better.

In recent decades – especially over the past few years – discussions surrounding natural resources trade in the GATT/WTO have increasingly focused on the concerns of commodity-importing countries which are worried about rising resource prices and signs of increasing restrictions on the export of raw materials. The issue stems in part from growing global demand for scarce resources which, moreover, are often exported by a relatively small number of countries. Resource scarcity and uneven geographical distribution create scope for countries holding reserves to influence the prices and quantities of the raw materials made available on world markets (Korinek and Kim, 2009).

In effect, producing nations may restrict or tax exports for several reasons. These include offsetting tariff escalation in importing countries, guaranteeing local supplies of strategic resources to downstream domestic industries, improving terms-of-trade by limiting market supply and raising world prices, creating comparative advantages in high-tech industries that depend on access to rare metals or minerals and protecting the environment.

Many of these issues were raised during the Uruguay Round. At the insistence of a number of commodity-exporting countries, a specific Negotiating Group on Natural Resource Based Products (NRBPs) was established at the outset of the Round, which not only looked at long-standing issues such as tariffs (including preferences, tariff peaks – relatively high tariffs – and tariff escalation), non-tariff barriers to trade, and subsidies, but also attempted – unsuccessfully – to bring energy issues and export restrictions into the scope of its negotiations (Stewart, 1993). Similar pressure to bring export taxes and restrictions and "dual pricing"[2] (see Section D) into WTO negotiations has been felt in the current Doha Round and in the accession negotiations of a number of countries.

Box 26: "Commercial presence" mode of supply under the GATS: Rules relevant for investment in services

Many services are characterized by the simultaneity of production and consumption, which means that in some sectors it is important for service suppliers to establish a commercial presence in the markets where they want to sell services.

Commercial presence is estimated to represent close to 60 per cent of international trade in services. The "commercial presence" mode of supply, also referred to as mode 3, covers the supply of a service "by a service supplier of one Member, through commercial presence in the territory of any other Member" (Art. I:2(c)). This covers any type of business or professional establishment, including through (i) the constitution, acquisition or maintenance of a juridical person; or (ii) the creation or maintenance of a branch or a representative office, within the territory of a Member for the purpose of supplying a service (Art. XXVIII(d)). Commercial presence may take place through a new establishment, or through acquisition, in whole or in part, of an existing firm.

The GATS does not make a distinction between pre- and post-establishment phases, but it *de facto* addresses both of them. The difference stems from the nature of the obligations themselves. For instance, while national treatment (MFN) address both pre- and post-establishment restrictions, the market access provision tends to be related more to pre-establishment.

GATS obligations on commercial presence depend to a large extent on the type of specific commitments undertaken by WTO members. Market access and national treatment obligations exist only in sectors where members have undertaken specific commitments, and assuming that mode 3 has not been left "unbound". Members retain flexibility when scheduling mode 3 commitments. They may subject these commitments to various types of market access limitations: for instance, they may limit the number of suppliers through economic needs tests, exclude certain types of legal entity, require joint-venture, or limit the participation of foreign capital. National treatment limitations may include restrictions on land ownership, different subsidy and tax regimes, residency requirements, etc. Regardless of the existence of specific commitments, the MFN obligation applies to all government measures affecting trade in services.

There are several important differences between GATS mode 3 and bilateral investment treaties (BITs) or investment chapters contained in certain preferential trade agreements. Among other things, the definition of investment tends to be broader in the latter two than under the GATS. Moreover, the GATS does not provide for an investor-state dispute settlement mechanism and does not contain investment protection obligations, such as minimum standards of protection or compensation in cases of expropriation. The large majority of BITs, on the other hand, cover only the post-establishment phase as they tend to focus on protecting foreign investment rather than granting market access opportunities.

(b) WTO rules and the particular characteristics of the natural resources trade

(i) Trade rules and the uneven global distribution of natural resources

Import tariffs (Article II of the GATT 1994)

Article II of the GATT 1994 prohibits WTO members from applying "ordinary customs duties" on the importation of a product that are higher than the rate specified (or "bound") in their schedules of commitments. Through successive rounds of trade negotiations, the number of products subject to tariff bindings has increased and the levels at which tariffs are bound have been progressively brought down.[3] Members are also prohibited from applying any other duties or charges on the importation of a product, unless specified in the schedule of commitments.[4] Similar limitations apply to agricultural goods under Article 4 of the Agreement on Agriculture.

Maximum tariff rates (referred to as "tariff bindings") have been progressively reduced in the eight rounds of GATT negotiations, the last of which was the Uruguay Round. Further reductions are presently being negotiated as part of the WTO Doha Round. Tariff levels on natural resources were examined in Section D, which concluded that tariff protection for natural resource sectors is generally lower than for overall merchandise trade, with the possible exception of fisheries. Tariff escalation can be seen for some natural resource goods, such as forestry and mining, but not for others, such as fuels.

Import and export restrictions (Article XI of the GATT 1994)

Article XI of the GATT 1994 provides that no prohibitions or restrictions, other than duties, taxes or other charges, shall be applied by any WTO member on the importation of any product or on the exportation or sale for export of any product. This provision covers quotas and other similar measures that establish quantitative limitations on imports or exports (other than duties, taxes or other charges). Because Article XI refers both to "prohibitions" and "restrictions", a WTO panel has found that "'restriction' need not be a blanket prohibition or a precise numerical limit" (Panel Report, *India – Autos*, para. 7.270). Following this interpretation, a recent panel found that a measure that limited the number of ports through which certain goods entered a WTO member (albeit not the quantities that could enter through the authorized ports) was inconsistent with Article XI because the measure had a "limiting effect" on imports (Panel Report, *Colombia – Ports of Entry*, para. 7.240).

Article XI provisions applying to export restrictions are particularly relevant for some of the natural resource sectors covered in this report. As noted in Section D,

information extracted from the WTO's Trade Policy Reviews shows a higher incidence of export taxes on natural resources than on other sectors. The use of the phrase "other than duties, taxes or other charges" in Article XI has been generally understood to mean that this provision does not prohibit WTO members from applying export taxes. Another issue is whether Article XI applies to production limitations, as opposed to export restrictions. Again, based on the language of the provision, it has been generally understood that production restrictions are not covered by Article XI and thus would be permissible.

There is an exception to the prohibition in Article XI that permits WTO members to impose export prohibitions or restrictions temporarily "to prevent or relieve critical shortages of foodstuffs or other products essential to the exporting contracting party". This exception, which is found in Article XI:2(a), is discussed below in Section E.1(b)(ii).[5]

Non-discrimination (Articles I and XIII of the GATT)

Article I of the GATT sets out the most-favoured-nation principle, one of the fundamental obligations of the multilateral trading system. This provision prohibits a WTO member from treating the products originating in or destined for another member less favourably than the "like" products originating in or destined for any other country (including non-WTO members).

Article I is broad in scope and covers customs duties and charges of any kind imposed on or in connection with importation or exportation or imposed on the international transfer of payments for imports or exports, the method of levying such duties and charges, and all rules and formalities in connection with importation and exportation, as well as internal taxes and domestic regulations. This provision has important implications for trade in natural resources.

Under Article I, a WTO member that is a consumer of a natural resource must provide similarly favourable treatment (in terms of tariffs, customs formalities, internal taxes, domestic regulations, etc) to imports of the like natural resource originating in other members.[6] Thus, WTO member A cannot subject imports of coal from WTO member B to a higher tariff than imports of coal from WTO member C. Export taxes and other export regulations are also subject to the obligations in Article I, even if such measures are not prohibited under Article XI. This means that WTO member A cannot subject its exports to WTO member B to a higher export tax than it applies to exports to WTO member C.

Article XIII of the GATT states that no prohibition or restriction shall be applied by any WTO member on the importation of any product of the territory of any other member or on the exportation of any product destined for the territory of any other member, unless the importation of the like product of all third countries or the exportation of the like product to all third countries is similarly prohibited or restricted. Article XIII applies to tariff rate quotas on imports. Moreover, even where a WTO member is allowed to apply an export prohibition or restriction, its application must be non-discriminatory. The non-discrimination obligation in Article XIII would be relevant, for example, where a member imposes an export prohibition or restriction temporarily to prevent or relieve critical shortages of foodstuffs or other essential products under Article XI:2(a) of the GATT (Mavroidis, 2005).

State-trading enterprises (Article XVII of the GATT)

Article XVII:1 of the GATT recognizes that WTO members may establish or maintain state enterprises or grant exclusive or special privileges to private enterprises. Several state-trading enterprises relating to natural resources have been notified by members under Article XVII. Examples of such notifications include those by Brazil relating to ITAIPU Binacional (imported electrical energy) and Industria Nucleares do Brasil S.A.-INB (imports of spare parts and fuel for nuclear installations), and by the Bolivarian Republic of Venezuela on Petroleos de Venezuela S.A. (PDVSA) and its subsidiaries (hydrocarbons).[7] An initial point worth noting is that the prohibition in Article XI of the GATT and the non-discrimination obligation in Article XIII of the GATT apply to import and export restrictions made effective through state-trading operations (Ad note to Articles XI, XII, XIII, XIV and XVIII of the GATT).

Sub-paragraph (a) of Article XVII:1 states that state-trading enterprises shall, in their purchases or sales involving either imports or exports, act in a manner consistent with the general principles of non-discriminatory treatment prescribed in the GATT for governmental measures affecting imports or exports by private traders. Sub-paragraph (a) "seeks to ensure that a Member cannot, through the creation or maintenance of a state enterprise or the grant of exclusive or special privileges to any enterprise, engage in or facilitate conduct that would be condemned as discriminatory under the GATT 1994 if such conduct were undertaken by the Member itself" (Appellate Body Report, *Canada – Wheat Exports and Grain Imports*, para. 85).

Sub-paragraph (b) provides that the provisions of sub-paragraph (a) shall be understood to require that such enterprises shall make any such purchases or sales solely in accordance with commercial considerations, and lists a number of factors to be taken into account. The Ad Note to Article XVII:1(b), however, clarifies that a state enterprise may charge different prices for its sales of a product in different markets, provided that such different prices are charged for commercial reasons, to meet conditions of supply and demand in export markets. Moreover, the Appellate Body has stated that, while Article XVII:1 aims to prevent certain types of discriminatory behaviour, it does not impose "comprehensive competition-law-type obligations" on state-trading enterprises (Appellate Body Report, *Canada – Wheat Exports and Grain Imports*, para. 145).

Freedom of transit (Article V of the GATT)

Article V sets out rules that apply to goods, vessels and other means of transport that are "traffic in transit" – that is, when they cross the territory of another WTO member and the passage is only a portion of a complete journey beginning and terminating beyond the frontier of the member through whose territory the traffic passes. Article V ensures that freedom of transit is extended through the territory of each WTO member, via the routes most convenient for international transit, for traffic in transit to or from the territory of other members. Traffic in transit must also be accorded MFN treatment with respect to all charges, regulations and formalities in connection with transit.

Goods in transit through a WTO member's territory do not enter the market of that member (they are not "imported"), so there is no national treatment obligation in the sense of Article III of the GATT. However, in addition to requiring that freedom of transit is extended to all goods in transit from other members via the most convenient routes for international transit, Article V:2 prohibits any discrimination with respect to the nationality, place of origin, departure, entry, exit or destination, or any circumstances relating to the ownership of goods, of vessels or of other means of transport. In that context, while Article V does not require that goods in transit are treated like goods destined for, or originating in, the WTO member's domestic market, it might be argued that Article V:2 entails a limited form of national treatment, i.e. a requirement not to discriminate between foreign-owned and nationally-owned goods in transit (Cossy, 2010). In addition, one could contend that Article V:2 seems, in certain respects, to favour goods in transit over national goods as it requires members to guarantee international transit via the most convenient routes.

There has been some discussion as to whether Article V applies only to "moving" modes of transport, such as vessels and trucks, or also applies when transit occurs through the use of fixed infrastructure, such as electricity grids or gas and oil pipelines. Cossy (2010) argues that there is nothing in the text of Article V to support a narrow reading of Article V that would exclude transportation via fixed infrastructure. She notes that Article V refers generally to "vessels and other means of transport" and includes an explicit exception for aircraft in transit, which would suggest that the drafters did not intend to exclude other forms of transportation.

The obligations of Article V apply only to WTO members and are thus of limited relevance where a natural resource is transported via a third country that is not a member. Today, such a scenario is commonplace in the context of trade in energy products, where oil and gas are transited from Central Asia or Eastern Europe to Western Europe through a large number of countries that are still negotiating their accession to the WTO, such as Azerbaijan, Belarus, Kazakhstan, Russia, Tajikistan and Uzbekistan. Indeed, the issue of freedom of transit is central to the accession processes of many non-WTO members (see sub-section 3).

Another important limitation is that Article V imposes obligations on WTO members – it is not clear whether and how such disciplines would apply to situations where infrastructure is owned and operated by a state-trading enterprise or a private corporation (Cossy, 2010). A proposal has been made in the trade facilitation negotiations for members to agree that enterprises to which they have granted special privileges comply with GATT provisions on transit.

(ii) Trade rules and the exhaustibility of natural resources

Subsidies and countervailing measures

In some circumstances, subsidies can exacerbate the over-exploitation of scarce natural resources. The WTO includes important disciplines on the use of subsidies by WTO members. Subsidies to non-agricultural goods are regulated under the SCM Agreement. Specific disciplines on agricultural subsidies are set out in the Agreement on Agriculture. The SCM Agreement defines a "subsidy" as a financial contribution by a government or any public body within the territory of a member that confers a benefit. A financial contribution is deemed to exist where (i) a government practice involves a direct transfer of funds; (ii) government revenue that is otherwise due is foregone; (iii) a government provides goods or services other than general infrastructure; or (iv) a government entrusts or directs a private body to carry out one or more of the types of functions listed in (i) to (iii). A benefit is conferred where a financial contribution is received on terms more favourable than those available to the recipient on the market (Appellate Body Report, *Canada – Aircraft*).

Only subsidies that are "specific" to an enterprise, industry or a group of enterprises or industries are regulated by the SCM Agreement. Export subsidies and subsidies contingent on the use of domestic products are prohibited. The remaining subsidies are considered "actionable", which means that they can be challenged if they have adverse effects. A WTO member that is affected by subsidies granted by another member can challenge those subsidies in the WTO dispute settlement mechanism. Alternatively, the affected member can apply countervailing duties to the subsidized imports if it shows that they cause or threaten to cause injury to its domestic industry.

Some of the products discussed in this report, such as certain wood products and raw materials, are subject to the Agreement on Agriculture. The disciplines on agricultural subsidies differ from the rules applicable to non-agricultural subsidies. Agricultural export subsidies are subject to limitations agreed upon by each member of the WTO in its schedule of commitments. Members who have included export subsidy commitments in their schedules may not grant export subsidies that exceed those commitments. Those who have not included export subsidy commitments in their schedules are prohibited from granting such subsidies. WTO members also undertook commitments to reduce the domestic

support provided to their agricultural sectors. It has been estimated that agriculture is responsible for 85 per cent of global water consumption (Hoekstra, 2010). Thus, to the extent the disciplines of the Agreement on Agriculture have an impact on global agricultural production, they also have implications for the preservation of water supplies.

Article XVI of the GATT also regulates subsidies and includes less stringent disciplines for certain export subsidies to primary products. The Ad Note to Article XVI defines "primary products" as "any product of farm, forest or fishery, or any mineral, in its natural form or which has undergone such processing as is customarily required to prepare it for marketing in substantial volume in international trade". There may be questions about the continued relevance of this provision in the light of the adoption of the SCM Agreement and the Agreement on Agriculture. Some of the primary products covered by Article XVI, such as minerals, fish and fish products, are not covered by the Agreement on Agriculture and, therefore, would be subject to the prohibition on export subsidies in the SCM Agreement. Under the general interpretative note to Annex 1A, the provisions of the SCM Agreement would prevail over a provision of the GATT and its schedules in the event of a conflict. By contrast, the GATT, its schedules and the SCM Agreement are subject to the provisions of the Agreement on Agriculture.

WTO exceptions that permit otherwise inconsistent conduct (Article XX of the GATT)

Article XX of the GATT, entitled "*General Exceptions*", permits WTO members to take certain actions that are inconsistent with their GATT obligations. The WTO Appellate Body has found that in order for such conduct to be protected by Article XX, a member must show first that the measure at issue is of the type that is covered by one of the sub-paragraphs of Article XX. Secondly, the measure must be applied in a manner that is consistent with the chapeau of Article XX, which requires that measures not be applied in a manner that would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade (Appellate Body Report, *US – Shrimp*, paras. 118-121). Article XX has ten sub-paragraphs, of which (g) and (j) relate directly to the issue of exhaustibility. Sub-paragraph (b) may also be relevant. It concerns measures taken to protect human, animal or plant life or health and is discussed in Section E.2(b)(iii) below.[8]

Article XX(g) of the GATT permits the adoption of measures that are related to the conservation of exhaustible natural resources, provided that such measures are made effective in conjunction with restrictions on domestic production or consumption. This provision was first invoked in the WTO dispute settlement in *US – Gasoline*, where it was determined that "a policy to reduce the depletion of clean air was a policy to conserve an exhaustible natural resource within the meaning of Article XX(g)" (Appellate Body Report, *US – Gasoline*, p. 14). In *US – Shrimp*, the issue arose whether the term "exhaustible natural resource" refers exclusively to mineral or non-living resources or could also encompass living and renewable resources (particularly sea turtles in that case). On the question of whether a renewable natural resource could be considered exhaustible, the Appellate Body stated:

> "One lesson that modern biological sciences teaches us is that living species, though in principle, capable of reproduction and, in that sense, 'renewable', are in certain circumstances indeed susceptible of depletion, exhaustion and extinction, frequently because of human activities. Living resources are just as 'finite' as petroleum, iron ore and other non-living resources" (para. 128).

In addition to showing that the natural resource in question is "exhaustible", a WTO member relying on Article XX(g) must also ensure its measure *relates* to the conservation of this resource. In one dispute, this requirement was satisfied because the measure was "primarily aimed" at the conservation of a natural resource (Appellate Body Report, *US – Gasoline*).[9] In another dispute, it was noted that "the means and ends relationship" between the measure and the legitimate policy of conserving an exhaustible natural resource was "observably a close and real one" (Appellate Body Report, *US – Shrimp*, paras. 142-144). Finally, the requirement that the measure be "made effective in conjunction with restrictions on domestic production or consumption" has been described as "a requirement of even-handedness in the imposition of restrictions, in the name of conservation" (Appellate Body Report, *US – Gasoline* pp. 20-21).

Article XX(j) allows WTO members to take measures that are essential to the acquisition or distribution of products in general or local short supply. However, any such measures must be consistent with the principle that all members are entitled to an equitable share of the international supply of such products. This provision, in its original form, was adopted for a limited period of time to "take care of temporary situations arising out of the war",[10] before being accepted as a permanent provision in 1970.[11]

The phrase "general or local short supply" was intended to apply to "cases where a product, although in international short supply, was not necessarily in short supply in all markets throughout the world. It was not used in the sense that every country importing a commodity was in short supply."[12] This exception would provide WTO members with some flexibility to take trade-restrictive action when a particular resource becomes temporarily scarce. This flexibility is constrained by the requirement imposed by sub-paragraph (j) to respect the principle of equitable shares for members and the requirements of the chapeau of Article XX.

Box 27: General exceptions in the GATS and the protection of the environment

The GATS contains a general exceptions provision which is modelled on GATT Article XX. The preamble of GATS Article XIV is nearly identical, but the list of possible exceptions is shorter. While the GATS also contains an exception allowing WTO members to take measures "necessary for the protection of human, animal or plant life or health" (Art. XIV(b)), it does not provide for an exception addressing "the conservation of exhaustible natural resources" (GATT Art. XX(g)).

The scope of GATS general exceptions as they relate to the environment was discussed during the Uruguay Round. Some delegations proposed an exception referring to the "conservation of natural resources" or to "the environment". These proposals were not retained, but the compromise solution was that WTO members would revisit the issue after the entry into force of the GATS.

In the 1995 Ministerial Decision on Trade in Services and the Environment,[13] the Council for Trade in Services (CTS) acknowledges that measures necessary to protect the environment may conflict with the provisions of the GATS and notes that "since measures necessary to protect the environment typically have as their objective the protection of human animal or plant life or health, it is not clear that there is a need to provide for more than is contained in paragraph (b) of Article XIV". The CTS further decided:

> "[i]n order to determine whether any modification of Article XIV of the Agreement is required to take account of such measures, to request the Committee on Trade and Environment to examine and report, with recommendations if any, on the relationship between services trade and the environment including the issue of sustainable development. The Committee shall also examine the relevance of inter-governmental agreements on the environment and their relationship to the Agreement."

In December 1996, the Committee on Trade and Environment (CTE) reported that preliminary discussions on this issue "had not led to the identification of any measures that Members feel may need to be applied for environmental purposes to services trade which would not be covered adequately by GATS provisions, in particular Article XIV(b)".[14] The issue is still under consideration in the CTE.[15]

The 1950 Working Party on "The Use of Quantitative Restrictions for Protective and Other Commercial Purposes" noted that the equitable share principle in sub-paragraph (j) is different from the principle of non-discrimination, and emphasized that a determination of what is equitable "will depend upon the facts in ... any given circumstances". It also noted that circumstances in which a WTO member "diverts an excessive share of its own supply to individual countries" will be contrary to the principle of equitable distribution. To date, there have been no WTO dispute settlement proceedings addressing this provision.[16]

Exceptions to the prohibition of non-tariff restrictions (Article XI of the GATT)

As discussed in Section E.1(b)(i) above, Article XI of the GATT prohibits non-tariff import restrictions and bans export restrictions other than duties, taxes or other charges. Article XI(2)(a) provides an exception to this prohibition, and permits WTO members to impose export prohibitions or restrictions temporarily "to prevent or relieve critical shortages of foodstuffs or other products essential to the exporting contracting party". Although this provision has not been examined in either a GATT or WTO dispute, GATT preparatory work indicates that the words "prevent or" were added to "enable a [m]ember to take remedial action before a critical shortage has actually arisen" (EPCT/141).

The Report of the Review Working Party on "Quantitative Restrictions" states that "to the extent that the rise in prices was associated with acute shortages of the products in question ... (a temporary export restriction whether affecting foodstuffs or other products, was clearly covered by ... sub-paragraph (2(a))" *(GATT Analytical Index,* p. 326). De Han (1997) argues that export restrictions on water could be covered by this exception, as a product essential to the exporting state or as a foodstuff.

Article 12 of the Agreement on Agriculture sets out two obligations that are triggered when a WTO member invokes Article XI:2(a) of the GATT 1994 to institute a new export prohibition or restriction on foodstuffs. First, Article 12 requires the member instituting the measure to give due consideration to the effects of such a prohibition or restriction on importing members' food security. Second, the member must give notice in writing, as far in advance as practicable, to the Committee on Agriculture and shall consult, upon request, with any other member having a substantial interest as an importer. The obligations in Article 12 apply only to developed country members and to developing country members that are net food exporters of the specific foodstuff concerned.

(iii) Trade rules and the existence of externalities

Principle of non-discrimination: MFN and national treatment (Articles I and III of the GATT)

The principle of non-discrimination may constrain the ways in which a WTO member can impose measures designed to manage externalities. As mentioned earlier,

the principle of non-discrimination is articulated in the MFN (Article I of the GATT) and national treatment obligations (Article III of the GATT). Prohibitions and restrictions on imports and exports are also subject to a non-discrimination obligation under Article XIII of the GATT.

A key question is whether it is consistent with the principle of non-discrimination for WTO members to treat products differently based on non-product related process and production methods (PPMs). An example of this would be to treat products differently depending on the source of energy used in the manufacturing process. A specific example would be the situation where the value-added tax (VAT) applied to a plastic toy manufactured using "clean" electricity is lower than the VAT applied to the same toy when it is manufactured using electricity from other sources.

Some argue that it is consistent to treat goods with PPMs that minimize negative externalities differently from goods with PPMs that do not minimize these externalities (Potts, 2008). Others argue that policies such as these are inconsistent with the principle of non-discrimination because "like" products are not afforded equal treatment. The basis of this argument is that different PPMs are not an appropriate basis to treat differently products that are otherwise physically identical. Many equate such discrimination with "richer countries attempting to impose their environmental and socials standards on the rest of the world".[17] From a legal perspective, the focus of the debate concerns the meaning of the term "like products" as it appears in various provisions of the GATT.

The analysis of likeness between two products must be undertaken on a case-by-case basis. The four criteria that have been considered in the process are:

- the properties, nature and quality of the products
- the end uses of the products
- consumers' tastes and habits
- the tariff classification of the products.[18]

Those seeking to justify differential treatment based on non-product related process and production methods are likely to emphasize that in *EC – Asbestos* the Appellate Body considered the health risks associated with crysotile asbestos fibres in its analysis of the products' properties (Appellate Body Report, *EC – Asbestos*, paras. 135-136). By analogy, it has been suggested that distinctions relating to PPMs could also be taken into account in the analysis of likeness – for example, under consumers' tastes and habits, if consumers perceive those products that minimize negative externalities differently from those products that do not.

Some commentators have interpreted the Appellate Body's decisions in *US - Shrimp* and *EC – Asbestos* as supporting the proposition that differentiation based on PPMs is permitted by the GATT (Charnovitz, 2002; Halle, 2007). Conversely, there are others that consider that differences in PPMs do not necessarily make products unlike. Those holding this view emphasize that the properties, end-uses and the tariff classification are the same for both products, even if their PPMs differ. They would refer to the GATT Panel in *Tuna/Dolphin II*, which found that "... Article III calls for a comparison between the treatment accorded to domestic and imported like *products*, not for a comparison of the policies or practices of the country of origin with those of the country of importation" (GATT Panel Report, *Tuna/Dolphin II*). It is worth noting, however, that this panel report dates back to 1994 and was not adopted by the contracting parties, which means that it was never legally binding.

Labelling (Technical Barriers to Trade Agreement)

A WTO member may seek to encourage better management of certain negative externalities by requiring products to bear "eco-labels" (see Section D.4). An eco-label is a policy instrument designed to provide consumers with information about the impact of a product (including its PPM) on the environment and on sustainable development (Staffin, 1996; Chalifour, 2000). The rationale underpinning eco-labelling is that consumers will usually select the product for which negative externalities were best managed, and in doing so compel environmentally unfriendly producers to adjust their products and PPMs to better address these externalities (Staffin, 1996; Chalifour, 2000).

The Agreement on Technical Barriers to Trade (TBT Agreement) governs the use of technical regulations and voluntary product standards. The definition of technical regulations includes documents that refer to "product characteristics or their related processes and production methods". Similar language is used in the definition of a standard. The second sentence of both definitions, however, refers to labelling requirements "as they apply to a product, process or production method". The absence of the qualifying language "relating to" in the second sentence "has been interpreted by some as providing some scope for the labelling of a non-product related process or production method (i.e. that does not leave a trace in the final product, so-called 'unincorporated PPMs') to be covered by the TBT Agreement" (WTO and UNEP, 2009).

If an eco-label is regulated by the TBT Agreement, a WTO member must ensure that it is applied in a non-discriminatory manner to imported "like" products (Article 2.1, TBT Agreement). Moreover, members must ensure that the eco-label is not prepared, adopted or applied with a view to, or with the effect of, creating unnecessary obstacles to international trade (Article 2.2, TBT Agreement). Article 2.4 of the TBT Agreement expresses a preference for use of international standards as a basis for technical regulations where those standards exist or their completion is imminent. Under Article 2.5, whenever a technical regulation is in accordance with relevant international standards, it shall be rebuttably presumed not to create an

unnecessary obstacle to international trade. However, members are not required to use international standards where those standards would be an ineffective or inappropriate means for the fulfilment of the legitimate objectives pursued.

Sanitary and phytosanitary measures (SPS Agreement)

The Agreement on Sanitary and Phytosanitary Measures (SPS Agreement) recognizes that WTO members have the right to adopt sanitary and phytosanitary measures to protect human, animal or plant life or health (Article 2(1), SPS Agreement). However, the SPS Agreement imposes a number of conditions on this right.

First, SPS measures must be applied only to the extent necessary to protect human, animal or plant life or health, and must based on scientific principles and not maintained without sufficient scientific evidence (Article 2(2), SPS Agreement). Second, SPS measures must not arbitrarily or unjustifiably discriminate among WTO members where identical or similar conditions prevail (Article 2(3), SPS Agreement). Finally, members may choose to base their SPS measures on international standards (Article 3(1), SPS Agreement). Measures which conform to international standards shall be deemed to be necessary to protect human, animal or plant life or health and presumed to be consistent with the relevant provisions of the SPS Agreement and the GATT (Article 3(2), SPS Agreement). Members may introduce measures which result in a higher level of SPS protection than would otherwise be achieved by measures based on international standards, provided that there is scientific justification or as a consequence of the level of SPS protection a member determines to be appropriate (Article 3(3), SPS Agreement).

Article 2(4) of the SPS Agreement provides that if a SPS measure conforms with the requirements of the SPS Agreement, it is deemed to comply with the exception contained in Article XX(b). In the context of trade in natural resources, the SPS Agreement provides WTO members with a mechanism to limit, or even ban, the importation of certain harmful natural resource products without breaching their WTO obligations. This could, for example, include prohibiting the importation of certain forestry products that are likely to contain invasive species, such as Chestnut Blight, Dutch Elm Disease or Asian Longhorned Beetles (Chalifour, 2000; Hughes, 2010).

Charges equivalent to an internal tax on inputs

Article II of the GATT allows WTO members to impose a charge equivalent to an internal tax on the importation of any product. Issues relating to the interpretation of this and other related GATT provisions have been debated in relation to carbon taxes (WTO and UNEP, 2009).

WTO exceptions that permit otherwise inconsistent conduct (Article XX of the GATT)

The WTO recognizes that a member, in certain circumstances, may need to act inconsistently with its obligations in order to manage negative externalities, such as a negative impact on the environment. In the context of trade in natural resources, the most relevant "exceptions" are contained in Article XX of the GATT.[19] For a member seeking to manage a negative externality by implementing a WTO-inconsistent measure, the most relevant provisions of Article XX are contained in sub-paragraphs (b), (d) and (g). Sub-paragraph (g) is discussed above in Section E.1(b)(ii); sub-paragraphs (b) and (d) are discussed below.

Article XX(b) permits the adoption of measures that are necessary to protect human, animal or plant life or health. When invoking Article XX(b), a member must first show that the policy underpinning the measure in question falls within the range of policies designed to protect human, animal or plant life or health. Next, it must prove that the inconsistent measure was necessary to fulfil the policy objective.

On the first question, it is often the case that parties to a dispute will agree that the policy in question is designed to protect human or animal life, and thus falls under Article XX(b).[20] Where parties disagree, a panel will undertake an assessment of the purported risk, and determine whether the policy in question is designed to protect human or animal life from this risk. For example, in *EC – Asbestos*, the WTO Appellate Body affirmed a finding by the panel that "the evidence before it tends to show that handling chrysotile-cement products constitutes a risk to health (…)" and that therefore "the EC ha[s] shown that the policy of prohibiting chrysotile asbestos implemented by the Decree falls within the range of policies designed to protect human life or health" (paras. 8.193-8.194).

On the second question, in *Brazil – Retreaded Tyres*, the Appellate Body stated that a determination of whether a measure is "necessary" for the purposes of Article XX(b) involves an assessment of "all the relevant factors, particularly the extent of the contribution to the achievement of a measure's objective and its trade restrictiveness, in the light of the importance of the interests or values at stake" (para. 156). The Appellate Body further stated that a measure will be "necessary" if it is "apt to bring about a material contribution to the achievement of its objective" (Appellate Body Report, *Brazil – Retreaded Tyres*, para 151). Marceau and Wyatt (2009) have argued that the test applied by the Appellate Body in *Brazil – Retreaded Tyres* "seems less stringent in terms of what relationship it requires between the measures adopted and the policy objective pursued – thus producing more policy space for, amongst other things, environmental protection measures". They further suggest that this means that sub-paragraph (b) allows for similar flexibility as sub-paragraph (g), which concerns measures relating to the conservation of exhaustible natural resources.[21]

Article XX(d) permits the adoption of measures that are necessary to secure compliance with laws or regulations which are not inconsistent with the provisions of the GATT. In order for a measure otherwise inconsistent with the GATT 1994 to be justified under Article XX(d), it must first be shown that the measure is designed to secure compliance with laws or regulations that are not themselves inconsistent with some provision of the GATT 1994 (Appellate Body Report, *Mexico – Soft Drinks*, para. 67). The term "laws or regulations" has been understood to cover rules that form part of the domestic legal system of a WTO member, including rules deriving from international agreements that have been incorporated into the domestic legal system of a member or have direct effect according to that member's legal system. In reaching this conclusion, a concern identified was that a contrary interpretation would mean that WTO panels and the Appellate Body would become adjudicators of non-WTO disputes (Appellate Body Report, *Mexico – Soft Drinks*, paras. 78-79).

The requirement that the measures "secure compliance" was discussed by the panel in *US - Gasoline*, which had to determine whether the methods used by the United States to assess the composition and emission effects of imported gasoline were measures necessary to "secure compliance with a law or regulation" for the purposes of Article XX(d). The panel found these methods did not secure compliance with a law or regulation because "(they) were not an enforcement mechanism. They were simply rules for determining the individual baselines" (para. 6.33). In relation to the second element of Article XX(d) – that the measure be "necessary" to secure compliance – the panel in *Thailand – Cigarettes* held that the word "necessary" has the same meaning under Articles XX(d) as it does under Article XX(b) (para 74).

It has been suggested that sub-paragraph (d) could be used to justify import restrictions on illegally logged timber as it could be argued that the restrictions seek to secure compliance with forestry laws. One difficulty is that Article XX(d) is usually understood as applying to measures that seek enforcement of the domestic law of the WTO member applying the import restriction. In other words, the enforcement measure and the laws and regulations being enforced are taken by the same member. By contrast, in the example concerning illegally logged timber mentioned earlier, the import restriction would be applied by the importing member in order to secure compliance with the exporting member's forestry law (Brack, 2009).

Subsidies to manage externalities (SCM Agreement)

Article 8 of the SCM Agreement deems certain governmental assistance as non-actionable (i.e. not subject to challenge in the WTO or to countervailing measures). This includes assistance granted for research and development, and assistance to promote the adaptation of existing facilities to new environmental requirements. This provision, however, expired in 1999 and has not been renewed.

The SCM Agreement may also have a bearing on a WTO member's ability to provide access to natural resources to domestic users in exchange for undertakings by those users to harvest or extract the natural resources in a manner that minimizes negative externalities. For example, in a WTO challenge to a countervailing measure, the complaining party argued that standing timber provided to domestic users should not be characterized as subsidy because the price reflected "various forest management obligations and other in-kind costs relating to road-building or silviculture" (Panel Report, *US – Softwood Lumber IV*, para. 7.15).

There has been some discussion regarding whether Article XX of the GATT could be invoked to justify a measure that is contrary to the SCM Agreement or to other agreements regulating trade in goods. Some consider that the text of Article XX – particularly the phrase "nothing in this Agreement" – makes it clear that this provision may only be used to justify measures that are inconsistent with the GATT. There are others who see scope for Article XX to apply to other agreements regulating trade in goods, such as the SCM Agreement; they find support for this in a recent decision of the Appellate Body to the effect that Article XX could be invoked in relation to a specific provision in China's Protocol of Accession (Pierola, 2010).

Import licensing

Import licences are sometimes used to control the importation of products for conservation purposes. For example, endangered specimens of wild animals and plants covered by the CITES Agreement (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) may only be imported in exceptional circumstances and importation requires a permit. Some countries have also adopted import licensing schemes to control the importation of certain forestry products (Brack, 2009). The WTO Agreement on Import Licensing may be relevant in these cases. The Agreement provides that import licensing should be simple, transparent and predictable. It requires publication of information that allows traders to know how and why the licences are granted and includes requirements regarding notifications to the WTO. The Agreement also provides guidance on how governments should assess applications for licences.

Government procurement

Some WTO members impose conditions on the purchases of their central and sub-central government entities as a means of minimizing certain international externalities, such as the negative environmental consequences of certain practices. Brack (2009), for example, notes that several countries require that timber products purchased by government entities must come from timber that is legally and sustainably harvested. The Agreement on Government Procurement (GPA) is plurilateral, which means that it only applies with respect to those countries and customs territories

that are parties to it. Furthermore, the obligations in the GPA apply only to government entities and sectors which the corresponding party has included in its schedule of commitments. Brack (2009) observes that several important consumers of timber are parties to the GPA, but many of the largest producers are not.

For those entities and sectors that are covered, the GPA establishes obligations concerning openness, non-discrimination, and transparency. For instance, in respect of the procurement covered by the Agreement, parties are required to accord the products, services and suppliers of any other party to the Agreement treatment "no less favourable" than that given to their domestic products, services and suppliers (Article III:1(a)). Furthermore, parties may not discriminate among goods, services and suppliers of other parties (Article III:1(b)). In addition, each party is required to ensure that its entities do not treat domestic suppliers differently on the basis of a greater or lesser degree of foreign affiliation or ownership and to ensure that its entities do not discriminate against domestic suppliers because a good or service is produced in the territory of another party (Article III:2).

The GPA also prohibits the use of offsets, such as measures to encourage local development or improve the balance-of-payments accounts by means of domestic content, licensing of technology, investment requirements, counter-trade or similar requirements. Article VI of the GPA allows technical specifications laying down the characteristics of the products or services to be procured, including the processes and methods for their production, provided that such specifications do not create unnecessary obstacles to international trade. Article XXIII sets out various exceptions, including one for measures necessary to protect human, animal or plant life or health.

The revised GPA text (GPA/W/297), which is yet to come into force, has specific provisions regarding environmental concerns. For instance, Article X:6 will permit parties, including their procuring entities, to prepare, adopt or apply technical specifications to promote the conservation of natural resources or protect the environment. Article X:9 provides that environmental characteristics may be taken into consideration in spelling out evaluation criteria in tender documentation or notices.

Brack (2009) explains that some domestic government procurement policies allow the use of certain private certification schemes to demonstrate that timber products meet procurement criteria. He argues that certification under the main international schemes (the Forest Stewardship Council and the Programme for the Endorsement of Forest Certification Schemes) has proved to be the easiest way of meeting procurement criteria, and the latter have boosted the market for certified timber. In his view, the use of these certification schemes is consistent with the GPA where other equivalent forms of proof are also allowed.

(iv) Trade rules and dominance in markets for natural resources

Dual pricing

Dual pricing arrangements establish different prices in domestic and export markets. This may be achieved, for example, through the imposition of export taxes, quantitative export restrictions, or through state monopolies. A maximum domestic price may also be established administratively at a lower level than the export price. Dual pricing may be used as a means of diversifying the domestic production structure or the export base. Such policies can raise issues under the WTO. Where dual prices are established through export restrictions, for example, those restrictions may be found inconsistent with obligations in Article XI of the GATT.

The SCM Agreement may also be relevant. As noted earlier, the SCM Agreement defines a subsidy as a financial contribution provided by a government that confers a benefit. A WTO member that adopts a policy of dual pricing may be accused of subsidizing its domestic producers by providing discounted input materials. It has been argued by Ripinsky (2004) that a dual-pricing programme could be considered equivalent to the provision of goods or services by a government under Article 1.1(a)(1)(iii) of the SCM Agreement.

In 2000, Canada challenged before a WTO panel the US approach of treating export restraints as a "financial contribution" in countervailing duty investigations against allegedly subsidized imports. Canada argued that the US countervailing duty regime wrongly treated export restraints as financial contributions as government-entrusted or government-directed provision of goods by a private body, along the lines specified in Article 1.1(a)(1)(iv). The United States argued that export restraints could indeed (at least in some factual circumstances) constitute government-entrusted or government-directed provision of goods by a private body.

The panel concluded that the treatment of export restraints as financial contributions is inconsistent with Article 1.1(a) of the SCM Agreement. It rejected the US argument that, to the extent an export restraint resulted in an increased domestic supply of the restrained good, this was as if a government had expressly entrusted or directed a private body to provide the good domestically. However, the panel emphasized that its findings concerned an export restraint as defined by Canada in the context of that particular dispute – namely, a border measure that expressly limits the quantity of exports or places explicit conditions on the circumstances under which exports are permitted, or that takes the form of a fee or tax on exports of the product calculated to limit the quantity of exports (Panel Report, *US – Export Restraints*, paras. 8.19, 8.75 and 8.76).

Another issue is whether the provision of goods at suppressed prices confers a benefit. Article 14(d) of the SCM Agreement provides that to confer a benefit a good has to be provided at less than adequate remuneration.

Under this provision, the adequacy of remuneration is determined with reference to prevailing market conditions in the country of provision. In countries where there is dual pricing, it may be the case that the government is the predominant provider of the good. In the *US – Softwood Lumber IV* case, where Canadian provincial governments were the predominant suppliers of standing timber, the Appellate Body found that "it is likely that (the government) can affect through its own pricing strategy the prices of private providers ... inducing (those providers) to align their prices to the point where there may be little difference, if any, between the government price and the private prices" (Appellate Body Report, *US – Softwood Lumber IV*, paras. 101, 103). In these circumstances, the Appellate Body held that it may be necessary to consider private prices in another market to assess accurately the level of benefit conferred.[22]

Even if the provision of discounted goods under a programme of dual pricing amounts to a subsidy, some commentators contend that it would not be an actionable subsidy because it would not satisfy the specificity requirement contained in Article 2 of the SCM Agreement (Quick, 2009; Benitah, 2010). It is argued that a system of dual pricing is unlikely to provide *de jure* specific subsidies because, in most cases, the "low-priced ... product is generally available within the economy of the subsidizing government (i.e. available without restriction to all users)" (Marceau, 2010a, 2010b).

Article 2.1(c) of the SCM Agreement lists four factors that may be considered when assessing whether a subsidy that is not specific in a *de jure* sense may be specific in its operation (i.e. in a *de facto* sense). These factors are: i) the use of a subsidy programme by a limited number of certain enterprises; ii) the predominant use of such a programme by certain enterprises; iii) the granting of disproportionately large amounts of subsidy to certain enterprises; and iv) the manner in which discretion has been exercised by the granting authority in the decision to grant a subsidy. The extent to which a given dual-pricing programme involves subsidies that respond to any of these factors is a factual matter relevant to the programme in question.

Canuto and Finenberg (2003) note that a provision specifically dealing with dual pricing of government-supplied inputs was included in an early draft of the SCM Agreement during the Uruguay Round negotiations. The provision, included in a November 1990 draft of Article 14, read as follows:

> "When the government is the sole provider or purchaser of the good or service in question, the provision or purchase of such good or service shall not be considered as conferring a benefit, unless the government discriminates among users or providers of the good or service. Discrimination shall not include differences in treatment between users or providers of such goods or services due to normal commercial considerations."

The provision was deleted in a December 1991 negotiating draft.

Essential quantities exception (Article XX(i) of the GATT)

Article XX(i) permits otherwise WTO-inconsistent restrictions on exports of domestic materials where such restrictions are necessary to ensure essential quantities of such materials to a domestic processing industry during periods when their domestic price is held below the world price as part of a governmental stabilization plan. Such restrictions, however, "shall not operate to increase the exports of or the protection afforded to such domestic industry, and shall not depart from the provisions of the (GATT) relating to non-discrimination". The exception was proposed by New Zealand at the Geneva session of the Preparatory Committee in 1947 and was designed:

> "... to provide for the case of countries like New Zealand which maintain as a matter of permanent policy price stabilization schemes covering, generally, the whole range of their economy. A country which, like New Zealand, stabilizes its general price levels is faced with the problem that the world price for certain commodities, particularly raw materials which it exports, will be substantially higher than the stabilized price for the like commodity" (*GATT Analytical Index*, p. 591).

As an example of why this provision was necessary, New Zealand mentioned that leather was sold to its domestic producers at a price much below the world price. It then explained that, in these circumstances, it was necessary to ensure that local requirements of leather were satisfied by applying an export restriction; otherwise there would be no leather for the local market or the local price of leather would rise to the world level (*GATT Analytical Index*, p. 591).

Nevertheless, the 1950 Report of the Working Party on "The Use of Quantitative Restrictions for Protective and other Commercial Purposes" noted that Article XX(i) "does not permit the imposition of restrictions upon the export of a raw material in order to protect or promote a domestic industry, whether by affording a price advantage to that industry for the purchase of its materials, or by reducing the supply of such materials available to foreign competitors, or by other means" (*GATT Analytical Index*, p. 592).

Part IV of the GATT: trade and development

In 1965, Articles XXXVI, XXXVII and XXXVIII were added to the GATT 1947 to form Part IV, entitled *Trade and Development*.[23] A number of provisions contained in these Articles address the issue of dominance. Article XXXVI sets out the principle and objectives of Part IV, and recognizes the need for a "rapid and sustained expansion of the export earnings of the less-developed

(members)". Sub-section 5 of Article XXXVI relates to the export earning capacity of the less-developed members and directly addresses dominance:

> "The rapid expansion of the economies of the less-developed (members) will be facilitated by a diversification* of the structure of their economies and the avoidance of an excessive dependence on the export of primary products. There is, therefore, need for increased access in the largest possible measure to markets under favourable conditions for processed and manufactured products currently or potentially of particular export interest to less-developed (members)."

"Diversification" is defined in the Ad Note to Article XXVI as follows:

> "A diversification programme would generally include the intensification of activities for the processing of primary products and the development of manufacturing industries, taking into account the situation of the particular (member) and the world outlook for production and consumption of different commodities."

The scope and operation of Part IV of the GATT was considered in the GATT Panel Report in *EC – Refunds on Exports of Sugar*. In that case, the complainant, Brazil, argued that the European Communities' system for granting refunds on exports of sugar was inconsistent with commitments under Article XXXVI of the GATT. The European Communities argued that Brazil's complaint could not be grounded on Article XXXVI of the GATT alone because "the provisions of (this) Article ... constituted principles and objectives and could not be understood to establish precise, specific obligations" (para. 2.28). In rejecting this argument, the GATT panel affirmed that developing members could expect to enjoy the benefits articulated in Article XXXVI of the GATT (para. 4.30). Based on this interpretation, developing members may be able to invoke Article XXXVI to support efforts to diversify their economies with a view to addressing dominance.

Article XXXVI also recognizes the "need for positive efforts" and "individual and joint action" so that developing countries would be able to share in the growth in international trade and further their economic development. This resulted in the Agreed Conclusions of the United Nations Conference on Trade and Development (UNCTAD) Special Committee on Preferences which recognized that preferential tariff treatment accorded under a generalized scheme of preferences was key for developing countries "*(a)* to increase their export earnings; *(b)* to promote their industrialization; and *(c)* to accelerate their rates of economic growth" (para. I.2). With a view to achieving these goals, the GATT contracting parties adopted the 1971 Waiver Decision, which had the effect of waiving, for a period of ten years, the obligations of Article I of the GATT 1947 in respect of the granting of tariff preferences to developing countries.

In 1979, the GATT contracting parties adopted the Decision on Differential and More Favourable Treatment, Reciprocity and Fuller Participation of Developing Countries (the "Enabling Clause"), which had the effect of making permanent the waiver contained in the 1971 Waiver Decision. The Enabling Clause is now part of the GATT 1994 and thus of the WTO agreements.

The Enabling Clause was considered by the WTO Appellate Body in *EC – Tariff Preferences.* In examining the obligation imposed on the European Communities by Article I of the GATT to afford MFN treatment to India, the Appellate Body held that the Enabling Clause:

> "...excepts Members from complying with the obligation contained in Article I:1 for the purpose of providing differential and more favourable treatment to developing countries, provided that such treatment is in accordance with the conditions set out in the Enabling Clause. As such, the Enabling Clause operates as an 'exception' to Article I:1" (para. 90).

The WTO Appellate Body also interpreted footnote 3 to paragraph 2(a) of the Enabling Clause, which requires that any preferential tariff treatment under the Enabling Clause must be "non-discriminatory". The Appellate Body found that "the term 'non-discriminatory' should not be interpreted to require that preference-granting countries provide identical tariff preferences to all developing countries" (para. 155). Rather, preference-granting countries are authorized "to 'respond positively' to 'needs' that are *not* necessarily common or shared by all developing countries." Thus, developed-country members may grant different tariffs to products originating in different beneficiaries, provided that such differential tariff treatment meets the remaining conditions in the Enabling Clause. Nonetheless, WTO members granting the preferences "are required, by virtue of the term 'non-discriminatory', to ensure that identical treatment is available to all similarly-situated beneficiaries, that is, to all beneficiaries that have the 'development, financial and trade needs' to which the treatment in question is intended to respond" (para. 173).

Many WTO members have implemented preferential programmes under Part IV of the GATT 1994 and the Enabling Clause (Wang, 2005).[24] The 2007 *World Trade Report* has an extensive discussion of the effectiveness of these programmes, and describes some of the other measures that may be taken under provisions that provide special and differential treatment to developing countries.

(v) Trade rules and volatility

International commodity agreements (Article XX(h) of the GATT)

Price stabilization was one of the principal objectives of international commodity agreements negotiated between supplier and consumer countries. Article XX(h) provides a specific exception for measures taken under international commodity agreements. More specifically, it provides an exception for measures "undertaken in pursuance of obligations under any intergovernmental commodity agreement which conforms to criteria submitted to the contracting parties and not disapproved by them or which is itself so submitted and not so disapproved".

The Ad Note to Article XX(h) further states that "[t]he exception provided for in this subparagraph extends to any commodity agreement which conforms to the principles approved by the Economic and Social Council in its Resolution 30 (IV) of 28 March 1947". This Resolution calls for the creation of an Interim Co-ordinating Committee for International Commodity Arrangements and for UN member states to adopt the principles laid out in Chapter VII of the Havana Charter as a general guide for international action with respect to commodity problems (see sub-section 2 below).

No commodity agreement has been formally notified under Article XX(h) and measures taken under an international commodity agreement have never been challenged in GATT/WTO dispute settlement (*GATT Analytical Index*, p. 591). This provision may be of limited relevance today, at least for the natural resource sectors covered by this report. Other instruments of international law are discussed in what follows.

2. Other international law and natural resources

The WTO is part of a much broader framework of international cooperation. Many aspects of natural resources are regulated by other rules of international law outside of the WTO. Some international rules developed as customary international law, much of which was codified in international agreements in the second half of the 20th century.

(a) Relationship between WTO agreements and other international law

The WTO agreements are treaties and as such are regulated by the international rules on treaties codified in the Vienna Convention on the Law of Treaties (Abi-Saab, 2005). Likewise, the WTO is an international organization and its international personality also depends on general international law. As explained by WTO Director-General Pascal Lamy, "WTO norms are not hierarchically superior or inferior to any other norms (except *jus cogens*[25])" (Lamy, 2007).

Some provisions of the WTO agreements expressly refer to other international agreements. In these circumstances, the relationship between WTO and general international law is more straightforward. For example, Article 2.1 of the Agreement on Trade-Related Aspects of Intellectual Property Rights expressly incorporates several provisions of the Paris Convention for the Protection of Industrial Property of 1967. As a result, these provisions are binding on all WTO members and are subject to the WTO's dispute settlement system, as occurred in the *US – Section 211 Appropriations Act* dispute. Another example is the exception in Article XX of the GATT for measures undertaken under certain international commodity agreements.

A concern expressed by some observers is that trade-related measures taken under other international agreements, particularly multilateral environmental agreements, could be challenged in the WTO as incompatible with the obligations in the WTO agreements. This is an issue that has been discussed in the WTO Committee on Trade and Environment (CTE). The CTE has noted that only about 20 of the approximately 250 multilateral environmental agreements in force include trade provisions.[26] This has led some to argue "that the dimension of the problem should not be exaggerated".

The debate about the relationship between the WTO and other international agreements has also focused on the extent to which international law is applicable in disputes brought to the WTO. It is generally accepted that only claims brought under the WTO agreements may be brought to the WTO dispute settlement system (Van Damme, 2009). This means that a WTO member could not bring a dispute to the WTO claiming a violation of another international agreement or general international law, unless those obligations have been incorporated in the WTO agreements. There is, however, less clarity about the extent to which non-WTO agreements and general international law may be applied by panels and the Appellate Body when resolving a dispute brought under the WTO agreements.

It has been suggested that the WTO's Dispute Settlement Understanding (DSU) does not provide an explicit delimitation of applicable law in WTO dispute settlement (Van Damme, 2009). Article 3.2 of the DSU provides that one of the functions of the WTO dispute settlement system is "to clarify the existing provisions of those agreements in accordance with customary rules of interpretation of public international law." The WTO Appellate Body has interpreted the reference to "customary rules of interpretation of public international law" as including the rules codified in Articles 31 and 32 of the Vienna Convention on the Laws of Treaties. In addressing this issue, the Appellate Body made the often-quoted statement that the GATT 1994 cannot "be read in clinical isolation from public international law" (*US – Gasoline*).

There is little disagreement about the applicability of the rules of interpretation codified in Articles 31 and 32 of the Vienna Convention in WTO dispute settlement.

There is, however, significant divergence of opinion as to whether any scope exists in WTO dispute settlement to apply rules of international law other than those codified in Articles 31 and 32.

The general rule of interpretation set out in Article 31 states that "(a) treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose". Paragraph (3)(c) of Article 31 provides that, together with the context, there shall be taken into account "any relevant rules of international law applicable in the relations". For some observers, Article 31(3)(c) of the Vienna Convention provides an avenue for a WTO adjudicator to refer to other international agreements or to general international law when interpreting provisions of the WTO agreements. One issue here is whether only the disputants or all WTO members would have to be parties to the other international agreement for it to have relevance pursuant to Article 31(3)(c).

The panel in *EC – Approval and Marketing of Biotech Products* took the view that, for an international agreement to be relevant under Article 31(3)(c), all WTO members would have to be parties to the agreement. The panel's approach has been criticized by some academics (Howse, 2008) and by the Rapporteur of the UN International Law Commission's Study Group on Fragmentation, who wrote that the panel's approach "makes it practically impossible ever to find a multilateral context where reference to other multilateral treaties as aids to interpretation under article 31(3)(c) would be allowed" (International Law Commission, 2006).

The Appellate Body has occasionally sought guidance from other international agreements or general international law when interpreting provisions of the WTO agreements. In *US – Shrimp*, for example, the Appellate Body referred to various international environmental instruments when interpreting the term "exhaustible natural resources" in Article XX(g) of the GATT 1994. Relying on the principle of effectiveness in treaty interpretation, the Appellate Body, in that case, also emphasized the need to interpret the term "exhaustible natural resources" in an evolutionary manner, noting that Article XX "is not 'static' in its content or reference" (para. 130).[27]

It is important to distinguish the situation where an adjudicator seeks "guidance" from broader sources of international law, as the Appellate Body did in *US – Shrimp*, from the situation where another international treaty or a rule of general international law is considered to be binding on the WTO members that are parties to the dispute.

Some see little scope, if any, for the application of other international agreements or general international law as binding rules in the WTO (Marceau, 1999; Trachtman, 1999). They find support for their position in the last sentence of Article 3.2 of the DSU, which provides that dispute settlement rulings "cannot add to or diminish the rights and obligations provided in the covered agreements". Others, however, see some scope for the application of outside international rules in the WTO. Pauwelyn (2003) has argued that another international treaty or a rule of general international law may apply where a matter is not regulated by the WTO agreements. He has also noted that there may be circumstances where a WTO member could argue that its conduct conforms to another international agreement and this would constitute a defence to a claim that the conduct violates its WTO obligations.

The debate about the relationship between the WTO agreements and other international law is not settled. The UN International Law Commission has identified several principles that may be of assistance when seeking to understand the relationship between different international norms (International Law Commission, 2006). The WTO Agreement itself offers avenues for members to reconcile their WTO obligations with those under other international agreements. If WTO members want to privilege an obligation in another international agreement that is in potential conflict with their obligations under the WTO, they can adopt a waiver under Article IX:3 of the WTO Agreement, thus avoiding any uncertainties about the relationship between the two. This is how WTO members proceeded in relation to certain measures taken as part of international efforts to control the trade of "conflict" diamonds, known as the "Kimberley process" (see Section E.2(b) below).

(b) Trade in natural resources and other international law

(i) Sovereignty over natural resources

The WTO does not regulate ownership of natural resources. An important body of international law concerns sovereignty over territories, land masses, lakes, rivers, and areas of the ocean. These rules are also relevant for purposes of determining which state has sovereignty over the natural resources that are present in these territories, land masses and waters. Claims of sovereignty by states over territories and other land masses, as well as the oceans and seabed, have often been driven by a desire to assert control over the natural resources that may be contained in these areas.

It is universally accepted that the subsoil belongs to the state that has sovereignty over the surface (Brownlie, 2008). A state is also sovereign over any internal waters, such as lakes and rivers wholly within its territory, land-locked seas and historic bays. Sovereignty extends to the riverbed or lakebed of any internal waters (Brownlie, 2008). The rights and obligations of states in relation to rivers and lakes that border more than one state are frequently established by treaty.

Coastal states have asserted sovereignty over the continental shelf, which is a stretch of seabed that separates the deep ocean floor from the coast of land masses and is, in geological terms, part of the continent.

The continental shelf can have significant deposits of oil and gas, and its seabed has sedentary fishery resources (Brownlie, 2008).

The 1958 Convention on the Continental Shelf recognizes that the "coastal state exercises over the continental shelf sovereign rights for the purpose of exploring it and exploiting its natural resources" (Article 2.1, Continental Shelf Convention). This is an exclusive right and no-one may explore or exploit the natural resources on the continental shelf without the express consent of the coastal state. The natural resources covered "consist of the mineral and other nonliving resources of the seabed and subsoil together with living organisms belonging to sedentary species" (Article 2.4, Continental Shelf Convention). The status of the waters above the continental shelf is not affected by a coastal state's rights over its continental shelf (Article 3, Continental Shelf Convention).

Coastal states have sovereignty over their territorial sea, which includes the seabed and subsoil. Although the breadth of the territorial sea was debated for some time, most coastal states today claim a territorial sea of 12 miles, which is the limit established in the 1982 United Nations Law of the Sea Convention (Brownlie, 2008). Additionally, some states claim a fishing zone of 200 miles (Brownlie, 2008). A larger number of states claim an Exclusive Economic Zone (EEZ) of 200 miles and an EEZ of 200 miles is recognized also under the 1982 Convention on the Law of the Sea (Article 57, UNCLOS).

Within the EEZ, the coastal state enjoys "sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the sea-bed and of the sea-bed and its sub-soil, and with regard to other activities for the economic exploration and exploitation of the zone, such as the production of energy from water, currents and winds" (Article 56, UNCLOS). Coastal states also have jurisdiction within their EEZ as regards the protection and preservation of the marine environment (Article 56, UNCLOS).

The high seas are considered as "being open to all nations [and] no State may validly purport to subject any part of them to its sovereignty" (Article 2, Convention on the High Seas). Thus, freedom of fishing is generally recognized on the high seas (Brownlie, 2008). The 1982 Law of the Sea Convention makes certain changes to the regime of the high seas. First, it provides that the high seas do not include the EEZs (Articles 55 and 86, UNCLOS; Brownlie, 2008). Furthermore, the Convention establishes a special regime for the resources of the seabed and subsoil that are outside national jurisdictions (Brownlie, 2008). The Law of the Sea Convention declares that the Area, defined as the seabed and ocean floor and subsoil thereof and its resources, are beyond the limits of national jurisdiction and therefore are the common heritage of mankind (Articles 133 and 136, UNCLOS). An International Sea-Bed Authority is established under the Law of the Sea Convention and the Authority is given exclusive responsibility for organizing and controlling all activities in the Area so defined.

The fact that the high seas remain open to the use and enjoyment of all states and that many fish are migratory (referred to in the economic literature as fugitive resources) poses challenges for the sustainable use of these resources. The Law of the Sea Convention and the UN Fish Stocks Agreement attempt to regulate fishing practices on the high seas and in relation to fugitive species, but significant challenges remain. These challenges are discussed in sub-section 3.

Several states have made claims over the polar regions. These claims have gained prominence in recent years as some predict that global warming could make the polar areas more accessible to oil and minerals exploration, fishing, and shipping (Ebinger and Zambetakis, 2009; Dutter, 2006). There is no treaty regime for the Arctic region. The Arctic Council, which was established in 1996, serves as a forum for discussion and collaboration. Claims relating to the Arctic region involve maritime boundaries in relation to areas of the Arctic Ocean or the continental shelf. These claims are made under customary international law, the Law of the Sea Convention or the Convention on the Continental Shelf.

A rule of particular relevance for the Arctic region is the provision in the Law of the Sea Convention under which a state may try to demonstrate that its continental shelf extends beyond 200 nautical miles from its shoreline. If the claim is successful, the state obtains legal rights to exploit oil, gas and minerals in the extended zone (Ebinger and Zambetakis, 2009). States only have one opportunity to claim an extension of the continental shelf and they must do so within ten years of signing the Law of the Sea Convention. Several states have done so already, sometimes making headlines by planting a flag on the seabed (Ebinger and Zambetakis, 2009; (Reynolds, 2007).

In contrast to the Arctic region, a treaty regime was set up for Antarctica in 1959. The Antarctic Treaty, however, expressly states that it does not affect the territorial claims made by some states (and denied by others), nor provides a basis for the assertion of territorial sovereignty. The purpose of the Antarctic Treaty is to ensure "in the interest of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes". It establishes "freedom of scientific investigation in Antarctica" and provides a framework for cooperation. The Protocol for Environmental Protection, which entered into force in 1998, prohibits all activities relating to mineral resources other than scientific research. A Convention on the Regulation of Antarctic Mineral Resource Activities was negotiated in 1988. It set out rules on prospecting, exploration and the development of mineral resources activities. The Convention never entered into force because not all of the states with territorial claims over Antarctica became parties to it (U.S. Department of State, 2002).

Antarctica is thought to hold reserves of oil, gas, coal, iron, chromium and other precious metals (Dutter, 2006). Concerns have been raised over "bioprospecting" (searching for and collecting biological resources) and

the commercial exploitation of scientific research of biological organisms in Antarctica. A study by the UN University in Tokyo reportedly found that 92 patents referring to Antarctic organisms or molecules extracted from them have been filed in the United States, and a further 62 patents have been filed in Europe (Sample, 2004).

Issues concerning sovereignty over natural resources were raised in the context of the debate that followed the post-Second World War wave of nationalization of property held by foreign corporations in Eastern Europe, Africa, the Middle East and in several Latin American countries (Lowenfeld, 2003). The debate concerned whether the nationalizing state had an obligation to compensate the foreign investor and, if so, how this compensation should be determined. In 1962, the UN General Assembly adopted a Resolution on "Permanent Sovereignty Over Natural Resources", which stated that the "right of peoples and nations to permanent sovereignty over their natural wealth and resources must be exercised in the interest of their national development and of the well-being of the people of the State concerned."

The General Assembly adopted a further Resolution in 1973 stating "that the application of the principle of nationalization carried out by States, as an expression of their sovereignty in order to safeguard their natural resources, implies that each State is entitled to determine the amount of possible compensation and the mode of payment, and that any disputes which might arise should be settled in accordance with the national legislation of each State carrying out such measures". In 1974, the UN General Assembly adopted a Resolution entitled "Charter of Economic Rights and Duties of States", which declared that "[e]very State has and shall freely exercise full permanent sovereignty, including possession, use and disposal, over all its wealth, natural resources and economic activities."

There is no provision in the WTO that speaks directly to the issues of ownership of natural resources or the allocation of natural resources between states and foreign investors. Nor does the WTO dispute settlement system provide a means for foreign investors to obtain monetary redress for any harm to their investment done by the host government (bilateral investment treaties are discussed below in Section E.2(b)(v)). The WTO provides only for state-to-state dispute settlement and the remedies are generally prospective and non-monetary.

(ii) Price stability, addressing terms of trade, and rent-shifting

The Havana Charter for an International Trade Organization recognized that the "special difficulties" confronting primary commodities "may, at times, necessitate special treatment of the international trade in such commodities through inter-governmental agreement" and included an entire chapter with provisions on international commodity agreements (Havana Charter, chapter VI).

International commodity agreements encompassed both producer and consumer countries. Among their stated objectives were to: i) prevent or alleviate the serious economic difficulties which may arise when adjustments between production and consumption cannot be effected by normal market forces alone as rapidly as circumstances require; ii) prevent or moderate pronounced fluctuations in the price of a primary commodity; and iii) maintain and develop the natural resources of the world and protect them from unnecessary exhaustion (Havana Charter, Article 57). These objectives were later recognized in Resolution 30(IV) adopted by the UN Economic and Social Council and became the basis for the work of the Interim Co-ordinating Committee for International Commodity Arrangements. UNCTAD broadened the objectives of international commodity agreements in the 1960s by including increased export earnings for developing countries, re-allocation of resources, and increased consumption (Gariepy, 1976).

International commodity agreements were established for three products covered by this report: tropical timber, natural rubber and tin. The only one that remains operational today is the International Tropical Timber Agreement (ITTA), which was first negotiated in 1983. The ITTA however, has been described as "no conventional commodity agreement", but rather "as much an agreement for forest conservation and development as for trade". (See the International Tropical Timber Organization (ITTO) website: www.itto.int). The International Tin Agreement operated from 1955 to 1985, while the International Natural Rubber Agreement was in force between 1979 and 1999. Both of these agreements tried to stabilize prices using buffer stocks and export controls. A difficulty arising with these agreements concerned divergent views on the distinction between interventions that stabilized prices and those that affected price trends. As noted earlier, a specific exception is provided in Article XX(h) of the GATT for measures undertaken under international commodity agreements that conform to the principles approved by the UN Economic and Social Council in its Resolution 30 (IV) of 28 March 1947.

A number of commodity-specific agreements exist among producer countries, the most relevant of which is the Organization of the Petroleum Exporting Countries (OPEC).[28] As it does not include consumer countries, OPEC is not understood to be an international commodity agreement and thus the exception in Article XX(h) would not be applicable. However, Desta (2008) has suggested that this could be changing. He relies on paragraph 95 of the Doha Draft Modalities for Agriculture, which states that "[t]he general exceptions provisions of Article XX(h) of GATT 1994 shall also apply to intergovernmental commodity agreements of which only producing countries of the concerned commodities are Members".

The primary aim of OPEC is "the coordination and unification of the petroleum policies of Member Countries and the determination of the best means for safeguarding their interests individually and collectively",

which includes "devis[ing] ways and means of ensuring the stabilization of prices in international oil markets with a view to eliminating harmful and unnecessary fluctuations" (Article 2, OPEC Statute). OPEC pursues this aim by recommending oil production targets to its members (Crosby, 2009).

Twenty-eight advanced economies that are consumers of oil have created the International Energy Agency (IEA).[29] The IEA was created during the oil crisis of 1973-74, and its principal mandate was to coordinate measures in times of oil supply emergencies. Its mandate has been broadened beyond oil crisis management and now also encompasses issues relating to energy efficiency, climate protection and energy technology collaboration. Producer and consumer countries discuss issues relating to energy resources and markets in the International Energy Forum (Selivanova, 2007).

(iii) Regional and bilateral agreements

Some regional and bilateral trade agreements include obligations that go beyond WTO commitments. These agreements generally provide for more favourable tariff treatment for the products covered.[30] They may also include rules that go beyond WTO disciplines. For example, Article 314 of the North American Free Trade Agreement (NAFTA) prohibits a party from adopting or maintaining "any duty, tax or other charge on the export of any good to the territory of another Party, unless such duty, tax or charge is adopted or maintained on: a) exports of any such good to the territory of all other Parties; and b) any such good when destined for domestic consumption."[31]

Some of the bilateral agreements that the European Union has concluded also include additional disciplines on the use of export taxes. Article 17(1) of the agreement concluded with Algeria states that "[n]o new customs duties on imports or exports or charges having equivalent effect shall be introduced in trade between the Community and Algeria, nor shall those already applied upon entry into force of this Agreement be increased". The agreement between the European Union and South Africa contains a similar provision, while the agreement with Croatia calls for the abolition of "any customs duties on exports and charges having equivalent effect" upon its entry into force.

The NAFTA has a chapter on energy and petrochemicals, which sets out specific rules for these sectors. It eliminated import tariffs and quantitative restrictions, but allowed Mexico to maintain a licensing system for petroleum and electricity trade (Hufbauer and Schott, 2005). Minimum and maximum import and export prices are prohibited, while domestic prices are not regulated. The chapter also clarifies that energy regulatory measures – defined as "any measure by federal or sub-federal entities that directly affects the transportation, transmission or distribution, purchase or sale, of an energy or basic petrochemical good" – are subject to the disciplines on national treatment, import and export restrictions, and export taxes. Another provision of interest is Article 605, which defines the circumstances when a party may adopt or maintain a restriction under Article XI:2(a) or XX(g), (i) or (j) of the GATT in relation to the export of energy or a basic petrochemical good.[32]

An agreement that is of particular relevance to some of the sectors covered by this report is the Energy Charter Treaty (ECT), which came into force in 1998. The ECT has been signed by 51 states, the European Union and the European Atomic Energy Community (Euratom). Its membership comprises energy producers, consumers and transit states, including some that are not WTO members.

According to some commentators, the ECT has a "unique role as the only energy-specific multilateral agreement that covers all major aspects of international energy turnover: trade, transit, investment and energy efficiency" (Rakhmanin, 2009). The ECT also includes provisions on competition, transfer of technology, and access to capital. Victor and Yeuh (2010) point out that the effectiveness of the ECT has been affected by a lack of full participation in the treaty by Russia. Russia has signed the ECT but indicated in 2009 that it did not intend to become a contracting party to the ECT.

The ECT has been described as "primarily a multilateral investment protection treaty" (Selivanova, 2007). Nevertheless, the ECT includes a number of trade provisions, some of which are incorporated by reference to the WTO. ECT provisions on energy trade are based on the GATT/WTO principles of non-discrimination, national treatment, prohibition of quantitative export and import restrictions and access to markets on an open and transparent basis (Herman, 2010). Article 4 of the ECT provides that nothing in the treaty shall derogate, as between parties that are parties to the GATT, from the provisions of the GATT as applied between them. According to Selivanova, "[n]on-derogation from the provisions of the GATT/WTO is a core principle" of the ECT. GATT/WTO rules that are incorporated by reference apply to energy trade relations between the contracting parties of the ECT, including where a party is not a WTO member.

In relation to energy transit, "the (ECT) contains in its Article 7 several disciplines that are more specific and detailed than those of Article V of the GATT 1994" (Ehring, 2007). These include the obligation not to obstruct arbitrarily the creation of new capacity if transit cannot be carried out through existing infrastructure due to lack of capacity, and the obligation not to interrupt or reduce existing transit flows, even if there is a dispute with another country concerning this transit. There is a special conciliation procedure foreseen for resolution of transit disputes.[33] The Transit Protocol to the ECT, the negotiations of which are pending, would elaborate in more detail some specific aspects of energy transit, such as conditions for access to networks and methodologies for calculation of transit tariffs.

The ECT does not prescribe the structure of the domestic energy sector, the ownership of energy

companies or oblige member countries to open up their energy sector to foreign investors. The ECT expressly recognizes national sovereignty over energy resources: each member country is free to decide how, and to what extent, its national and sovereign energy resources will be developed, and also the extent to which its energy sector will be opened to foreign investments (Article 18 of the ECT). At the same time, there is a requirement that rules on the exploration, development and acquisition of resources be publicly available, non-discriminatory and transparent.

Once a foreign investment is made, the ECT is designed to provide a reliable and stable interface between this investment and the host government. Investors are protected against the most important political risks, such as discrimination, expropriation and nationalization,[34] breach of individual investment contracts,[35] damages due to war and similar events, and unjustified restrictions on the transfer of funds. Host states are obliged to grant to investments from other ECT members as well as to related activities, such as management, maintenance, use, enjoyment or disposal, treatment at least as favourable as that accorded to the investments of their own investors or of investors of other countries. The non-discrimination obligation is applicable only to the post-investment stage, i.e. only to investments already made.

As regards the pre-investment phase,[36] there is only a "best endeavour" obligation to grant non-discriminatory treatment. Furthermore, ECT members must endeavour not to introduce new restrictions on foreign investors concerning the making of an investment ("standstill") and to progressively reduce remaining restrictions ("rollback").

(iv) Externalities

A large number of international agreements establish mechanisms for states to cooperate in dealing with international externalities, many of which relate to the protection of the environment. There are more than 250 multilateral environmental agreements currently in force. They cover a broad array of issues, such as endangered wild fauna and plants (Convention on International Trade in Endangered Species), fisheries (United Nations Fish Stocks Agreement), tropical timber (International Tropical Timber Agreement), climate change (United Nations Framework Convention on Climate Change and the Kyoto Protocol), and hazardous wastes (Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal).

As noted earlier, about 20 of these multilateral environmental agreements include trade provisions.[37] For example, the Convention on International Trade in Endangered Species subjects trade in certain specimens of wild animals and plants to controls through the use of a licensing system. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal imposes prohibitions on the exportation of hazardous wastes. The UN Fish Stocks Agreement allows parties to prohibit landings and trans-shipments where it has been established that the catch has been taken in a manner which undermines the effectiveness of sub-regional, regional or global conservation and management measures on the high seas.

Some observers have expressed concern about the relationship between these trade-related measures in multilateral environmental agreements and the international trade rules in the WTO agreements. The need to ensure coherence between multilateral efforts aimed at preserving the environment and the multilateral trading regime has been emphasized both in international environmental discussions and at the WTO. On the environmental side, the need for coherence is expressly acknowledged in Principle 12 of the Rio Declaration on Environment and Development, which reads:

> "States should cooperate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation. Trade policy measures for environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade. Unilateral actions to deal with environmental challenges outside the jurisdiction of the importing country should be avoided. Environmental measures addressing transboundary or global environmental problems should, as far as possible, be based on an international consensus."

The Preamble of the WTO Agreement recognizes that the expansion of trade and production must allow "for the optimal use of the world's resources in accordance with the objective of sustainable development" and must "seek to protect and preserve the environment". The 1994 Ministerial Decision on Trade and Environment states "that there should not be, nor need be, any policy contradiction between upholding and safeguarding an open, non-discriminatory and equitable multilateral trading system on the one hand, and acting for the protection of the environment, and the promotion of sustainable development on the other".

Article XX of the GATT 1994 provides exceptions for measures "necessary to protect human, animal or plant life or health" or "relating to the conservation of exhaustible natural resources". The TBT Agreement allows WTO members to adopt technical regulations to protect human health or safety, animal or plant life or health, or the environment. In the case of trade in services, Article XIV of the GATS permits WTO members to adopt or enforce measures necessary to protect human, animal or plant life or health.[38]

To date, no trade measures taken under a multilateral environmental agreement have been challenged as being incompatible with WTO obligations. Multilateral environmental agreements were referred to in the *US – Shrimp* dispute, which involved a restriction on imported shrimp harvested without the use of devices that prevent the accidental capture of sea turtles. One of the issues raised in that case was whether the term "exhaustible natural resources" covered living organisms or only covered non-living mineral resources. The Appellate Body concluded that the term included living organisms after referring to several international environmental instruments, such as the Convention on Biological Diversity and Agenda 21.

Another issue that was raised in the *US – Shrimp* dispute was whether the measure was applied consistently with the chapeau of Article XX of the GATT 1994, which requires that it not be "applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade". In the original proceedings, the WTO member applying the import restriction was found not to have met this requirement because it had "negotiated seriously" with one group of exporting countries, but not with the exporting countries that had initiated the dispute. This was deemed to have a discriminatory effect and was considered unjustifiable (Appellate Body Report, *US – Shrimp*, para. 172).

However, in a subsequent proceeding, the conditions in the chapeau of Article XX were found to have been met after it was shown that the WTO member applying the import restriction had made "serious, good faith efforts … to negotiate an international agreement" with the group of exporting countries concerned. Those proceedings also clarified that "it is one thing to prefer a multilateral approach in the application of a measure that is provisionally justified under one of the subparagraphs of Article XX of the GATT 1994; it is another to require the conclusion of a multilateral agreement as a condition of avoiding 'arbitrary or unjustifiable discrimination' under the chapeau of Article XX". No such requirement was found in that case (Appellate Body Report, *US – Shrimp (Article 21.5 – Malaysia)*, paras 124 and 134).

Another concern is that disputes involving environmental measures may be brought to the WTO and simultaneously to another forum, and that each may issue conflicting decisions. WTO members have so far avoided such situations. This is illustrated by a dispute between Chile and the EU concerning the landing of swordfish.

In April 2000, the EU requested consultations with Chile in relation to Chilean legislation that prohibited EC vessels from unloading their swordfish in Chilean ports either to land them for warehousing or to tranship them onto other vessels (WT/DS193/1). The EU alleged that such a prohibition made transit through Chilean ports impossible, and as such was inconsistent with Article V of the GATT 1994. Chile, for its part, asserted that the EU was required, under its obligations in UNCLOS, to enact and enforce conservation measures for its fishing operations on the high seas, and Chile initiated proceedings against the EU before the International Tribunal for the Law of the Sea (ITLOS). However, in March 2001, the EU and Chile informed the Dispute Settlement Body that they had come to a provisional arrangement concerning this dispute and accordingly had agreed to suspend the WTO panel process. Chile and the EU eventually reached a settlement of the dispute and, at their request, the ITLOS Tribunal discontinued the case on 16 December 2009.

Some consider it advisable to spell out further the relationship between the WTO and multilateral environmental agreements. Thus, at the 2001 Doha Ministerial Conference, WTO members agreed to negotiate on the relationship between WTO rules and the multilateral environmental agreements, particularly those that contain "specific trade obligations". These negotiations take place in special sessions of the Trade and Environment Committee. Members have agreed that the scope of these negotiations would be limited to the applicability of WTO rules to WTO members that have signed the multilateral environmental agreement under consideration.

Corruption is another issue on which states have cooperated to address an international externality. The OECD Convention on Combating Bribery of Foreign Public Officials in International Business Transactions requires its signatories to criminalize the bribing of foreign officials in international business transactions. The Extractive Industries Transparency Initiative (EITI) is a coalition of governments, companies, civil society groups, investors and international organizations that seeks to promote improved governance in resource-rich countries through the verification and publication of company payments and government revenues from oil, gas and mining.

An international initiative that has been the subject of discussion in the WTO is the Kimberley Process Certification Scheme (KPCS). This is a joint initiative of governments, industry and civil society that seeks to stem the flow of "conflict diamonds". These are rough diamonds used by rebel movements to finance conflicts aimed at undermining legitimate governments, as described in relevant United Nations Security Council resolutions. The KPCS obliges its members to ensure that a Kimberley Process Certificate accompanies each shipment of rough diamonds being exported. The document certifies that conflict diamonds are not included in a shipment of rough diamonds.

In 2003, the WTO General Council approved a request by 11 members of the KPCS to waive the application of certain GATT rules with respect to measures taken to prevent the export of conflict diamonds in accordance with the KPCS. In particular, the WTO General Council waived the application of Article I:1, Article XI:1 and Article XIII of the GATT for the period 1 January 2003 to 31 December 2006 for 11 WTO members (WT/L/518).[39] In December 2006, the Kimberley

Waiver was extended to 2012, and the members to which it applies expanded to 19 (WT/L/676).

(v) "Hold-up"

Bilateral investment treaties (BITs) play an important role, particularly in relation to minerals and energy resources. These treaties seek to resolve what is known as the hold-up problem[40], by constraining the host government from changing the rules that apply to the investor once the investment has been made (Guzman, 1998). It is estimated that there are more than 1,100 BITs in force, with more than 800 having been concluded since 1987, and more than 155 countries are parties to a BIT. Most BITs are between developed and developing countries, but a substantial number of BITs have been concluded between developing countries (Lowenfeld, 2003).

BITs require the host state to give foreign investors "fair and equitable treatment" and "full protection and security" (Lowenfeld, 2003). They also prohibit the host state from discriminating against foreign investors and from taking their property without compensation. Most BITs provide that "expropriation is lawful and not inconsistent with the BITs if it (i) is carried out for a public purpose; (ii) is non-discriminatory; (iii) is carried out in accordance with due process; and (iv) is accompanied by payment of compensation" (Lowenfeld, 2003). BITs also provide for recourse to international arbitration when an investor considers that a host state has violated its obligations under the BIT. One of the most frequently used fora for such arbitration is the World Bank's International Centre for Settlement of Investment Disputes.[41] Investment protection provisions also may be found in other international agreements, including multilateral sector-specific agreements, such as the Energy Charter Treaty, and in regional or bilateral trade agreements, such as NAFTA.

The WTO does not regulate investment, except for services provided under the so-called mode 3 (see Box 26). At the Ministerial Conference held in Singapore in 1996, WTO members agreed to establish a working group to examine the relationship between trade and investment.

In 2001, at the Doha Ministerial Conference, WTO members recognized "the case for a multilateral framework to secure transparent, stable and predictable conditions for long-term cross-border investment, particularly foreign direct investment, that will contribute to the expansion of trade" and agreed "that negotiations will take place after the Fifth Session of the Ministerial Conference on the basis of a decision to be taken, by explicit consensus, at that session on modalities of negotiations". WTO members also agreed on a work programme for the Working Group on the Relationship Between Trade and Investment. Nevertheless, at a General Council meeting held in 2004, members decided that the relationship between trade and investment would no longer form part of the Doha Work Programme and that "therefore no work towards negotiations on any of these issues will take place within the WTO during the Doha Round".

3. Trade-related issues affecting natural resources: Challenges ahead

As discussed in previous sections, natural resources display a number of characteristics that make a case for government intervention to improve social welfare, as compared to the free trade outcome. Much of the analysis of this report has focused on GATT/WTO aspects of trade in natural resources. Some of the issues raised below are not necessarily within the purview of the WTO, but they are nevertheless discussed here as they appear relevant to international cooperation in the field of natural resources.

As far as our review of WTO rules is concerned, it has been shown that these provide scope for governments to address market failures related to the specific nature of natural resources. At the same time, certain measures limiting access to natural resources are prohibited by WTO rules. Tariffs on most natural resources, with the exception of fish, are relatively low and the number of disputes involving natural resources is not particularly high. None of this means, however, that trade in natural resources is free of contention and varying views on the preferred nature and content of multilateral trading rules. Differences of view among WTO members arise in a number of areas, particularly in relation to export restrictions and subsidies. Concerns have also been raised in regard to possible negative interactions between WTO rules and commitments and conservation policies.

Issues taken up here, which have emerged in various contexts, include export restrictions, subsidies, domestic and international regulation, investment-related challenges in natural resource industries, competition questions, transit and transportation, the distinction between goods and services in relation to natural resources, intellectual property rights and natural resources conservation. This list does not pretend to be exhaustive, nor is there any suggestion in the selection of these issues that they all fall within the scope of agreed WTO competence.

(a) Export restrictions

(i) Export taxes

As discussed in sub-section 1, WTO rules prohibit the use of quantitative export restrictions with some exceptions but it has been generally recognized that they do not prohibit the use of export taxes or duties. Sub-section 1 also explained that the panel on *US – Exports Restraints* did not find that certain export restraints were subsidies that would allow countervailing measures to be taken under the Agreement on Subsidies and Countervailing Measures.[42]

WTO members could have made binding commitments to reduce their export taxes (as they have done with respect to import tariffs), but most of them have not.

Box 28: **What is the economic rationale for trade agreements?**

Economists have identified two main reasons why governments sign a trade agreement: first, to avoid "beggar-thy-neighbour" policies that are unilaterally attractive but multilaterally destructive; second, to avoid "beggar-thyself" policies that are attractive in the short run but do not serve the long run interests of society (Bagwell and Staiger, 2009; World Trade Organization, 2007).

The beggar-thy-neighbour problem is based on the idea that trade policy decisions of one country affect the welfare of another country. While it is by no means the only beggar-thy-neighbour effect, the formal literature focuses on the terms-of-trade effect (Johnson, 1954). The purpose of a trade agreement such as the WTO is, therefore, to make sure that governments account for these effects when they make policy.

Consider two large open economies able to affect global demand and supply and, hence, world prices in a specific sector. By imposing an import tariff, a country increases the price of imports for consumers but lowers the price received by foreign exporting firms. This price change constitutes a terms-of-trade gain at the expense of the trading partner, which experiences a terms-of-trade loss. As countries interact strategically in the international arena, the trading partner will react by imposing a tariff on its imported good, also improving its terms of trade to the detriment of the other economy. Eventually the economy ends up in an equilibrium with inefficiently high tariffs and low trade volumes, which economists generally refer to as a terms-of-trade driven "Prisoners' Dilemma". A trade agreement like the GATT/WTO contains a set of rules and principles, such as non-discrimination and reciprocity, that facilitate trade cooperation and allow members to escape this non-cooperative behaviour and achieve higher welfare (Bagwell and Staiger, 1999; Bagwell and Staiger, 2002).[43]

The other reason why countries sign a trade treaty is because governments may also face problems in committing to follow a welfare-maximizing trade policy. First, an efficient trade policy may be time inconsistent. This can arise when a government's policy preferences change as circumstances change over time. As a result, an efficient but time-inconsistent trade policy may not be credible in the eyes of private agents (Staiger and Tabellini, 1987). Second, an efficient trade policy may not be convenient for a government under political pressures, such as lobbying from import-competing sectors (Maggi and Rodriguez-Clare, 1998). Under these scenarios, a trade agreement can be a welfare-enhancing institutional reform as it may provide an effective commitment device to tie the hands of member governments to an efficient policy. The WTO system, in this view, provides an anchor to avoid beggar-thyself policies.

The two approaches are complementary in the sense that one does not exclude the other, and several recent papers provide empirical support for both theories. Broda et al. (2008) and Bagwell and Staiger (2006a) find evidence consistent with the terms-of-trade approach, while Staiger and Tabellini (1999) and Tang and Wei (2009) substantiate the belief that WTO commitments address credibility problems.

A trade agreement, like any other international cooperation agreement, needs to be self-enforcing. In the absence of a supranational authority that can punish governments that deviate, members need to find it in their own interest to abide by international rules. Economic theory has formalized the requirement of self-enforcement in trade agreements by introducing the concept of repeated games.[44] Trade cooperation arises as countries balance the gains of deviating from the agreement against the ensuing losses from retaliation (i.e. trade sanctions). For this reason, the GATT/WTO system allows for retaliatory measures that can be implemented when members do not adhere to their commitments.

However, several countries that have recently joined the WTO, including China, Mongolia, Saudi Arabia, Ukraine and Viet Nam have been requested by existing members to negotiate commitment "schedules" for export duties in the context of their accession negotiations.[45] In a number of cases, the export duties covered by such commitments concern natural resources. The extent to which these commitments reduce or remove export taxes varies across members.

Divergent interests in relation to export taxes have come to the fore in the context of the Doha Round negotiations on market access for non-agricultural products. In their initial submissions to the Negotiating Group on Market Access, two members noted that negotiations should also address export restrictions, including export duties.[46] One of those members tabled a proposal for a WTO Agreement on Export Taxes aimed at the elimination of all such measures over time, allowing only for a small number of general exceptions and for limited flexibilities for developing countries (Job(07)/43). This proposal, which was motivated by concerns that export taxes can be used to restrict access to crucial raw materials and input goods and can thereby impede growth and development of other WTO members, met with critical reactions from a number of other members who argued that export duties are legitimate tools of economic development.

The proposal was subsequently revised and the revised submission was included in the fourth revision of draft modalities for non-agricultural market access. The revised approach represents a shift from a general prohibition of export taxes, with exceptions based on

GATT rules, to the establishment of rules on transparency and predictability, which, in the view of the proponents, could be ensured through scheduling commitments and the binding of members' export taxes (i.e. setting upper limits).

Export policy has also been the subject of discussion in the agriculture negotiations. This is reflected in the draft negotiating modalities[47] on export prohibitions and restrictions. The proposed text on this topic seeks to improve transparency and accountability. It also seeks to shrink the duration of quantitative export restrictions on agricultural products, which are permitted under Article XI.2(a) of GATT 1994 as temporary measures to relieve critical shortages. Several members also made proposals on export taxes in the agricultural sector. Many of the proposals seek to restrict or eliminate the use of export taxes. They were made either in the context of the post-Uruguay Round discussions on agriculture that fed into the Doha Round, or they were made in the first two or three years of the Doha Round. The proposals have received limited attention in recent years.

In this context, a number of regional and bilateral trade agreements prohibit the application of customs duties, taxes and charges having equivalent effects on exports of originating goods traded between parties to the agreements.[48]

The economic theory of trade agreements sheds some light on the reasons why governments may be interested in negotiating restrictions on their use of export tariffs.[49] The reasoning is based on the idea that from an economic point of view, export taxes are the mirror image of tariffs. It is thus not surprising that the same terms-of-trade argument for international cooperation that applies to import tariffs also applies to export taxes. A large country can improve its terms of trade at the expense of its trading partners by imposing export restrictions. The reduction in supply will push up the world price. As in the tariff case, two large countries restricting their exports to each other could end up in a "Prisoners' Dilemma" situation if they did not cooperate (see Box 28). If this is the case, a trade agreement that would allow trading partners to commit to export tax reductions would be beneficial. Note that this argument does not apply to export taxes on natural resources only. It applies more generally to export taxes imposed by countries when they are large enough to affect world prices.

Commitments to reduce export taxes could be exchanged against commitments to reduce either export taxes or import tariffs. Consider the case where an importing country imposes escalating tariffs along a production chain in a natural resource sector with the result that higher levels of processing of a good attract higher tariffs. The country exporting a natural resource may decide to impose an export tax to offset the effects of the import tariffs. In this particular case, an agreement involving a commitment on export taxes on the one side and a commitment on import tariffs on the other would be mutually beneficial.

In theory, the rationale for allowing governments to negotiate commitments on export taxes could be extended to certain domestic policy instruments. This is because basic economic arguments can be used to show the conceptual equivalence between certain trade policy instruments and certain domestic policy instruments. As explained in Section D, in the absence of domestic consumption, a domestic production quota is equivalent to an export quota. Yet, while an export quota is prohibited by Article XI of the GATT, most observers consider that a production quota is not subject to this prohibition. Instead, many consider that decisions concerning how much of a natural resource is extracted or harvested fall within the sovereignty of each state (see sub-sections 1 and 2 above). Similarly, an export tax is equivalent to a consumption subsidy. Also, in the absence of domestic production, a consumption tax is equivalent to a tariff. Given this equivalence, depending on the circumstances, governments may have reasons to prefer using a domestic policy instrument rather than the equivalent trade policy measures.

Consider the market for oil. Exporters typically use production restrictions while importers typically use consumption taxes. Like an import tariff, a consumer tax in the importing country will reduce the domestic – and, hence, global – demand for oil and lower its world price, shifting part of the resource rent (i.e. the premium that the producer or exporter receives above opportunity cost) from the exporting country to the importing country. Similarly, like an export restriction, a production quota in the exporting country lowers the supply in international markets and increases the world price, thus shifting the rent from the importing to the exporting country.[50]

The cross-border impact created by the rent-shifting effects of consumer taxes and production quotas gives rise to a Prisoners' Dilemma situation, similar to the one discussed earlier. If each country acts non-cooperatively, it will have an incentive to set its policy at an inefficient level in order to shift the resource rent away from its trading partner. For instance, while consumer taxes on oil could be efficiently set at a positive rate to offset the environmental damage created by carbon dioxide emissions, importing countries may have an incentive to go beyond the efficient tax rate. A similar argument may apply to producing countries, which may restrict production (and hence export) of oil for both beggar-thy-neighbour and resource conservation purposes. Collier and Venables (2009) argue that attempts to shift rents internationally in tariff or export tax wars are zero-sum games, whereby one trading partner's gain or loss is balanced by the losses or gains of the other trading partner. They show that these policy interventions create substantial price variation across different national markets, which creates inefficiency. For example, high prices in importing countries may reduce consumption to a greater degree than is necessary to meet environmental concerns. Also, the lessons that we learn from the theory of trade agreements apply to this environment. It would in

principle be possible to reach a mutually beneficial deal between importing and exporting countries in which production restrictions and consumption taxes would be reduced, so as to cut efficiency losses while the international distribution of rents is unaffected.

Clearly, a reduction of production restrictions in the oil sector may stop short of a complete elimination of restrictions. Production may need to be restricted on account of the efficient management of an exhaustible resource or the adverse effects of carbon dioxide emissions.

(ii) Export licensing

A discussion related to that on export taxes has taken place in the framework of the Doha Round negotiations, where four WTO members recently circulated a proposal for a protocol on transparency in export licensing.[51] This proposal reflects a concern about the use of quantitative export restrictions on natural resources which was first expressed by one of the four proponents in a paper circulated in 2006.[52]

The 2006 paper discussed the need for enhanced disciplines on export restrictions, arguing that the provisions that regulate the use of quantitative restrictions on imports and on exports in the GATT/WTO framework are unbalanced. Existing provisions regarding export restrictions are often less explicit and less precise than those for import restrictions. The paper therefore proposed disciplines to enhance the transparency of export restrictions, in particular when applied to mineral products and other exhaustible natural resources. Based on this paper, a proposal for negotiations on Enhanced Transparency on Export Restrictions was subsequently submitted, including a draft agreement on export licensing procedures. This proposal was further revised and evolved into the proposed protocol, which would not be limited to natural resources.

(b) Subsidies

A number of issues relating to subsidies in natural resource industries have been debated in WTO accession negotiations and/or are being discussed in the Doha Round negotiations. Before examining these specific issues, let us consider what economic theory tells us about the rationale for subsidy disciplines in trade agreements.

As explained in Box 28, there are two main explanations for the role of trade agreements in economics literature: the commitment approach and the terms-of-trade approach. According to the former, WTO subsidy rules may provide policy-makers with a commitment mechanism to credibly eliminate or limit an inefficient policy. Brou and Ruta (2009) and Brou, Campanella and Ruta (2010) demonstrate this point in the context of domestic subsidies, but the logic of the argument applies also to export subsidies.

In the terms-of-trade approach, the case for imposing disciplines on the use of subsidies is more limited (Bagwell and Staiger, 2006b; Bagwell and Staiger, 2001b; Janow and Staiger, 2003). The fundamental inefficiency associated with unilateral trade policy choices is insufficient trade volumes and, to the extent that a subsidy increases trade volumes, it enhances efficiency. Consequently, restricting its use would work against efficiency.[53] However, when subsidy rules prevent the use of new subsidies that have the effect of undermining negotiated tariff commitments, they help governments negotiate more efficient market access agreements and thereby enhance efficiency.

A related issue is the role of domestic subsidies as an efficient (i.e. first-best) policy tool in addressing market failures (Bhagwati and Ramaswami, 1963; Johnson, 1965). This argument suggests that the design of subsidy rules within a trade agreement should leave sufficient policy flexibility to member governments to address distortions. Failing to do so might induce policy-makers to over-use other – less efficient – measures, such as tariffs, as substitutes to domestic subsidies (Sykes, 2005).

(i) Subsidies to fisheries

A well-documented example of subsidization of a natural resources sector is the fisheries industry. Many commentators consider that fishing subsidies exacerbate the problem of exhaustibility by encouraging over-exploitation. In this context, one question that has been raised is whether the Agreement on Subsidies and Countervailing Measures (SCM) in its current form adequately disciplines such subsidies. As noted in Section C, one might expect the supply schedule for fish to bend backwards above a certain price level because of over-exploitation and falling productivity in a situation of poorly defined property rights. This means that above this threshold price level, a subsidy might reduce rather than increase the amount of fish harvested. Under such circumstances, neither importers of subsidized fish nor exporters to the subsidizing country would appear to have grounds for complaint to the WTO.

A second issue is that a fishing subsidy is unlikely to be challenged as an export subsidy under the SCM Agreement because fishing subsidies are usually granted by net importers of fish for domestic consumption (Young, 2009). Fishing subsidies are more likely to be deemed to be actionable subsidies. In this case, for a WTO member to challenge successfully the subsidy at the WTO, it would be necessary to show adverse effects to the member's interests. According to a number of commentators, this is a difficult task (Young, 2009). There are a number of reasons for this. First, the disparate nature of fish species makes market displacement harder to prove. Second, distortions will be in resource availability rather than in the prices for exporters (which does not give grounds for a challenge under the SCM Agreement). Third, it is difficult to identify a price reference point against which the loss

can be measured because the entire industry is distorted through subsidization (Submission from New Zealand, 2002).

A final issue that, allegedly, makes it difficult to enforce the SCM Agreement in relation to fisheries subsidies is the failure of WTO members to report adequately their use of fishing subsidies. Consequently, there is a lack of meaningful data on such subsidies available to other members (Submission from Australia, Chile, Ecuador, Iceland, New Zealand, Peru, Philippines and the United States, 2002).

For these reasons, concerted efforts have been made in the Doha Round to negotiate a set of rules that would deal specifically with fishing subsidies. The Declaration adopted at the WTO Ministerial Conference held in Hong Kong, China in 2005, noted the "broad" agreement of WTO members on the need to "strengthen disciplines on subsidies in the fisheries sector, including through the prohibition of certain forms of fisheries subsidies that contribute to overcapacity and over-fishing" and called on members "promptly to undertake further detailed work to, *inter alia*, establish the nature and extent of those disciplines, including transparency and enforceability".

The economics of subsidies sheds some light on the effect of such measures in the fisheries sector. If the sector suffers from an open access problem that causes over-fishing, a subsidy that stimulates production (such as a production or an export subsidy) will worsen over-fishing and, possibly, reduce social welfare (see Section D). So, why would policy-makers introduce such policy measures? And what can WTO rules do about it? Economists see two main reasons why governments may want to use subsidies in the presence of an open access problem – political economy motivations (i.e. pressures from the import or export-competing sector), and, in the case of subsidies to import-competing industries, terms-of-trade manipulation (i.e. the desire to alter world prices to obtain a terms-of-trade gain).

Consider the political economy argument first. Suppose fisheries are contained within a single Exclusive Economic Zone (EEZ), which gives the country certain exclusive rights. In the absence of other market failures, a fisheries subsidy redistributes income within the country from tax-payers to fishermen, and lowers social welfare through the over-exploitation of the country's resource. A politically organized sector gains at the expense of the rest of society (including current and future generations). In this situation, WTO rules disciplining fisheries subsidies would provide policy-makers with a commitment mechanism to credibly eliminate an inefficient policy, much in the spirit of the commitment role of trade agreements discussed in Box 28.

A subsidy to fisheries aimed at manipulating the country's terms of trade might seem attractive when tariffs are constrained by commitments. If fisheries are contained within a single EEZ, the only impact that subsidies would have on other countries would be a terms-of-trade effect. Indeed, a subsidy to import-competing domestic fisheries would reduce imports. If the subsidizing country is large enough, this constitutes a beggar-thy-neighbour policy (i.e. imposes a negative terms-of-trade effect on trading partners). Unilateral attempts to manipulate terms of trade through subsidies will lead to a "Prisoners' Dilemma" situation (see Box 28), exactly as in the case of a tariff war.[54] An agreement allowing signatories reciprocally to commit to the reduction/elimination of fisheries subsidies would eliminate all terms-of-trade effects and would improve global social welfare.

It should be noted, however, that in both cases discussed above, over-fishing would be mitigated, but not eliminated. As discussed in Section D, there would still be a need to address the open access problem through appropriate allocation of property rights and domestic regulation within each country. Finally, in the presence of global commons (i.e. with fugitive or highly migratory fish stocks), subsidies induce two types of effects – a typical terms-of-trade manipulation externality and an externality related to the over-exploitation of a global resource. A trade agreement would address only the terms-of-trade effect. There would still be a need for another agreement to address the global open access problem because countries would not have an incentive to control their harvests if other countries did not simultaneously control theirs.

Economics distinguishes "bad" subsidies (those discussed above that distort trade and worsen open access problems) from "good" subsidies. The latter are those that aim at addressing a market failure. Efficient subsidy rules need, therefore, to strike the right balance and provide some form of flexibility (see Brou, Campanella and Ruta (2010) for the general case). For example, an economic case can be made for a distinction between subsidies that contribute to over-fishing and subsidies that help governments manage fisheries and reduce fishing capacity (see Section D). This point is made by Copeland and Taylor (2009), who discuss the importance of monitoring for appropriate resource management. In their view, what matters for addressing the open access problem are effective property rights rather than formal property rights. This suggests that "good" subsidies, such as those needed to establish monitoring capacity, would need to be excluded from any reduction or elimination commitments.

The negotiations on fisheries subsidies in the context of the Doha Round have made progress even if a number of issues remain highly controversial (Bilsky, 2009). In November 2007, the Chair of the Negotiating Group on Rules issued a negotiating text including proposed amendments to the SCM Agreement that would establish new disciplines on fisheries subsidies.[55] The Chair's negotiating text lists a number of specific fisheries subsidies that would be prohibited as they are most likely to lead to harmful excess capacity or fishing effort.[56] The text also includes a list of subsidies that would not be prohibited. Subject to certain conditions, all WTO members would, for instance, be able to administer subsidies for natural disaster relief, for the adoption of techniques to reduce the environmental

impact of fishing, for improved compliance with fisheries management regimes, and for vessel decommissioning.

The Chair's text also responds to the demand for special and differential treatment for developing countries. Least-developed countries would be allowed to administer any type of subsidy. As for developing countries generally, they would be allowed to administer subsidies for infrastructure, income support and price support. They would also be allowed to administer any subsidy to subsistence fisheries while subsidies to the most industrial fisheries would be subject to certain conditions. In addition to the list of prohibited subsidies and exceptions, the Chair's text also contains general, across-the-board disciplines on subsidies that are shown to have adverse effects on fugitive or highly migratory fish stocks or on other stocks in which another WTO member has an identifiable fishing interest.

The Chair's text was extensively discussed. Participants' views, however, continued to differ and the discussions did not generate the necessary elements that would have allowed the Chair to propose a revision of his text that could lead to greater convergence. Instead, the Chair decided to circulate a roadmap for discussions on fisheries. The roadmap raises a series of questions, all of which are aimed at clarifying participants' positions on different aspects of the mandate.

(ii) Fisheries access agreements

Several WTO members have submitted proposals to the Negotiating Group on Rules that address access arrangements. These arrangements generally involve government-to-government payments in return for foreign access to developing countries' EEZs. Such access arrangements constitute significant sources of income for some developing countries which have proposed excluding them from the scope of any fisheries subsidy disciplines. At the same time, fisheries access arrangements now represent the main source of supply for fish species such as tuna, some demersal fish, and molluscs to the EU and Japan, which are major Distant Waters Fishing Nations (DWFNs). According to Orellana (2007), the terms of the arrangements often leave the host country with only a fraction of the actual resource value, and more than a few access arrangements have led to the depletion of host country stocks.

One question that has arisen is whether the transfer of access rights acquired by the DWFN through these access arrangements to its distant water fleet represents a subsidy. The answer to this question depends on whether the DWFN receives sufficient payment in exchange for the right to fish that it provides to its distant-water fishing fleet. The submissions tabled by WTO members typically address access payments. However, they also reflect different views on the role and legal status of access arrangements. Proposals range from the total exemption of access agreements from new disciplines to conditioning the exemption of access agreements on the non-existence of a subsidy as well as environmental and/or transparency criteria.

The Chair's November 2007 text would provide that government-to-government access payments are not subsidies. Subsidies arising from the further transfer, by a paying member government, of such access rights to its fishermen would in principle be prohibited, except where the access relates to fisheries within the EEZ of a developing country, the access agreement is made public, and it contains provisions designed to prevent over-fishing based on internationally recognized best practices.

(iii) Dual pricing

Another subsidies-related issue that has arisen in the WTO accession negotiations of several members, as well as in disputes and in the Doha Round negotiations on rules, is the "dual pricing" issue. As mentioned previously, dual pricing is a system of differentiated prices in the domestic and the export market, which governments can implement, for instance, through a regulation that sets the maximum price at which a natural resource can be sold on the domestic market. This price is lower than the price prevailing in the export market.

Sub-section 1 discussed how dual pricing raised issues under the Subsidies and Countervailing Measures Agreement, and possibly under Articles XI and XVII of the GATT. In several accession negotiations, for example, there have been discussions on whether dual energy pricing gives domestic exporters in energy-intensive sectors an unfair competitive advantage that would be deemed illegal under the SCM Agreement. In the rules negotiations, one delegation tabled a proposal aimed at clarifying the disciplines on dual pricing in the SCM Agreement.[57]

As argued in Section D, a dual-pricing scheme on natural gas, for example, has an effect similar to an export tax on gas which in turn is equivalent to a subsidy to domestic users of gas. The measure lowers the domestic price of the natural resource relative to its export price. For this reason, it gives a cost advantage to downstream industries (i.e. producers of energy-intensive goods), which leads to higher exports and results – if the country is large enough in international markets – in a reduction of the world price for the products of these industries. The similarities between dual-pricing arrangements and export taxes are worth bearing in mind for purely analytical purposes.

As in the case of export taxes and subsidies, economists argue that a dual-pricing scheme has a beggar-thy-neighbour component when it lowers the world price of resource-intensive products. This may trigger (or be the result of) trade policy measures aiming at restricting imports of such products originating from the country that adopts a dual-price regime (tariff escalation). An agreement that regulates dual-pricing practices in the resource-rich country and tariff escalation by resource importers would be mutually beneficial.

Governments may have a legitimate efficiency reason to offer subsidies where there is some form of market failure. In the case of a dual-price regime, arguably the market failure must involve an inefficient level of consumption of the natural resource, or the existence of an infant industry. While a dual-pricing scheme may be an effective way to provide a subsidy (if a price control can be easily implemented), such a policy measure is not necessarily first-best. Unless the dual-pricing mechanism can be properly fine-tuned, all consumers of the natural resource would benefit from the implicit subsidy provided by the system of dual-price regulation. This could be a problem if only a subset of users is the intended target of the subsidy. In this case, a consumption subsidy that directly addresses the problem may be a more appropriate measure as it avoids the over-consumption of the natural resource in all the other sectors. This is important to keep in mind as, in the light of the commitment approach (see Box 28), the regulation of dual-pricing mechanisms in a trade agreement could be motivated by the need to limit a beggar-thyself policy.

(iv) Fossil fuels subsidies

The leaders of the G20 agreed in September 2009 to phase out inefficient fossil fuel subsidies. Specifically, the Pittsburgh communiqué states that "inefficient fossil fuels subsidies encourage wasteful consumption, reduce our energy security, impede investment in clean energy sources and undermine efforts to deal with the threat of climate change".[58] As discussed in section C.4, consumption of fossil fuels has a negative effect on the environment, through the production of CO_2 emissions, that is not fully reflected in market prices. Certain forms of subsidies, such as consumption subsidies, exacerbate this negative environmental externality. An international undertaking to limit the use of an inefficient policy is very much in the spirit of the commitment role of trade agreements discussed in Box 28.

(v) Exception under the SCM Agreement

Another concern that has been raised and that is also linked to the existence of market failures relates to the possibility that WTO rules may prevent governments from pursuing conservation policies. Under Article 8 of the Subsidies and Countervailing Measures Agreement, certain environmental subsidies were deemed to be non-actionable (i.e. not subject to challenge in the WTO or to countervailing measures). However, these provisions expired at the end of 1999 as WTO members did not agree to retain them.[59] As noted by Marceau (2010b), numerous commentators have called for reinstating such a provision to provide a safe haven for certain environmental subsidies such as those for renewable energy or for climate change mitigation or adaptation. As of now, however, those calls have not been reflected in any proposals or discussions by members in the Doha Round negotiations on WTO rules.

(c) Domestic regulation

What are the challenges for the WTO when market failures in the natural resources sector are purely local – that is, when the "external" effect of an economic transaction (e.g. pollution, depletion of the natural resource) is contained within national borders and, hence, does not cause any welfare loss to citizens in other countries? Economists have identified two main challenges. Some fear that WTO rules will induce countries to impose sub-optimal regulations, which might possibly result in the dissipation of the natural resource. In this scenario, with their hands tied on the trade policy side, governments may be reluctant to adopt efficient regulations which favour foreign producers. Others are concerned that domestic regulations will be used to influence trade flows. They see the possibility that governments may offset the effect of tariff reductions on market access with looser domestic regulations that create a cost advantage for import-competing producers.

Bagwell and Staiger (2001a) show that trade negotiations can affect a government's incentive to set an efficient regulation in two different ways, each of which raises a distinct challenge. In their model, trade policy may have a negative impact on trading partners through a terms-of-trade effect (see Box 28) and domestic regulations are set to address a local market failure.

As a concrete example, consider the case where both governments need to regulate fishing in an internal lake. In this context, countries affect each other only through their market interactions (i.e. through trade) and no other cross-border external effect arises. This means that countries may care about how their trading partners regulate the open access problem, but only because of the trade effects that such choices could imply. If there are no institutions to facilitate international cooperation, governments would efficiently regulate the open access problem but would have an incentive to set inefficiently high trade restrictions. The reason for this is that the only inefficiency associated with unilateral policy choices derives from the desire to obtain a terms-of-trade gain at the expense of trading partners. As the open access is a purely domestic problem, the government has no incentive to under (or over)-regulate the natural resource sector.

The situation is different when countries negotiate over tariffs, but unilaterally set domestic policies. In this case, once tariffs have been committed in a trade agreement, governments may face an incentive to set an inefficient domestic regulation. Intuitively, trade liberalization may change the optimal level of domestic regulation, but governments now understand that – with their tariff bound (i.e. with a firm commitment to a tariff ceiling) – a change in the regulatory policy may affect the market access granted to trading partners. Two situations can emerge, as explained below.

(i) Natural resources regulation as an obstacle to trade?

If domestic regulations affect market access, trade policy commitments may induce a government to alter its regulatory stance to reduce market access granted to trading partners.[60] For example, the removal of a restrictive domestic regulation (e.g. the weakening of mining regulations aimed at preserving the environment, an extension of the fishing season in an internal lake) can confer a cost advantage to the import-competing sector over foreign producers, and hence lower the trading partner's access into the domestic market.

Bagwell and Staiger (2001a) show that, from a theoretical point of view, including a "non-violation" clause (such as the one in Article XXIII of GATT) in the trade agreement may address this problem. The ability of a trading partner to bring a complaint to the WTO even if the change in domestic regulation does not violate WTO rules keeps in check the incentive to make the regulation less stringent. This institutional solution allows WTO members to achieve the efficient combination of trade and domestic policies whenever governments have the incentive to use the domestic regulation to undo the market access granted to trading partners through a tariff reduction.

However, as observed by Staiger and Sykes (2009), in practice only three non-violation claims have been successful in the history of the GATT/WTO system and none of those involved domestic regulation. In Staiger and Sykes' view, "the reasoning of both the panel and the Appellate Body in *EC – Asbestos* casts serious doubt on the prospect of successful non-violation claims relating to domestic regulation in the future".

(ii) Trade rules as an obstacle to natural resource conservation?

With trade policy commitments restricting their margin of manoeuvre, policy-makers may face weaker incentives to enact domestic regulations that grant more (and not less) market access to trading partners. Assume, for instance, that the price of a natural resource attracts increased entry into the natural resources sector and exacerbates the open access problem. In this case, the efficient domestic policy would be to restrict access to the resource (for instance, move into a system of stricter harvest quotas), but the government may be reluctant to do so as this policy would increase the market access of the trading partner to the detriment of the import-competing sector.

A second example of this type of situation is the introduction of a norm for an "environmentally-friendly" extraction or harvesting method (i.e. a method that reduces damage to the environment). If the norm implied an increase in production costs for domestic firms, policy-makers are again caught in the dilemma between improving natural resources management and worsening the competitiveness of import-competing producers.

Bagwell and Staiger (2001a) argue that this incentive problem would be solved if trade rules granted the right to governments to choose the mix of domestic and trade policies that stabilizes their market access commitments with trading partners. The additional flexibility provided by this would ensure the adoption of efficient trade and domestic policy, as the government could change domestic regulations without worrying about the resulting market access implications. Following the logic of the examples above, the government could introduce a system of stricter harvest quotas or a norm for clean extraction/harvesting methods and increase its tariff so as to maintain the same level of market access in the resources sector.

As discussed in sub-section E.1, the ability of governments to combine natural resources management and trade measures as suggested above may be limited by the non-discrimination rules (Articles I and III of the GATT). Restricting access to the domestic market for foreign producers employing an environmentally unfriendly process and production methods (PPMs) could be justified on the basis that goods produced with different PPMs are not "like products", but this issue is not settled. However, even if a regulation is, on the face of it, contrary to Articles I or III of the GATT, WTO rules provide some flexibility through GATT Article XX to address conservation and environmental problems associated with natural resources management.

As previously noted, Article XX allows WTO members to impose otherwise inconsistent trade measures if they are related to the conservation of exhaustible natural resources (Article XX(g)) or if they are necessary to protect human, animal or plant life or health (Article XX(b)). Some might argue that since the measure that directly relates to the conservation of the resource is the new regulation, the trade measure may not be covered by Article XX. Others might point to the decision in *Brazil - Retreaded Tyres* which stated that the regulation mix as a whole should be examined rather than the regulation alone.[61]

(d) International regulation

While the management of some natural resources in one country may not directly affect the welfare of citizens living in other countries (or, more precisely, only affects them through its trade effects), in many cases domestic regulation – or the lack of it – has spillover effects that cross national borders. Striking examples are poorly defined property rights that lead to the over-exploitation of a natural resource shared by different countries (e.g. fish) or which aggravates global warming (e.g. forests). When international externalities are involved, natural resources are "global commons". It is clearly not possible to reach efficient policy outcomes with international negotiations over trade policy alone. This is because unilateral policy choices create inefficiencies that have nothing to do with those relating to terms-of-trade manipulation. Global commons need

efficient regulation and, because of the spillover effects of national choices, efficiency can only be achieved if such regulation is entrenched in an international agreement.

Water provides an interesting example of possible interactions between international agreements on natural resources and trade agreements. Opening trade in water-intensive products may save water if products are exported by countries with high water productivity to countries with low water productivity. However, trade in "virtual" water may also accelerate depletion of water stocks if the social and environmental costs associated with water use are not accounted for in the price paid by consumers in importing countries (see Box 4).

Trade in agricultural products is of particular relevance, given that 85 per cent of global water consumption occurs in agricultural production and water used in agricultural production is typically under-priced (Hoekstra and Chapagain, 2008a). Economic analysis suggests that the first-best policy is to ensure the correct pricing of water. This could be facilitated by an international treaty on proper water pricing (Hoekstra, 2008b).

Global fisheries constitute another illustration of the problem. Evidence suggests that the vast majority of fisheries are either open access or poorly regulated. Assigning property rights may not be enough to reduce the over-exploitation of the resource: one country does not have the unilateral incentive to control its harvest if other countries do not enact effective controls at the same time. Countries concerned with marine biodiversity and the global impact of the over-exploitation of fisheries may envisage different measures to conserve over-exploited fish species.[62] One approach is to negotiate multilateral agreements regulating fisheries. The United Nations Fish Stocks Agreement (1995), for instance, provides a framework for the conservation and management of highly migratory and fugitive fish stocks in international waters regulated by regional fisheries management organizations (RFMOs). Nine RFMOs are in existence today.

(i) Problem of "issue linkage"

Two main reasons for linking trade with non-trade international issues have been identified by economists. The first is the "grand bargain" approach, while the second is the "enforcement" argument, as explained below.

According to the first approach, "issue linkage" (i.e. making the agreement on one issue dependent on progress in another issue) can be used as a means of achieving mutually welfare-enhancing cooperation (Abrego et al., 2001; Cesar and de Zewe, 1996). Consider an issue X on which cooperation benefits country A but hurts B and an issue Y on which cooperation benefits country B but hurts A. Linking the two issues may facilitate a global deal. For instance, trade concessions can be granted on condition that there is cooperation in preventing over-harvesting of a natural resource such as forestry. Therefore, a grand bargain may be more efficient than two separate deals. While this argument has its obvious merits, it should also be noted that agreements may become more difficult as the number of issues on the table and the complexity of the bargain increase.

As observed in Box 28, enforcement problems are a key issue for some international agreements as a supranational authority to punish violators is generally absent. For this reason, some economists have investigated the possibility of linking different issues as a means of enforcing cooperation (Spagnolo, 1999; Limao, 2005). For instance, trade sanctions could reduce the enforcement problem in agreements aimed at preserving natural resources. Critics of the enforcement approach raise the concern that linkage may work against trade opening efforts. For this reason, it is important to understand under what conditions linking different issues may result in greater cooperation, with each policy moving in the desired direction. (Limao, 2005) argues that issue linkage leads to gains in both the trade and the non-trade area when the international externalities are substantial. This would be true, for instance, when managing global commons. In this case, linking trade and natural resource issues would improve cooperation in trade and resource management.

(ii) Problem of coherence

Another issue is consistency among different international agreements. As explained in sub-section 2, the WTO is part of a much broader framework of international cooperation and many aspects of natural resources are regulated by international rules outside the WTO. This raises the challenge of maintaining coherence between these other international rules and the rules of the multilateral trading system. The challenge becomes greater as existing international regimes continue to develop and new regimes are created.

While coordination at the domestic level is crucial to ensure consistency among international agreements, actions at the international level can also help reduce the risk of incoherence.[63] Coherence between regimes is sometimes an explicit objective. Good examples of this are the commitments to pursue coherence between trade and environmental measures reflected in the 1994 WTO Decision on Trade and Environment and those in the Rio Declaration on Environment and Development (see sub-section 2). Increased cooperation between international organizations can also help promote coherence. Trade and environment again provides an example. As of April 2009, 25 intergovernmental organizations had observer status in the WTO Committee on Trade and Environment, including the United Nations Environment Programme (UNEP) and several multilateral environmental agreements, such as the United Nations Framework Convention on Climate Change (UNFCCC), CITES and the Convention on Biological Diversity (WT/CTE/INF/6/Rev.5).

There is a cooperation arrangement between the WTO and UNEP Secretariats. The WTO has observer status in the UNEP Governing Council, and the WTO Secretariat regularly attends the main meetings of multilateral environmental agreements which contain trade-related measures. Furthermore, the WTO and UNEP recently produced a joint report on trade and climate change, WTO-UNEP (2009). Existing forms of cooperation and information exchanges between the WTO, UNEP and multilateral environmental agreements are described in detail in WTO document TN/TE/S/2/Rev.2. This was prepared by the WTO Secretariat for the negotiations that ministers agreed to launch in Doha on "procedures for regular information exchange between MEA Secretariats and the relevant WTO committees, and the criteria for the granting of observer status".[64]

The decentralized nature of the international system and the co-existence of many international regimes means that these sometimes overlap. Few today consider that the WTO is a closed regime impermeable to other international rules, although there is debate about the extent of its permeability and the mechanisms of transmission. WTO adjudicators have looked at other international agreements for guidance when interpreting provisions of the WTO agreements, but whether other international rules might prevail over WTO rights and obligations in some circumstances remains a contested issue.

WTO members can jointly waive their obligations under the WTO agreements if there is the potential for conflict with measures taken under another international arrangement, as they did in relation to the Kimberley process, as described above. The UN International Law Commission has also described various tools that are available in international law to resolve instances of potential conflict. Some WTO members, however, see a need to clarify the relationship between the WTO and certain other international regimes. As a consequence, at the 2001 Doha Ministerial Conference, WTO members agreed to negotiate on the relationship between WTO rules and multilateral environmental agreements, particularly those that contain "specific trade obligations". Members have agreed that the scope of these negotiations would be limited to the applicability of WTO rules to members that have signed the multilateral environmental agreement under consideration.

(e) Investments: The "hold-up" problem

Trade policy in natural resource sectors is not just about the market for the resource itself, but is also about the market for the licences to explore and extract the resource that are granted by the governments of resource-rich countries to international investors. These contracts imply a long-run relationship as exploration and extraction generally entail large initial sunk costs (see subsection B.3). Also, the contracts often specify aspects of the fiscal regime that determine the distribution of rent between parties and shape incentives for future exploration and development. The design of these contractual arrangements is complex because they have to meet multiple objectives. The situation is further complicated by the volatility of these sectors and uncertainty about such matters as geology and technological developments as well as by the varying levels of information available to different parties to a contract.

The host government is not only concerned with the expected value of the rent, but also with the wider benefits that the resource exploitation brings to the economy. Moreover, where the resource revenue dominates the economy, actions in this sector are central to the development strategy of the country (see Section C.4). International investors, on the other hand, may be concerned that the large upfront capital costs have little or no alternative-use value and can take years to be recovered.

This type of contractual situation leaves parties open to what economists call a "hold-up" problem (i.e. a situation where the contractual agreement between two parties is affected by concerns that one party will gain undue bargaining power once investment by the other party has been committed). Specifically, hold-up is a credibility problem that emerges in investment relationships such as the one described above. The government has difficulty in committing credibly not to renegotiate the terms of the contract. It might see a need to change policies, such as the tax regime, that would affect the profits of the investing company. Anticipating this, investors are deterred by the risk of renegotiation.

The hold-up problem has three main effects: host governments may receive a lower initial payment, contract firms are likely to invest less than the efficient level, and the extraction rate may be faster than the optimum as firms try to recoup the initial investment more quickly. The hold-up problem may partly explain the under-exploration, and possibly the unsustainable extraction, of oil, gas and minerals in some regions of the world.

The fundamental issue is one of time inconsistency faced by the government of the resource-rich economy about the course of its future actions. This creates a market failure, the cost of which is predominantly borne by the host country, as international investors anticipate the problem and, hence, discount the cost of this failure (e.g. by investing less). Therefore, if the host government could lock in the course of its future actions in an appropriate institutional mechanism, this would mostly benefit the resource-rich economy.

As the source of the problem is the unlimited sovereignty of the host country, it should not come as a surprise that the solution to the credibility problem calls for constraints on governments' behaviour. Very much in the spirit of the commitment approach to trade agreements discussed in Box 28, host country governments often agree in the context of bilateral investment treaties (BITs) to limit their scope of action and to face consequences if they modify the conditions

of an agreement. In recent years, BITs have become the dominant international mechanism through which investments are protected (see sub-section E.2).

BITs are generally perceived to be efficiency-enhancing, but two sources of criticism have emerged in the relevant literature. First, differences in power are more pronounced in a bilateral than in a multilateral system. Hence, even where developing countries are able to make credible promises to potential foreign investors, their overall gains may be relatively modest (Guzman, 1998). Second, if the arbitration mechanisms provided in the agreements are not effective, the hold-up problem will only be partially resolved (Collier and Venables, 2008).

Some authors have proposed using the WTO and its enforcement mechanism to enable governments to commit themselves to resource extraction and investment agreements in natural resource sectors (Collier and Venables, 2008). Quite apart from the fundamental question as to whether WTO members would view such an idea favourably, there are two important limitations to such a proposal. First, the WTO dispute settlement system is only open to WTO members and private parties cannot initiate a dispute. The second concerns the remedy. The WTO dispute settlement system only provides for prospective relief and does not provide an opportunity to obtain compensation for any damages. By contrast, foreign investors can obtain monetary reparation for damages suffered in international investment arbitration, which can include lost profits (Dolzer and Schreuer, 2008).

As noted earlier, the WTO Working Group on Trade and Investment was established in 1996. Discussions on trade and investment were initially part of the mandate of the Doha Round but in 2004, WTO members decided to exclude trade and investment from the negotiations.[65]

(f) Competition

For reasons discussed in Section C, production and/or export of natural resources are often concentrated among a small number of firms and imperfect competition often prevails in those markets. The economic analysis in Section C also identified a number of effects of imperfect competition on trade in natural resources. First, it was shown that a monopolist or a resource cartel may lead to inefficient (i.e. slower than optimal) extraction path of non-renewable natural resources.[66] In the situation of an export monopoly or cartel, this implies an inefficient path of trade volumes. A second problem discussed in Section C is that through the allocation of export or production quotas, resource cartels may determine trade patterns in a way that is unrelated to comparative advantage. A third problem, only briefly touched upon in Section B.3, is that vertically integrated firms (or cartels) may undermine market access for foreign suppliers.

Governments may face different incentives and adopt different attitudes with regard to imperfect competition in natural resource sectors. In some cases, governments of resource-rich countries are closely involved in collusive export arrangements. In other cases, they may simply allow collusive practices among exporters as long as they do not affect domestic markets. The governments of exporting countries, for example, may have little incentive to impose disciplines on exporting firms exercising their market power in foreign markets. This is because monopoly rents accrue to the home country while consumer loss due to high prices is mostly felt in the foreign (importing) countries. As for the governments of resource-importing countries, they may respond to collusive or monopolistic practices either by using trade policy, as discussed in Section D, or when export cartels involve private firms, by prosecuting collusive behaviour.[67]

From the perspective of trade cooperation and regulation, certain government behaviour *vis-à-vis* collusive practices may have cross-border externalities. This would be the case, for example, when the governments of exporting countries fail to impose disciplines on exporting firms exercising their market power in foreign markets. As already mentioned, this may well lead foreign governments to use trade policy in an attempt to shift rents internationally and, therefore, constitutes a welfare-reducing non-cooperative situation. This would be an argument in favour of negotiating disciplines on competition, possibly in exchange for tariff concessions. Note, however, that a second-best argument can be made that slower extraction may offset negative environmental impact. Moreover, in some cases monopolies in these sectors may result from natural monopoly conditions rather than a lack of competition. As with investment, WTO members decided in 2004 to exclude negotiations on competition from the Doha Round negotiations.

(g) Transit and transportation

In recent years, a number of issues relating to the transit of natural resources – in particular gas – have been discussed in the WTO. Article V of the GATT requires WTO members to ensure freedom of transit through their territory. Freedom of transit ensures that third countries do not impede trade and allows exporters to minimize transport costs. However, as explained in sub-section E.1, views differ regarding the scope of Article V. One issue that has been discussed is whether Article V applies only to "moving" modes of transport or also to transport via fixed infrastructures, such as pipelines. Should the former view prevail, this would mean that freedom of transit would not be guaranteed for natural resources being transported by pipeline.

The importance of transit rules for trade in energy goods, in particular oil and gas, has contributed to raise the profile of GATT Article V in the WTO. The Doha Round negotiations on trade facilitation provide an opportunity to clarify and strengthen the disciplines contained in this provision. It has been proposed that Article V should be made to apply explicitly to fixed infrastructure (such as pipelines and grids). This would

ensure that enterprises with special privileges comply with transit disciplines. It has also been suggested that a general national treatment obligation be established for goods in transit (Cossy, 2009). Other proposals relate to disciplines on fees and charges, formalities and documentation requirements, and regional transit agreements (Marceau, 2010b). The scope of Article V has also been discussed in WTO accession negotiations. As a result, several WTO members which recently acceded to the WTO have confirmed a commitment in their Accession Protocol to comply with WTO obligations on transit and, in one instance, a specific reference has been made to energy.

The General Agreement on Trade in Services (GATS) covers energy transportation services, including: i) services incidental to energy distribution, which includes transmission and distribution services on a fee or contract basis of electricity, gaseous fuels and steam and hot water; and ii) transportation via pipeline of crude or refined petroleum and petroleum products and of natural gas. While all WTO members must grant most-favoured-nation treatment to services and service suppliers operating in these two sectors, few have undertaken GATS specific commitments. Only 18 members' schedules record commitments on services incidental to energy distribution and 12 on pipeline transportation. These commitments have been undertaken mainly by countries which have acceded to the WTO over the last ten years.

Energy transportation services are on the sidelines of the services market access negotiations in the Doha Round, presumably because they remain a sensitive topic for most WTO members. The reluctance to undertake GATS commitments in these two sectors contrasts with the interest expressed by various members in negotiating commitments on other energy-related services, in particular exploration, mining, engineering and consulting.

GATS specific commitments contribute to predictability and stability for foreign service supplies and suppliers regarding conditions of access to markets. However, with respect to energy transportation networks, they may not be sufficient to guarantee effective conditions for competition and access. The energy sector has traditionally been characterized by large vertically integrated state-owned monopolies which manage transmission and distribution networks. Pipelines in particular entail high fixed costs and long lead times, which makes their duplication uneconomical. They are thus often in the hands of a monopoly provider, whether public or private.[68] This in turn creates a high barrier to entry for potential participants.

GATS Article VIII imposes some disciplines on monopolies and exclusive suppliers, but these are insufficient to ensure fair and equitable access to energy networks. This is the reason why some WTO members proposed additional disciplines for energy services modelled on the Reference Paper for telecommunication services.[69] Such new disciplines could include provisions such as non-discriminatory third-party access[70] to, and interconnection with, networks, grids and other essential infrastructure, the establishment of a regulator independent of any supplier, and requirements preventing certain anti-competitive practices for energy services in general.

It may be noted that a reference paper is not a prerequisite for undertaking additional commitments under Article XVIII of the GATS. One WTO member, Ukraine, has already undertaken an additional commitment regarding pipeline transportation services. In its GATS schedule, Ukraine "commits itself to provide full transparency in the formulation, adoption and application of measures affecting access to and trade in services of pipeline transportation. Ukraine undertakes to ensure adherence to the principles of non-discriminatory treatment in access to and use of pipeline networks under its jurisdiction, within the technical capacities of these networks, with regard to the origin, destination or ownership of the product transported, without imposing any unjustified delays, restrictions or charges, as well as without discriminatory pricing based on the differences in origin, destination or ownership."[71]

(h) Drawing the line between goods and services

Trade in goods and trade in services are subject to different disciplines in the WTO, and determining that an activity amounts to the supply of a service is a prerequisite for the application of the GATS. This distinction is not always easy to make with respect to activities surrounding the exploitation and processing of natural resources.

It is acknowledged in the WTO that the production of goods on a company's own account – that is, performed by a company which owns the raw material it processes – is not a service covered by the GATS. The question is less clear with respect to production on a fee or contract basis, when a company produces goods owned by others. This issue arises in the manufacturing sector (textiles, automotive industry, for example), where processing or assembling material owned by others is common. It might also be relevant to certain natural resource processing activities, such as oil refining, should one consider that these activities amount to the production of a good (see next paragraph). The question whether production on a fee or contract basis should be treated as a service, and thus fall under the GATS, was discussed inconclusively by WTO members several years ago.

This leads us to the related question of distinguishing between production as such and services related to production. As noted above, the GATS covers a series of services related to the exploitation and processing of natural resources, such as services incidental to the following sectors: forestry, fishing, mining and manufacturing. These activities do not represent the production process as a whole, but they are an integral and essential part of it. They fall under the GATS when they are performed on a fee or contract basis.

In certain situations, however, it may be difficult to draw the line between production and activities related to production, especially when the production process consists of a chain of inter-related activities. Consider the two following examples taken from the energy sector. WTO members view drilling, which is an important contribution to the extraction of petroleum, as a "service incidental to mining". Thus, drilling is classified as a service if performed on a fee or contract basis by a separate entity, but constitutes value added to the extracted good if it is performed by the entity which owns the raw material (the oil). There are diverging views among WTO members regarding activities such as oil refining, gas liquefaction and re-gasification. While some view them as services, others consider that they amount to the production of a good because they entail a certain transformation of the product.[72]

In practice, it may not always be easy to categorize a given activity as a service or as the production of a good. The GATS offers no guidance on this issue because it does not define a service. The categorization of a given activity as a service or the production of a good can clearly have important consequences regarding WTO disciplines. For instance, should oil refining be considered a service, it would benefit from basic investment protection under the GATS through mode 3. If, on the other hand, oil refining is considered as the production of a good, it falls under Annex IA of the WTO Agreement, which does not protect investment *per se*.[73]

(i) Intellectual property rights and natural resources conservation

Section C emphasized that technology can have an ambiguous effect on natural resources conservation. Innovation can lead to resource-saving inventions, facilitate the discovery of alternative resources and introduce new technologies that reduce negative environmental externalities. Such innovations can be classified as resource-friendly, as they play a positive role in preventing the exhaustion of the resource stock or mitigating possible negative effects associated with trade in natural resources. However, in other situations, technological innovations can represent a curse for resource conservation. This is clearly the case when inventions increase the harvesting capacity of an over-exploited resource.

The development and diffusion of resource-friendly technologies is one of the issues addressed in the debate regarding the efficient protection of intellectual property rights (IPRs). Strong IPRs encourage research and development (R&D) activities, enabling companies to recoup their investments through the protection of the rights of use of their inventions. However, through the protection they afford the innovating companies, they may restrict access to key technologies for resource-rich developing countries, as IPRs may raise the cost of adoption and diffusion of resource-friendly technologies.

The efficient design of international rules on the protection of intellectual property rights should strike a balance between the need to encourage invention and innovation and the need to disseminate useful technologies as broadly as possible.[74] Note that strong IPRs do not necessarily limit technological diffusion. Acemoglu and Zilibotti (2001) show that a weak IPR regime prevents technological diffusion around the world as ill-defined IPRs in developing countries encourage firms in advanced economies to target the needs of their own markets, producing technologies inappropriate for developing countries.[75]

Two examples may clarify how access to resource-friendly technologies by resource-rich developing countries may be important for conservation purposes. Section C.3 extensively discusses the open access problem in renewable natural resources, such as fish and forestry, and the negative welfare effects that trade openness may have in the presence of this market failure. One important lesson that emerges from that discussion is on the role of *de facto* property rights on the natural resource. Recent work by Copeland and Taylor (2009) finds that the introduction of formal property rights may not be sufficient in addressing open access problems when governments lack adequate monitoring capacity. The reason is precisely that, in this case, *de facto* property rights on the natural resource are weak because detecting potential property right violations is difficult (and, hence, formal property rights are of little value). The diffusion of satellite technologies may facilitate the monitoring of forests, thus limiting the opportunities for fraud and illegal logging, which would reinforce an effective property rights regime.

A second example which has emerged in recent studies, such as in Brock, Kinzig and Perrings (2007), is the problem of invasive plant species that leads to international trade creating a negative environmental externality. In this case, scientific innovations such as "bar coding" of DNA plant species (a method for plant identification) might eventually pave the way to a plant "scanner" that could be used by customs officers to easily identify potentially invasive species. While the grant and enforcement of intellectual property rights creates a legal environment that contributes to these technological breakthroughs, the international diffusion of these technologies represents an important element in reconciling international trade and the proper conservation of natural resources.

The essential objective of the grant and enforcement of intellectual property rights, as set out in the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), is both to promote necessary innovation and facilitate the diffusion of technology, balancing legitimate interests in a socially beneficial manner. Article 7 of the TRIPS Agreement states that intellectual property protection should "contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations". While the

TRIPS Agreement sets out general standards for the protection of intellectual property under national laws, achieving this "balance" in practice is a matter for domestic policy-makers and legislators.

4. Conclusions

This section of the Report has focused on various aspects of international cooperation to manage trade in natural resources. Much but not all of the emphasis has been on the WTO's role in this area. Some space has also been devoted to a discussion of other international agreements and initiatives relating to natural resources.

The WTO's legal and institutional framework has contributed to the expansion of global trade in natural resources. The relevance of WTO rules has been discussed in considerable detail, focusing on a number of distinctive features that have been used as themes throughout the report. These are the uneven geographical distribution of natural resources, their exhaustibility, the environmental externalities associated with their use, their dominance within national economies, and the volatility of markets for these products.

An important conclusion regarding the reach of the rules is that the WTO generally does not regulate natural resources before they are extracted or harvested. However, in certain instances the rules may have implications for an unextracted or unharvested natural resource. Standing timber provided by a government for less than adequate remuneration was considered a subsidy under the Agreement on Subsidies and Countervailing Measures. Moreover, the exploration, extraction and distribution of natural resources may involve services activities that fall within the ambit of the General Agreement on Trade in Services (GATS). The Agreement on Trade-Related Aspects of Intellectual Property Rights provides a legal basis to promote innovation and the transfer of technology, both of which are particularly relevant to natural resources as new technologies open frontiers for exploration and promote more efficient use of natural resources.

WTO rules were not drafted specifically to regulate international trade in natural resources. This has arguably led in some cases to regulatory gaps, or at the very least to a lack of clarity about the precise applicability of the rules in the particular circumstances that characterize natural resources trade. This section has highlighted a number of these challenges.

One challenge is to manage the regulatory failures implicit in beggar-thy-neighbour policies. A key economic rationale of WTO rules is to induce governments to take into account the negative effects that their unilateral actions may have on trading partners, as uncooperative behaviour leads to a welfare loss from the point of view of world welfare. Taxes and quantitative restrictions on trade can have beggar-thy-neighbour characteristics. An agreement among WTO members to make binding commitments on export taxes could be mutually beneficial, although from the perspective of individual governments this may depend on why they are using such measures. As with all trade negotiations, trade-offs would be possible on a wider canvas, and not only among members that apply such measures. Even within the confines of trade taxes, a potential trade-off would be export taxes on natural resources against import tariffs on higher value-added products, where these are effectively offsetting because of tariff escalation in manufacturing processes.

Another challenge arises from the need to ensure the sustainability of natural resources. This may require an expansion of some of the flexibilities provided under the current rules. For instance, certain subsidies can secure better management of a resource or of environmental externalities associated with its extraction and use. Other areas where existing WTO rules interact with conservation policies include domestic regulations and the design and implementation of intellectual property rights.

A further issue identified in the study arises when certain domestic and trade measures are subject to different disciplines, even though they have the same economic impact. Given the geographical concentration of natural resources – and hence the fact that resource-scarce countries depend on imports for much of their supply of natural resources and resource-rich countries export nearly all their production – cases arise where trade measures are close substitutes for domestic regulatory measures. In these cases, regulating the trade measure is a necessary but insufficient condition to achieve undistorted trade in natural resources. For instance, a consumption tax in an importing country may be equivalent to an import tariff. A production restriction in a resource-rich country may have the equivalent effect to an export restriction. Similarly, an export tax has effects comparable to a domestic subsidy in terms of the consumption of the resource. In the presence of such equivalence, there is no economic basis for regulating these policies differently.

Improving the regulation of beggar-thy-self policies is another challenge. A measure might be beneficial in the short-run, possibly for political economy reasons, but carry significant long-run costs. This would be the case, for example, with a subsidy provided in connection with the exploitation of a resource that has an open access problem. Another example is that in the absence of international rules on investment, resource-rich countries may be exposed to the "hold-up" problem. Improved investment disciplines could help these countries improve the credibility of their policies towards investments as they underwrite a commitment to agreed-upon rules.

Although trade in most of the natural resources covered by this report face limited trade barriers, trade flows in some sectors still face some obstacles. Freedom of transit may be a case in point. A narrow understanding of WTO obligations in this area could exclude from their scope transport via fixed infrastructure, such as pipelines, and create regulatory uncertainty. This uncertainty can have consequences for access to

supplies of resources. Accession to the WTO of several suppliers of traditional energy products – currently under negotiation – will reduce uncertainty by providing a regulatory framework for a significant share of natural resources trade.

Finally, two main issues have been discussed in relation to the clarity and coherence of arrangements for international cooperation. The first of these relates to the border or overlap between different agreements within the WTO system. With respect to activities surrounding the exploitation and processing of natural resources it is not always clear whether the GATT or the GATS is applicable. The lack of clarity reduces certainty. The second issue concerns the relationship between the WTO and other international agreements. Many aspects of natural resources are regulated by international rules outside the WTO. A continuing and growing reliance on natural resources in the world economy, the exhaustibility of those resources, and the need to mitigate the negative externalities relating to their exploitation and consumption are challenges that can only be effectively confronted through international cooperation and better global governance.

Endnotes

1 Note that before the Second World War, primary commodities consisted mainly of agricultural products and problems relating to commodity price declines and volatility affected both developed and developing countries (many of them still colonies). At that time, there was no specific developing-country problem.

2 During the Uruguay Round negotiations, attempts were made by some participants to tighten multilateral rules to deal with certain policies relating to petroleum and petroleum products. These initiatives were taken largely in the context of the Negotiating Group on Natural Resource-Based Products (Stewart, 1993).

3 Article XXVIII of the GATT provides a mechanism for a WTO member to modify its schedule of commitments and raise a tariff above the bound level. Such member may be required to offer compensation to other members. Article XIX of the GATT and the Agreement on Safeguards provide a mechanism to raise tariffs temporarily where an increase in imports causes or threatens to cause serious injury to a domestic industry.

4 See the Understanding on the Interpretation of Article II:1(b) of the GATT 1994. This prohibition excludes changes equivalent to an internal tax, anti-dumping and countervailing duties, and customs fees commensurate with the cost of services rendered.

5 Another exception, in Article XI:2(c) of GATT, allows the application of import restrictions on any agricultural or fisheries product necessary to enforce governmental measures which operate, *inter alia*, to restrict quantities of the "like" domestic product that may be marketed, or to remove temporary surpluses of the like domestic products. Agricultural products are now subject to the disciplines of the Agreement on Agriculture. Fish and fish products are excluded from the Agreement on Agriculture and thus this provision may be of continued relevance for such products.

6 This obligation does not extend to more favourable treatment that is granted under a free trade area or customs union that is consistent with Article XXIV of the GATT, or under a preferential trade arrangement adopted pursuant to the Enabling Clause.

7 See G/STR/N/3/BRA and G/STR/N/7/VEN.

8 Article XX (i) is discussed below in the context of the problem of volatility.

9 This language came from the 1987 Panel Report in *Herring and Salmon*. Although the Appellate Body proceeded in its analysis on the basis of this interpretation, it cautioned that the phrase "is not itself treaty language and was not designed as a simple litmus test for inclusion or exclusion from Article XX(g)" (Appellate Body Report, *US – Gasoline*, pp. 18-19).

10 GATT, 3d Supp. BISD 230 (1955).

11 Decision of 20 February 1970, L/3361, 17S/18.

12 Passage cited from EPCT/A/PV/30 p. 22; report at EPCT/W/245.

13 *Decision on Trade in Services and the Environment*, adopted by the Council for Trade in Services on 1 March 1995, S/L/4.

14 *Report (1996) of the Committee on Trade and Environment*, WT/CTE/1, paras 153-158 and 210-211.

15 See also *Trade and Environment at the WTO* (2004), WTO.

16 It seems that the local short supply exception was also rarely used under the GATT. When the need for sub-paragraph (j) was reviewed at the Sixteenth Session in 1960, the Contracting Parties noted "that the contracting parties have resorted to the provisions of this sub-paragraph in a relatively limited number of cases..." (See *GATT Analytical Index,* p. 594).

17 Briefing Notes, Hong Kong, China WTO Ministerial 2005, available at http://www.wto.org/english/thewto_e/min05_e/brief_e/brief00_e.htm.

18 This approach was first articulated by the 1970 Working Party on Border Tax Adjustments. A number of Appellate Body and panel reports have also followed this approach: see, for example, Appellate Body Report, *Japan – Alcoholic Beverages*, 113 and footnote 46.

19 For a useful discussion of Article XX(b), (d) and (g) of the GATT, see Note by WTO Secretariat, GATT Dispute Settlement Practice relating to GATT Article XX(b), (d) and (g) (WT/CTE/W/203) (available at http://docsonline.wto.org/DDFDocuments/t/wt/cte/w203.doc).

20 See GATT Panel Report, *Thailand – Cigarettes*, para. 73 ("(S)moking constituted a serious risk to human health and that consequently measures designed to reduce the consumption of cigarettes fell within the scope of Article XX(b)"). See also Panel Report, *US – Gasoline*, para. 6.21:"(t)he policy to reduce air pollution resulting from the consumption of gasoline was a policy within the range of those concerning the protection of human, animal and plant life or health mentioned in Article XX(b)".

21 Marceau and Wyatt (2009) note that Article XIV of the GATS does not have an exception that is equivalent to sub-paragraph (g) of Article XX of the GATT. They submit that the Appellate Body may have had this in mind when interpreting sub-paragraph (b) of Article XX and that "it may have been influenced by the potential for an absurd incoherence pursuant to which one environmental protection measure may end up being permissible insofar as it impinged on trade in goods, but not permissible insofar as it affected trade in services".

22 The Appellate Body added that when an investigating authority proceeds in this manner it must ensure that the alternative benchmark it uses relates or refers to, or is connected with, prevailing market conditions in the country of provision (including price, quality, availability, marketability, transportation and other conditions of purchase or sale), with a view to determining, ultimately, whether the goods at issue were provided by the government for less than adequate remuneration (Appellate Body Report, *US – Softwood Lumber IV*, para. 120).

23 *Protocol Amending the General Agreement on Tariffs and Trade to Introduce a Part IV on Trade and Development*, BISD 13S/2 (1965).

24 Several WTO members have proposed the adoption of a transparency mechanism for preferential trade arrangements similar to that adopted provisionally by the General Council for regional trade agreements (see Job(08)103/Rev.1).

25 *Jus cogens* is a principle of international law from which no derogation is permitted. The prohibition of genocide, maritime piracy and slavery are examples of what would be considered by the international community as falling under this principle.

26 Trade & Environment Report, 36; WT/CTE/W160/Rev.4.

27 In accordance with the principle of effectiveness, the interpretation of a treaty should not deprive a treaty term of meaning. Marceau (2006) explains how the Appellate Body has used this principle to ensure the internal coherence of the WTO agreements.

28 There is also a Gas Exporting Countries Forum, which has 11 members and two observers. Together, they control nearly 70 per cent of the world's proven reserves of natural gas.

29 Victor and Yueh (2010) note the difficulties in expanding the membership of the IEA because of the requirement that its members also belong to the OECD. They thus submit that the "28-strong IEA includes many countries with small and shrinking energy needs but excludes giant energy consumers, such as China and India."

30 Preferential treatment provided under regional trade agreements need not be extended to other WTO members provided that the conditions in Article XXIV of the GATT (for goods) and Article V of the GATS (for services) are met. The Enabling Clause may be applicable to agreements between developing country members.

31 Annex 314 provides certain exceptions for Mexico in relation to foodstuffs. In the case of energy and basic petrochemicals, the relevant provision is Article 604.

32 Articles XI:2(a) and XX(g), (i) and (j) of the GATT are discussed above in section 1.

33 Article 7(7) of the ECT.

34 Article 13 provides certain conditions for expropriation. Expropriation needs to be in the public interest, non-discriminatory, carried out under due process of law and prompt, and adequate and effective compensation needs to be paid. Such compensation has to be calculated at the full market value at the time immediately preceding the announcement of the expropriation.

35 The breach of individual investment contracts by the host country is considered a violation of the Treaty. The investor can bring a dispute against the host state under Article 26 of the ECT.

36 Considering the importance of non-discrimination in the pre-investment stage, negotiations of a Supplementary Treaty were launched in 1995 but have not been concluded.

37 For further details, see the WTO Secretariat note containing a matrix on trade-related measures pursuant to selected MEAs (WT/CTE/W/160/Rev.4).

38 For a discussion of whether environmental measures may be justified under Article XIV of the GATS, see Box 27.

39 Some WTO members considered that measures taken pursuant to the Kimberley process are compatible with WTO rules. Thus, the Decision notes that the waiver "does not prejudge the consistency of domestic measures taken consistent with the Kimberley Process Certification Scheme with provisions of the WTO Agreement, including any relevant WTO exceptions, and that the waiver is granted for reasons of legal certainty".

40 A situation where the contractual agreement between two parties is affected by concerns that one party will gain undue bargaining power once investment by the other party has been committed.

41 Sometimes states have set up ad hoc arbitration arrangements to settle certain investment disputes between them, such as the Iran – United States Claims Tribunal.

42 Janow and Staiger (2003) suggest an economic interpretation of the view that an export tax can confer a subsidy to production in other sectors of the economy. This provides the basis for an alternative line of reasoning by which the panel might have argued that export restraints could never constitute specific subsidies.

43 This literature is based on the assumption of perfectly competitive markets. Ossa (2008) explores the role of trade agreements in an imperfectly competitive environment. While cross-border spillovers different from the terms-of-trade effect emerge in this setting, the role of a trade agreement remains that of neutralizing an international externality.

44 Bagwell and Staiger (2002), Chapter 6, provide an introduction to the formal models of enforcement in trade agreements.

45 In accession negotiations, the use of export duties has sometimes been regulated through commitments undertaken in Working Party Reports rather than through schedules of bindings.

46 See WTO documents TN/MA/W/1 and TN/MA/W/5.

47 See WTO document TN/AG/W/4/Rev.4, 6 December 2008.

48 See the discussion in sub-section E.2.(b)(iii).

49 This argument is an application of the Bagwell and Staiger (2002) case for trade cooperation based on mutually beneficial tariff reductions.

50 As seen in Section C, a dynamic model shows that these effect on the terms of trade are short-run and in the long-run measures may have the opposite effect. However, an analysis that highlights the immediate consequences of these policies is still useful as governments often value the short-run effects of their choice for political economy reasons.

51 See TN/MA/W/15/Add.4/Rev.3.

52 See Job(06)/14.

53 This is the case when no market failures are present. However, when property rights are poorly defined and the natural resources sector suffers from an open access problem, trade volumes may well be sub-optimally high. This situation will be further discussed below in the case of fishery subsidies.

54 See Bagwell and Staiger (2002), chapter 10.

55 WTO document TN/RL/W/213.

56 Subsidies that increase or maintain capacity (such as capital subsidies for boat-building) are distinguished from those that keep boats on the water (variable cost subsidies such as for fuel).

57 See TN/RL/GEN/135.

58 The full text of the communiqué can be accessed at: http://www.g20.org/Documents/pittsburgh_summit_leaders_statement_250909.pdf

59 See the discussion on the applicability of Article XX of the GATT to the SCM Agreement in subsection E.1.

60 Staiger and Sykes (2009) provide an interesting extension of this model. As in Bagwell and Staiger (2001a), the externality is purely local, but Staiger and Sykes (2009) allow for a domestic regulation, say a product standard, which implies a compliance cost for producers. This model shows that, in the absence of rules on non-discrimination, governments have an incentive to impose discriminatory product standards once tariffs have been committed. The reason for this is to shift part of the regulatory cost onto foreign producers. As in Bagwell and Staiger (2001a), when regulatory discrimination is prohibited by the treaty, governments still face an incentive to use domestic standards to erode market access commitments agreed in previous negotiations.

61 In *Brazil - Retreaded Tyres*, the Appellate Body had to examine whether an import ban on retreated tyres could be justified under Article XX(b) of the GATT as a measure necessary to protect, human, animal or plant life or health. In its analysis of this issue, the Appellate Body underscored that the import ban had to "be viewed in the broader context of the comprehensive strategy designed and implemented by Brazil to deal with waste tyres". This comprehensive strategy included a collection and disposal scheme, which made it mandatory for domestic manufacturers of new tyres and tyre importers to provide for the safe disposal of waste tyres in specified proportions, as well as an import ban on used tyres (Appellate Body Report, *Brazil – Tyres*, para. 154).

62 See the discussion of Article XX of the GATT, in sub-section E.1.

63 Often different government departments will represent the same state in the various fora where international rules affecting natural resources are negotiated, raising the risk of incoherence. Internal coordination is essential to reduce the risk that a state assumes obligations in one forum that conflict with those it has assumed in other fora. It is also necessary to ensure that implementing measures are consistent with obligations under other international agreements to which a state is a party.

64 The WTO agreements include provisions on IMF/World Bank/WTO coherence. The WTO also cooperates with the Food and Agriculture Organization, World Health Organization, World Organization for Animal Health, and the World Bank in the Standards and Trade Development Facility. The WTO Secretariat has working relations with almost 200 international organizations (Lamy, 2007).

65 For an overview of the academic and policy debate on the costs and benefits of the regulation of investment policies within the WTO, see Hoekman and Saggi (2000) and the literature quoted therein.

66 As explained, the oligopoly case has not been analysed by the literature.

67 The European Commission, for example, has recently opened a formal anti-trust investigation of iron ore production joint ventures between two Anglo-Australian mining companies. The Commission will in particular examine the effects of the proposed joint venture on the worldwide market for iron ore transported by sea. Opening of the proceedings does not imply that the Commission has conclusive evidence of an infringement, but merely that it will investigate the case as a matter of priority (see http://thegovmonitor.com/world_news/europe/ec-opens-formal-antitrust-investigation-2-into-anglo-australian-mining-companies-22177.html). Similarly, De Beers has faced anti-trust prosecution by the United States Department of Justice in 1945, 1957, 1974 and 1994. The 1994 indictment resulted in De Beers pleading guilty, in 2004, to a violation of the Sherman Act for conspiring with General Electric to fix prices of industrial diamonds ("De Beers Agrees to Guilty Plea to Re-enter the U.S. Market", *New York Times*, 10.07.04, available at: http://www.nytimes.com/2004/07/10/business/worldbusiness/10diamond.html).

68 Gordon et al. (2003) empirically investigate the cost structure associated with transporting natural gas by a Canadian carrier and conclude that this carrier is indeed a natural monopoly.

69 The Reference Paper has been incorporated into the schedules of some 60 members and includes certain competition and regulatory disciplines for the telecommunications sector. On this, see also the proposals by the United States (S/CSS/W/24) and Norway (S/CSS/W/59).

70 Third-party access (TPA) refers to the possibility for a third party to access and use energy network facilities (such as pipelines, grids, storage facilities) against the payment of a fee to the owner or operator of such facility.

71 See Ukraine, Schedule of Specific Commitments, GATS/SC/144.

72 *Energy Services*, Background Note by the Secretariat, S/C/W/311, 12 January 2010.

73 An additional difficulty arises in relation to government procurement. The procurement of goods and services by governmental agencies for their own use is not covered by the main WTO disciplines. The GATT explicitly excludes government procurement from the national treatment obligation and, under the GATS, the most-favoured-nation treatment obligation as well as specific commitments do not apply to services purchased by government agencies. Procurement of goods and services is subject to a separate plurilateral Agreement on Government Procurement (GPA), which has been signed by 41 governments, mostly developed members. In practice, activities in relation to natural resources (for instance, exploration, exploitation, consulting, decontamination, environmental impact assessment, water distribution) may be subject to different types of contractual relationship between a public authority and a private supplier, including, *inter alia*, concession, build-operate-transfer and management contracts. These transactions will escape relevant disciplines whenever they can be considered a form of government procurement, although they may be subject to the GPA in the case of signatories. Uncertainty exists, however, concerning the scope of the definition of government procurement. For more on this issue, see Cossy (2005) and Musselli and Zarrilli (2005).

74 While an exhaustive discussion on how to promote innovation in resource-friendly technologies is beyond the scope of the present report, it is clear that the design of the IPR regime is only one element of this debate. A recent study by Lee, Iliev and Preston (2009) suggests that other forms of public intervention are essential. For instance, governments could create public funds, such as technology prizes, to promote innovation and stimulate international collaboration in the R&D process.

75 For a more extensive discussion of this point, see *World Trade Report* (2008).

F. Conclusions

This report has addressed four fundamental issues relating to natural resources trade. The first is how key economic features of natural resources and the manner of their exchange influence patterns of trade for this class of goods. Second, we have examined how far the absence of trade barriers provides an efficient mechanism for ensuring access to natural resources and their long-run sustainability. The third issue concerns the incentives that governments face in setting trade policy in natural resource sectors and the consequences of this incentive structure. Finally, the report has considered how international cooperation affects the management of trade in natural resources, with particular emphasis on the role of the WTO.

Contents

Economic features of natural resources and patterns of trade

Natural resources have a number of distinctive features that have served as organizing themes throughout the report – the skewed geographical distribution of natural resources, their exhaustibility, the widespread occurrence of economic effects of natural resources exploitation disregarded by the market (externalities), high natural resource dependency in some economies, and tendencies towards high price volatility in natural resource markets. Keeping these characteristics in mind is essential for recognizing the effects of international trade, the rationale and consequences of trade policy measures, and the efficient design of rules governing resources trade.

The report has documented the sharp rise in the share (in value terms) of natural resources in world trade in recent years, mostly due to rising commodity prices, particularly for oil. Modes of trade in natural resources differ substantially from trade in manufactured goods in a number of important respects. First, natural resources are amenable to centralized trading as they tend to be quite homogeneous. This mode of trading has contributed to the establishment of international exchanges for natural resources, as well as to the stability of trade flows. Second, the unequal geographical distribution and other characteristics specific to certain resources have resulted in the adoption of special modes of trade, such as long-term intergovernmental contracts and vertical integration of various stages of the production process. The details of these arrangements have important implications for the patterns of international trade and the formation of resource prices.

Trade openness, access and sustainability

Due to the geographical concentration of natural resources, trade has the potential to improve efficiency and increase welfare by shifting resources from regions of relative abundance to regions of relative scarcity. However, welfare comparisons are complicated by factors such as the exhaustibility of natural resources and pervasive market failures. The latter include imperfectly competitive markets and open access to resources when property rights are poorly defined. Under some circumstances, cartels in non-renewable sectors may lead to a slower than optimal extraction of a resource in exporting countries, while the opposite – that is, faster depletion – can result from free trade in renewable resources that suffer from an open access problem. The latter leads to a situation where the standard result of welfare gains from open trade breaks down, at least for one country.

Four other major issues are commonly associated with natural resources trade – the presence of environmental externalities, the impact that technology has on the sustainability of resources, the so-called "curse" faced by resource-rich economies, and the high volatility that characterizes some resource sectors. International trade interacts with all these factors in complex ways, in some cases exacerbating existing problems and at times providing solutions. A negative impact on the environment can be intensified by an increase in the rate of extraction driven by exports, but the more efficient international allocation of resources promoted by trade has the effect of reducing this negative impact. Technological innovations – diffused internationally through trade – may accelerate the depletion of scarce resources, but they also improve the ability of governments to monitor remaining stocks and provide efficient substitutes to exhaustible resources. Finally, international trade may encourage over-specialization in natural resources but it can also provide opportunities for diversification that reduce the problems of high dependency on commodities and price volatility.

Trade policies and their consequences

The report has documented government intervention in natural resource sectors, noting that trade policy in this area is very nearly the reverse of what we observe in other traded goods sectors. Resource-rich countries often restrict exports through a variety of means, such as export taxes and quantitative restrictions, whereas tariffs and other import restrictions in resource-scarce countries are low. There are, however, two important qualifications to this general rule. First, domestic policies that are likely to affect trade flows, including subsidies, technical regulations and consumption taxes, are frequently used. Second, the structure of protection that resource exporters face tends to rise with the stage of processing (tariff escalation).

Policy interventions in natural resource sectors are justified on welfare grounds by the specific features of natural resources. Governments employ trade policies as instruments to achieve several objectives: to improve resource conservation, to reduce environmental externalities associated with the harvesting or consumption of resources, to stimulate diversification of exports away from dominant resource sectors, and to stabilize income in response to supply or demand shocks.

However, three significant caveats need to be kept in mind. First, restrictions on trade have beggar-thy-neighbour effects, as they shift rents across countries or alter the terms of trade. They also have beggar-thy-self consequences, as they may be politically expedient in the short run but welfare-reducing in the long run. Second, while in some cases they are the only available policy option, trade measures are typically a second-best policy to address problems associated with natural resources. The first-best intervention is often a domestic policy that addresses the distortion at the source. Finally, trade measures and domestic measures in natural resource sectors tend to be close substitutes. When resources are unevenly distributed across countries, there is sometimes little difference between the trade impact of domestic measures, such as consumption taxes and production restrictions, and the effects of traditional trade measures.

Rules to foster international cooperation

The general principles of the multilateral trading system provide a framework for limiting beggar-thy-neighbour and beggar-thyself trade policies, including within resource sectors. Several WTO rules have relevance in relation to the main features of natural resources. In particular, rules on non-discrimination, freedom of transit, tariff bindings and export restrictions are relevant to the unequal distribution of resources across countries and facilitate WTO members' access to supplies of scarce resources. The instruments of policy flexibility contained in the WTO agreements, such as Article XX, allow issues of resource exhaustibility, environmental externalities, dominance and price volatility to be addressed. In addition, other international agreements establish mechanisms for international cooperation in natural resource sectors. These agreements are often aimed at addressing related market or government failures, such as those associated with the protection of the environment or with corruption.

WTO rules were not specifically drafted to regulate natural resources trade and may not always respond adequately to the specific features of this sector. In this respect, the report has identified several areas where consideration could be given to intensified cooperation on the basis of mutual gain. One such area involves trade policies, such as export taxes, where bargains might ameliorate uncooperative trade outcomes. The scope for such bargains will depend in part on what objectives are being pursued by such policies and how these objectives might influence welfare at the national level. A second issue concerns the scope for conservation policies, such as the treatment of subsidies aimed at improving the conservation of natural resources.

A third issue relates to the facilitation of trade flows of natural resources, specifically the scope of freedom of transit covered under Article V of the GATT. A fourth area concerns the clarity of current rules, such as the applicability of the rules of the GATT or the General Agreement on Trade in Services (GATS) to exploration and processing of natural resources. A further area where coherence matters is the relationship between the WTO and rules of international law in different agreements and arrangements that may be relevant to natural resources.

Other issues that have been touched upon, but where no WTO mandate nor ongoing negotiations exist, include increased international cooperation on investment, competition and domestic policies such as consumption taxes. These issues have been included in the discussion on account of the analytical case that can be made, under specified circumstances, for further cooperation. This is distinct from advocating a new WTO negotiating agenda, which would be outside the competence of a report of this nature.

Concluding remarks

The tension between rising demand for natural resources due to population and income growth on the one hand, and their scarcity and exhaustibility on the other, is a challenge facing modern society. This tension seems likely to increase, especially as the global economy recovers from recession and the circle of development and industrialization continues to widen. Fears of inadequate access to supplies in resource-scarce countries and of inappropriate exploitation in resource-rich regions could lead to trade conflict or worse. Adequately defined rules for international cooperation, built on a shared perception of gain, will contribute to the avoidance of such an outcome.

In sum, the analysis in this report argues strongly for cooperation. The importance of natural resources to virtually every aspect of human activity, and the particular characteristics of these products, make it vital that governments work together to find common ground and appropriate trade-offs. Such cooperation should aim to ensure sound resource management, equity and mutual gain. The trade aspects of cooperation have been a particular focus of the report, and the case has been made for seeking accommodation through effective multilateral trade rules. Well-designed rules on trade are not only about securing the standard gains from trade; they are also a key component of cooperation in domains such as environmental protection and domestic policies to manage scarce resources.

Statistical appendix

The definition of natural resources in sub-section 1 of Section B is sufficient for many analyses, but a more precise statistical definition is required in order to deal consistently with data on trade flows, which is surveyed in sub-section 2 of Section B. An even broader conception of natural resources is needed when examining non-traded goods. This appendix provides details on alternative definitions of natural resources, followed by summary tables of trade by individual countries, as well as maps illustrating various aspects of natural resource supplies and trade.

The United Nations System of National Accounts (SNA) proposes a classification of natural resources that includes the following components natural land, subsoil assets, non-cultivated biological resources, water resources, and other natural resources (United Nations, 2006). The comprehensiveness of this definition is appealing, but its application to international trade is problematic. Natural land, for instance, is immobile and cannot be traded. In principle, water could be traded internationally with the aid of pipelines, but in practice this never occurs. International trade in water is limited to bottled water, the total value of which represents just 0.02 per cent of world merchandise trade according to Secretariat estimates.[1] Furthermore, this definition does not consider refined petroleum products to be natural resources, even though many countries import significant quantities of them. For example, although Viet Nam is an exporter of crude oil, the country imports all of its refined petroleum products.

The product classification used in the WTO's *International Trade Statistics* is better suited to the analysis of natural resources trade, since it includes aggregates that cover most international trade in this class of goods (WTO, 2009). Product groups are defined in terms of revision 3 of the Standard International Trade Classification (SITC) and are divided into primary products (SITC sections 0, 1, 2, 3, 4 plus division 68) and manufactures (SITC sections 5, 6, 7, 8 minus division 68 and group 891), with remaining codes (SITC section 9 and group 891) comprising unspecified products. The category "primary products" is broader than natural resources since it includes food and other cultivated goods that would not normally be considered natural resources. However, if we exclude food products other than fish, we arrive at a usable statistical definition for which data on global trade flows are readily available. The relevant product groups are as follows:

1. Fish (SITC division 03)

2. Raw materials (SITC divisions 21, 23, 24, 25, 26, 29)

of which:

- Raw hides, skins and furskins (21)
- Crude rubber (23)
- Cork and wood (24)
- Wood pulp (25)
- Textile fibres (26)
- Crude animal and vegetable materials, not elsewhere specified (29)

3. Fuels and mining products (SITC section 3 and divisions 27, 28, 68)

of which:

- Ores and other minerals (SITC divisions 27, 28)
- Fuels (SITC section 3)
- Non-ferrous metals (SITC division 68)

The sum of the above three product groups provides us with a basic, usable statistical definition of natural resources. Unfortunately, the category of raw materials is overly broad as it contains a number of cultivated agricultural products. However, we may still use it in cases where no further breakdown of the data is possible. This is not usually a problem, since forestry products make up the majority of raw materials trade for most countries and regions. This definition is also useful in that it covers products that may be considered natural resources in some circumstances but not in others – for example, crude rubber (which may be natural or synthetic) and furskins (either wild or farmed). It may also be seen as an upper bound definition.

Where sufficiently detailed data are available, it is preferable to use the following definition of forestry products in place of raw materials:

1 Based on 2008 data from the UN Comtrade database.

4. Forestry products (SITC divisions 24 and 25)

of which:

Cork and wood (24)

Wood pulp (25)

"Natural resources narrowly defined" is equal to the sum of groups 1, 3 and 4 and is our preferred definition since the products it covers are all unambiguously natural resources. For an even broader view of resources, one might also consider adding the category "Other semi-manufactures", which includes lightly processed manufactures made from natural resources.

5. Other semi-manufactures (SITC divisions 61, 62, 63, 64, 66, 69)

of which:

Leather, leather manufactures, not elsewhere specified (61)

Rubber manufactures, not elsewhere specified (62)

Cork and wood manufactures, excluding furniture (63)

Paper, paperboard and articles thereof (64)

Non-metallic mineral manufactures, not elsewhere specified (66)

Manufactures of metals, not elsewhere specified (69)

Two noteworthy details are 1) the fact that scrap metal is included in "Ores and other minerals", and 2) that non-monetary gold is excluded from natural resources altogether. The inclusion of scrap metal in ores is a result of the underlying SITC classification rather than a conscious decision on the part of the WTO, but it makes sense since both ores and scrap are used as inputs in new metal production. As for non-monetary gold (SITC 97), this is recorded under "commodities not elsewhere specified" in the SITC classification but is not recorded systematically by all countries. Its inclusion in statistics on natural resources would distort aggregate figures for natural resources for certain countries.

Unless otherwise noted, this report uses the standard WTO geographical regions from *International Trade Statistics 2009*.

Appendix Table 1: **World proved oil reserves by country and region, 2008** (Billion barrels and percentage)

	Proved reserves (Billion barrels)	Share in world (Percentage)
World [a]	1,258.0	100.0
Regions		
Middle East	754.1	59.9
Commonwealth of Independent States (CIS)	128.4	10.2
Africa	125.6	10.0
South and Central America	123.2	9.8
North America	70.9	5.6
Asia Pacific	42.0	3.3
Europe	13.8	1.1
Countries		
Saudi Arabia	264.1	21.0
Iran	137.6	10.9
Iraq	115.0	9.1
Kuwait	101.5	8.1
Bolivarian Rep. of Venezuela	99.4	7.9
United Arab Emirates	97.8	7.8
Russian Federation	79.0	6.3
Libya	43.7	3.5
Kazakhstan	39.8	3.2
Nigeria	36.2	2.9
United States	30.5	2.4
Canada	28.6	2.3
Qatar	27.3	2.2
China	15.5	1.2
Angola	13.5	1.1
Above 15	1,129.4	89.8
Brazil	12.6	1.0
Algeria	12.2	1.0
Mexico	11.9	0.9
Norway	7.5	0.6
Azerbaijan	7.0	0.6
Sudan	6.7	0.5
India	5.8	0.5
Oman	5.6	0.4
Malaysia	5.5	0.4
Viet Nam	4.7	0.4
Egypt	4.3	0.3
Australia	4.2	0.3
Ecuador	3.8	0.3
Indonesia	3.7	0.3
United Kingdom	3.4	0.3
Gabon	3.2	0.3
Yemen	2.7	0.2
Argentina	2.6	0.2
Syria	2.5	0.2
Congo, Dem. Rep. of	1.9	0.2
Equatorial Guinea	1.7	0.1
Colombia	1.4	0.1
Peru	1.1	0.1
Brunei Darussalam	1.1	0.1
Chad	0.9	0.1
Above 40	1,247.4	99.2
Memo items:		
OPEC	955.8	76.0
European Union	6.3	0.5

a Excludes Canadian oil sands.
Source: BP Statistical Review of World Energy.

Appendix Table 2: **Leading exporters and importers of natural resources including intra-EU trade, 2008**
(Billion dollars and percentage)

	Value	Share in world	Share in total merchandise	Annual percentage change		
				2000-08	2007	2008
Exporters						
World	**3,734.2**	**100.0**	**23.8**	**18.3**	**14.9**	**31.1**
Russian Federation	341.2	9.1	72.9	23.1	16.2	34.1
Saudi Arabia	282.0	7.6	90.0	18.8	9.9	35.7
Canada	177.7	4.8	39.0	13.0	13.6	24.9
United States	142.5	3.8	11.0	17.3	17.5	42.4
Norway	130.6	3.5	77.8	14.0	8.4	23.7
Australia	114.3	3.1	61.1	19.3	13.6	54.3
United Arab Emirates	109.4	2.9	52.1	17.6	8.9	33.5
Iran	95.5	2.6	84.2	18.0	38.4	27.1
Germany	89.9	2.4	6.1	17.9	14.6	11.1
United Kingdom	83.5	2.2	18.3	12.9	12.8	24.1
Kuwait	82.9	2.2	95.2	20.9	11.5	39.7
Bolivarian Rep. of Venezuela	79.8	2.1	95.8	14.1	7.4	27.8
Algeria	78.4	2.1	98.8	17.4	10.3	31.7
Netherlands	75.8	2.0	13.9	15.6	-10.6	25.3
Nigeria	75.4	2.0	92.2	13.7	-12.5	48.2
Above 15	1,958.7	52.5	-	-	-	-
Importers						
World	**3,832.6**	**100.0**	**23.8**	**17.8**	**14.0**	**31.2**
United States	583.4	15.2	27.0	15.0	6.9	27.9
Japan	350.2	9.1	45.9	13.9	9.2	40.6
China	330.3	8.6	29.2	30.0	32.5	43.0
Germany	231.5	6.0	19.2	16.7	6.4	29.2
Korea, Rep. of	182.0	4.7	41.8	17.3	13.4	37.0
France	148.5	3.9	21.4	16.2	7.5	32.2
India	135.4	3.5	42.9	25.1	20.8	52.5
Italy	117.3	3.1	21.2	14.2	14.3	15.8
United Kingdom	111.8	2.9	17.7	18.4	12.8	24.5
Spain	106.3	2.8	26.5	18.0	14.3	25.0
Netherlands	96.4	2.5	19.5	16.8	0.4	24.0
Belgium	96.3	2.5	20.5	19.1	5.4	33.5
Singapore	95.1	2.5	29.7	22.3	16.0	60.0
Taipei, Chinese	83.1	2.2	34.5	18.6	18.1	29.3
Canada	67.3	1.8	16.5	15.2	10.1	30.1
Above 15	2,735.0	71.4	-	-	-	-

Source: UN Comtrade database and WTO Secretariat estimates.

Appendix Table 3: **Leading exporters and importers of natural resources excluding intra-EU trade, 2008**
(Billion dollars and percentage)

	Value	Share in world	Share in total merchandise	Annual percentage change		
				2000-08	2007	2008
Exporters						
World excl. EU-Intra	**3,247.3**	**100.0**	**27.7**	**18.5**	**15.3**	**32.8**
Russian Federation	341.2	10.5	72.9	23.1	16.2	34.1
Saudi Arabia	282.0	8.7	90.0	18.8	9.9	35.7
Canada	177.7	5.5	39.0	13.0	13.6	24.9
European Union (27)	176.6	5.4	9.2	18.5	16.8	28.2
United States	142.5	4.4	11.0	17.3	17.5	42.4
Norway	130.6	4.0	77.8	14.0	8.4	23.7
Australia	114.3	3.5	61.1	19.3	13.6	54.3
United Arab Emirates	109.4	3.4	52.1	17.6	8.9	33.5
Iran	95.5	2.9	84.2	18.0	38.4	27.1
Kuwait	82.9	2.6	95.2	20.9	11.5	39.7
Bolivarian Rep. of Venezuela	79.8	2.5	95.8	14.1	7.4	27.8
Algeria	78.4	2.4	98.8	17.4	10.3	31.7
Nigeria	75.4	2.3	92.2	13.7	-12.5	48.2
Singapore	67.7	2.1	20.0	23.8	17.6	44.2
Angola	67.1	2.1	100.0	..	..	..
Above 15	2,021.0	62.2	-	-	-	-
Importers						
World excl. EU-Intra	**3,345.6**	**100.0**	**27.5**	**17.9**	**14.2**	**33.0**
European Union (27)	766.6	22.9	33.6	18.1	11.0	31.9
United States	583.4	17.4	27.0	15.0	6.9	27.9
Japan	350.2	10.5	45.9	13.9	9.2	40.6
China	330.3	9.9	29.2	30.0	32.5	43.0
Korea, Rep. of	182.0	5.4	41.8	17.3	13.4	37.0
India	135.4	4.0	42.9	25.1	20.8	52.5
Singapore	95.1	2.8	29.7	22.3	16.0	60.0
Taipei, Chinese	83.1	2.5	34.5	18.6	18.1	29.3
Canada	67.3	2.0	16.5	15.2	10.1	30.1
Turkey	50.7	1.5	25.1	22.3	22.5	33.4
Thailand	49.9	1.5	27.9	20.9	5.1	37.4
Brazil	42.8	1.3	24.7	19.1	29.3	47.5
Mexico	40.5	1.2	13.1	19.4	22.7	35.1
Indonesia	37.7	1.1	29.1	20.5	16.3	44.6
Australia	34.8	1.0	18.2	20.5	17.1	43.8
Above 15	2,849.8	85.2	-	-	-	-

Source: UN Comtrade database and WTO Secretariat estimates.

Appendix Table 4: **Leading exporters and importers of fish including intra-EU trade, 2008**
(Billion dollars and percentage)

	Value	Share in world	Share in total merchandise	Annual percentage change		
				2000-08	2007	2008
Exporters						
World	**97.6**	**100.0**	**0.6**	**7.9**	**7.7**	**9.1**
China	10.1	10.3	0.7	13.6	3.1	9.4
Norway	6.8	7.0	4.0	8.9	13.2	11.6
Thailand	6.5	6.6	3.7	5.1	8.1	15.5
United States	4.3	4.4	0.3	4.8	0.8	-0.3
Viet Nam	4.1	4.2	6.5	13.6	12.1	8.5
Canada	3.7	3.8	0.8	3.4	0.8	0.4
Spain	3.4	3.5	1.3	9.6	15.7	4.8
Chile	3.3	3.4	4.8	10.1	3.3	8.2
Denmark	3.3	3.4	2.9	7.4	6.6	7.7
Netherlands	2.8	2.9	0.5	9.8	13.8	5.5
Indonesia	2.5	2.5	1.8	5.7	7.3	17.4
Germany	2.1	2.1	0.1	11.3	9.3	11.0
France	1.9	2.0	0.3	8.0	16.0	4.7
Sweden	1.9	1.9	1.0	19.3	5.5	15.1
United Kingdom	1.8	1.9	0.4	7.4	15.1	-5.8
Above 15	58.5	59.9	-	-	-	-
Importers						
World	**102.6**	**100.0**	**0.6**	**7.7**	**7.2**	**9.2**
United States	14.8	14.4	0.7	4.5	2.7	3.3
Japan	14.0	13.7	1.8	-1.1	-5.6	9.9
Spain	6.4	6.2	1.6	8.3	10.1	-9.7
France	5.7	5.6	0.8	8.9	6.0	8.4
Italy	5.4	5.2	1.0	9.9	10.8	3.6
Germany	4.3	4.2	0.4	9.5	8.9	6.3
United Kingdom	4.1	4.0	0.6	9.2	13.1	1.8
China	3.7	3.6	0.3	15.0	9.8	6.7
Korea, Rep. of	3.2	3.1	0.7	11.4	10.9	7.5
Sweden	2.7	2.6	1.6	18.4	22.9	9.7
Thailand	2.4	2.3	1.3	16.0	11.2	41.6
Netherlands	2.3	2.2	0.5	10.6	15.3	16.6
Belgium	2.2	2.2	0.5	10.6	10.2	7.2
Russian Federation	2.2	2.2	0.8	39.1	40.9	18.7
Denmark	2.0	2.0	1.8	7.3	6.1	7.1
Above 15	75.4	73.5	-	-	-	-

Source: UN Comtrade database and WTO Secretariat estimates.

Appendix Table 5: **Leading exporters and importers of fish excluding intra-EU trade, 2008**
(Billion dollars and percentage)

	Value	Share in world	Share in total merchandise	Annual percentage change		
				2000-08	2007	2008
Exporters						
World excl. EU-Intra	**77.2**	**100.0**	**0.7**	**7.4**	**6.5**	**10.9**
China	10.1	13.1	0.7	13.6	3.1	9.4
Norway	6.8	8.8	4.0	8.9	13.2	11.6
Thailand	6.5	8.4	3.7	5.1	8.1	15.5
United States	4.3	5.6	0.3	4.8	0.8	-0.3
Viet Nam	4.1	5.3	6.5	13.6	12.1	8.5
European Union (27)	4.1	5.3	0.2	11.8	13.7	18.6
Canada	3.7	4.8	0.8	3.4	0.8	0.4
Chile	3.3	4.3	4.8	10.1	3.3	8.2
Indonesia	2.5	3.2	1.8	5.7	7.3	17.4
Iceland	1.7	2.3	32.5	6.1	11.0	-3.4
Ecuador	1.7	2.2	9.1	14.5	3.0	26.8
Japan	1.6	2.1	0.2	9.5	18.4	-1.5
India	1.6	2.0	0.9	1.7	3.6	-9.9
Taipei, Chinese	1.5	1.9	0.6	2.9	-0.4	24.6
Korea, Rep. of	1.3	1.7	0.3	-0.3	15.6	25.9
Above 15	54.7	70.9	-	-	-	-
Importers						
World excl. EU-Intra	**82.1**	**100.0**	**0.7**	**7.2**	**5.9**	**10.9**
European Union (27)	23.7	28.9	1.0	10.7	11.1	7.4
United States	14.8	18.0	0.7	4.5	2.7	3.3
Japan	14.0	17.1	1.8	-1.1	-5.6	9.9
China	3.7	4.5	0.3	15.0	9.8	6.7
Korea, Rep. of	3.2	3.9	0.7	11.4	10.9	7.5
Thailand	2.4	2.9	1.3	16.0	11.2	41.6
Russian Federation	2.2	2.7	0.8	39.1	40.9	18.7
Canada	1.9	2.3	0.5	4.6	10.1	0.6
Australia	1.0	1.3	0.5	9.8	12.0	7.7
Singapore	0.9	1.1	0.3	6.3	8.1	13.5
Ukraine	0.7	0.9	0.9	30.2	19.8	36.4
Brazil	0.7	0.8	0.4	10.9	26.1	21.6
Nigeria	0.6	0.8	2.3	12.5	59.0	-46.8
Switzerland	0.6	0.8	0.3	7.4	12.5	9.0
Taipei, Chinese	0.6	0.7	0.2	5.0	19.6	40.3
Above 15	71.1	86.6	-	-	-	-

Source: UN Comtrade database and WTO Secretariat estimates.

Appendix Table 6: **Leading exporters and importers of forestry products including intra-EU trade, 2008**
(Billion dollars and percentage)

	Value	Share in world	Share in total merchandise	Annual percentage change		
				2000-08	2007	2008
Exporters						
World	**106.36**	**100.0**	**0.7**	**6.7**	**17.1**	**0.3**
Canada	12.7	12.0	2.8	-2.7	-2.4	-14.2
United States	12.3	11.6	0.9	3.8	13.1	6.0
Russian Federation	7.7	7.3	1.6	14.0	31.2	-10.3
Sweden	6.7	6.3	3.6	6.7	21.4	-2.7
Brazil	5.3	5.0	2.7	11.0	16.5	12.5
Germany	5.0	4.7	0.3	13.0	21.1	-1.4
Chile	3.9	3.7	5.7	10.5	38.3	8.0
Finland	3.6	3.3	3.7	4.3	16.1	-14.9
Austria	2.7	2.5	1.5	8.3	32.1	-7.0
Belgium	2.4	2.2	0.5	10.0	31.8	2.6
Indonesia	2.0	1.9	1.4	7.7	0.8	20.2
France	1.9	1.8	0.3	5.7	26.6	0.4
Malaysia	1.8	1.7	0.9	0.5	0.8	-1.9
Netherlands	1.7	1.6	0.3	12.9	26.0	16.1
New Zealand	1.6	1.5	5.3	5.5	15.8	-0.3
Above 15	71.2	66.9	-	-	-	-
Importers						
World	**112.45**	**100.0**	**0.7**	**6.4**	**16.3**	**0.1**
China	19.7	17.5	1.7	17.7	30.9	16.5
United States	10.3	9.2	0.5	-2.1	-13.1	-19.5
Japan	8.6	7.7	1.1	-1.6	2.0	-1.1
Germany	6.9	6.1	0.6	6.0	14.1	1.9
Italy	5.8	5.2	1.1	3.3	13.4	-7.8
France	4.1	3.7	0.6	4.6	28.4	-1.0
United Kingdom	3.8	3.4	0.6	2.6	26.6	-21.4
Korea, Rep. of	3.6	3.2	0.8	4.0	20.9	8.0
Netherlands	3.2	2.8	0.6	7.8	22.8	3.0
Belgium	2.8	2.5	0.6	6.9	32.9	-5.4
Austria	2.4	2.1	1.4	8.6	12.2	2.2
India	2.2	2.0	0.7	14.3	30.3	15.9
Finland	2.2	1.9	2.3	18.3	39.7	23.3
Spain	2.1	1.9	0.5	3.4	21.7	-21.1
Canada	2.0	1.7	0.5	1.5	4.1	-4.0
Above 15	79.7	70.9	-	-	-	-

Source: UN Comtrade database and WTO Secretariat estimates.

Appendix Table 7: **Leading exporters and importers of forestry products excluding intra-EU trade, 2008**
(Billion dollars and percentage)

	Value	Share in world	Share in total merchandise	Annual percentage change		
				2000-08	2007	2008
Exporters						
World excl. EU-Intra	**76.0**	**100.0**	**0.6**	**6.2**	**14.4**	**0.8**
Canada	12.7	16.7	2.8	-2.7	-2.4	-14.2
United States	12.3	16.2	0.9	3.8	13.1	6.0
European Union (27)	9.1	12.0	0.5	10.9	20.5	4.5
Russian Federation	7.7	10.2	1.6	14.0	31.2	-10.3
Brazil	5.3	7.0	2.7	11.0	16.5	12.5
Chile	3.9	5.2	5.7	10.5	38.3	8.0
Indonesia	2.0	2.6	1.4	7.7	0.8	20.2
Malaysia	1.8	2.4	0.9	0.5	0.8	-1.9
New Zealand	1.6	2.1	5.3	5.5	15.8	-0.3
Australia	1.4	1.9	0.8	12.9	25.0	14.7
China	1.3	1.8	0.1	14.0	6.8	0.2
South Africa	0.9	1.2	1.3	3.5	5.7	13.6
Japan	0.9	1.2	0.1	26.1	28.8	15.1
Norway	0.6	0.7	0.3	7.5	14.9	14.4
Thailand	0.6	0.7	0.3	6.6	17.3	-3.2
Above 15	62.1	81.7	-	-	-	-
Importers						
World excl. EU-Intra	**82.1**	**100.0**	**0.7**	**5.9**	**13.5**	**0.5**
China	19.7	24.0	1.7	17.7	30.9	16.5
European Union (27)	16.0	19.5	0.7	4.2	19.3	-4.9
United States	10.3	12.6	0.5	-2.1	-13.1	-19.5
Japan	8.6	10.5	1.1	-1.6	2.0	-1.1
Korea, Rep. of	3.6	4.4	0.8	4.0	20.9	8.0
India	2.2	2.7	0.7	14.3	30.3	15.9
Canada	2.0	2.4	0.5	1.5	4.1	-4.0
Mexico	1.7	2.1	0.6	7.8	11.5	3.9
Taipei, Chinese	1.7	2.0	0.7	1.8	15.4	4.0
Indonesia	1.6	2.0	1.3	4.3	18.3	41.6
Thailand	1.2	1.4	0.6	4.8	7.9	14.6
Turkey	1.0	1.2	0.5	11.8	15.8	7.4
Egypt	1.0	1.2	2.1	8.2	30.6	27.9
Norway	0.9	1.0	1.0	5.7	40.9	-10.9
Switzerland	0.9	1.0	0.5	5.4	17.7	9.6
Above 15	72.4	88.1	-	-	-	-

Source: UN Comtrade database and WTO Secretariat estimates.

Appendix Table 8: **Leading exporters and importers of fuels including intra-EU trade, 2008**
(Billion dollars and percentage)

	Value	Share in world	Share in total merchandise	Annual percentage change		
				2000-08	2007	2008
Exporters						
World	**2,861.89**	**100.0**	**18.2**	**20.0**	**13.4**	**41.0**
Russian Federation	307.4	10.7	65.7	24.8	14.2	42.0
Saudi Arabia	281.0	9.8	89.7	18.8	9.9	35.8
Canada	125.9	4.4	27.6	16.8	13.0	43.9
Norway	113.7	4.0	67.7	14.6	5.8	29.7
United Arab Emirates	103.3	3.6	49.2	17.3	7.0	33.0
Iran	93.0	3.2	82.0	17.7	38.4	27.6
Kuwait	82.8	2.9	95.0	20.9	11.4	39.8
Bolivarian Rep. of Venezuela	78.2	2.7	93.8	14.4	4.9	31.1
Algeria	77.8	2.7	98.1	17.4	10.5	31.5
United States	76.5	2.7	5.9	24.4	20.3	82.4
Nigeria	75.1	2.6	91.7	13.6	-13.1	48.5
Angola	66.4	2.3	98.9	..	..	..
Singapore	62.5	2.2	18.5	25.5	15.9	51.2
United Kingdom	60.3	2.1	13.2	12.2	7.2	31.1
Australia	59.6	2.1	31.9	20.6	6.8	88.3
Above 15	1,663.3	58.1	-	-	-	-
Importers						
World	**2,921.96**	**100.0**	**18.1**	**19.5**	**12.2**	**41.3**
United States	501.9	17.2	23.2	17.3	7.9	34.8
Japan	267.8	9.2	35.1	16.8	6.9	55.0
China	168.8	5.8	14.9	30.0	17.9	60.8
Germany	163.7	5.6	13.6	18.1	0.3	46.6
Korea, Rep. of	142.5	4.9	32.7	17.9	11.3	47.7
France	117.4	4.0	16.9	18.6	4.6	43.5
India	115.8	4.0	36.7	25.1	19.2	58.2
Singapore	87.3	3.0	27.3	23.4	17.5	66.0
United Kingdom	81.7	2.8	12.9	23.9	8.8	38.5
Spain	81.4	2.8	20.3	20.3	12.7	39.3
Italy	78.8	2.7	14.2	16.6	12.7	30.0
Netherlands	77.1	2.6	15.6	18.4	-2.6	34.4
Belgium	72.7	2.5	15.5	21.8	-0.8	53.6
Taipei, Chinese	61.9	2.1	25.7	21.5	18.8	42.2
Canada	50.6	1.7	12.4	19.1	10.7	43.0
Above 15	2,069.5	70.8	-	-	-	-

Source: UN Comtrade Database and WTO Secretariat estimates.

Appendix Table 9: **Leading exporters and importers of fuels excluding intra-EU trade, 2008**
(Billion dollars and percentage)

	Value	Share in world	Share in total merchandise	Annual percentage change		
				2000-08	2007	2008
Exporters						
World excl. EU-Intra	**2,565.6**	**100.0**	**21.8**	**20.0**	**14.2**	**40.9**
Russian Federation	307.4	12.0	65.7	24.8	14.2	42.0
Saudi Arabia	281.0	11.0	89.7	18.8	9.9	35.8
Canada	125.9	4.9	27.6	16.8	13.0	43.9
European Union (27)	114.0	4.4	5.9	20.3	13.8	39.4
Norway	113.7	4.4	67.7	14.6	5.8	29.7
United Arab Emirates	103.3	4.0	49.2	17.3	7.0	33.0
Iran	93.0	3.6	82.0	17.7	38.4	27.6
Kuwait	82.8	3.2	95.0	20.9	11.4	39.8
Bolivarian Rep. of Venezuela	78.2	3.0	93.8	14.4	4.9	31.1
Algeria	77.8	3.0	98.1	17.4	10.5	31.5
United States	76.5	3.0	5.9	24.4	20.3	82.4
Nigeria	75.1	2.9	91.7	13.6	-13.1	48.5
Angola	66.4	2.6	98.9	..	..	..
Singapore	62.5	2.4	18.5	25.5	15.9	51.2
Australia	59.6	2.3	31.9	20.6	6.8	88.3
Above 15	1,717.0	66.9	-	-	-	-
Importers						
World excl. EU-Intra	**2,625.6**	**100.0**	**21.6**	**19.4**	**12.9**	**41.2**
European Union (27)	619.0	23.6	27.1	20.1	8.2	42.4
United States	501.9	19.1	23.2	17.3	7.9	34.8
Japan	267.8	10.2	35.1	16.8	6.9	55.0
China	168.8	6.4	14.9	30.0	17.9	60.8
Korea, Rep. of	142.5	5.4	32.7	17.9	11.3	47.7
India	115.8	4.4	36.7	25.1	19.2	58.2
Singapore	87.3	3.3	27.3	23.4	17.5	66.0
Taipei, Chinese	61.9	2.4	25.7	21.5	18.8	42.2
Canada	50.6	1.9	12.4	19.1	10.7	43.0
Thailand	37.2	1.4	20.8	22.1	1.1	43.7
Brazil	34.3	1.3	19.8	19.4	30.2	53.6
Turkey	32.8	1.2	16.2	20.2	17.4	37.4
Indonesia	30.7	1.2	23.7	22.4	15.6	39.4
Australia	30.0	1.1	15.7	22.6	15.2	48.8
Mexico	29.2	1.1	9.5	23.8	34.1	50.4
Above 15	2,209.7	84.2	-	-	-	-

Source: UN Comtrade database and WTO Secretariat estimates.

Appendix Table 10: **Leading exporters and importers of mining products including intra-EU trade, 2008**
(Billion dollars and percentage)

	Value	Share in world	Share in total merchandise	Annual percentage change		
				2000-08	2007	2008
Exporters						
World	**668.3**	**100.0**	**4.3**	**16.9**	**20.9**	**7.2**
Australia	52.4	7.8	28.0	19.0	19.6	29.9
United States	49.4	7.4	3.8	16.6	18.0	17.0
Germany	45.3	6.8	3.1	16.3	20.0	3.8
Chile	41.5	6.2	60.1	22.7	19.5	-2.5
Canada	35.4	5.3	7.8	14.5	25.4	-2.3
Russian Federation	25.5	3.8	5.5	13.3	28.9	-10.9
Brazil	25.3	3.8	12.8	20.8	19.0	34.1
China	23.5	3.5	1.6	22.7	5.3	7.1
South Africa	21.5	3.2	29.0	29.0	25.4	14.4
United Kingdom	20.2	3.0	4.4	15.3	28.8	11.0
Japan	18.9	2.8	2.4	15.6	19.8	9.1
Belgium	15.9	2.4	3.3	15.0	21.0	0.6
France	15.5	2.3	2.6	13.4	15.2	-0.4
Peru	13.4	2.0	43.0	25.0	21.0	-1.8
Netherlands	12.8	1.9	2.3	15.7	0.7	-8.1
Above 15	416.6	62.3	-	-	-	-
Imports						
World	**695.5**	**100.0**	**4.3**	**16.5**	**20.5**	**7.7**
China	138.1	19.9	12.2	34.0	52.6	30.7
Japan	59.8	8.6	7.8	14.0	23.6	9.0
Germany	56.6	8.1	4.7	15.7	19.5	-0.1
United States	56.4	8.1	2.6	9.2	7.1	-0.8
Korea, Rep. of	32.7	4.7	7.5	17.8	20.2	8.8
Italy	27.3	3.9	4.9	12.8	18.7	-6.3
United Kingdom	22.2	3.2	3.5	11.7	21.8	1.2
France	21.2	3.0	3.0	11.5	16.4	0.7
Taipei, Chinese	18.9	2.7	7.9	14.7	16.7	1.4
Belgium	18.5	2.7	3.9	14.8	18.8	-6.3
India	17.3	2.5	5.5	27.9	28.7	26.7
Turkey	16.7	2.4	8.3	29.3	33.9	28.2
Spain	16.4	2.4	4.1	16.6	20.7	-2.8
Netherlands	13.8	2.0	2.8	13.3	7.3	-9.9
Canada	12.9	1.9	3.2	9.8	9.5	3.7
Above 15	528.9	76.0	-	-	-	-

Source: UN Comtrade database and WTO Secretariat estimates.

Appendix Table 11: **Leading exporters and importers of mining products excluding intra-EU trade, 2008**
(Billion dollars and percentage)

	Value	Share in world	Share in total merchandise	Annual percentage change		
				2000-08	2007	2008
Exporters						
World excl. EU-Intra	**528.6**	**100.0**	**4.5**	**17.3**	**21.2**	**10.3**
Australia	52.4	9.9	28.0	19.0	19.6	29.9
European Union (27)	49.5	9.4	2.6	17.1	22.5	12.7
United States	49.4	9.3	3.8	16.6	18.0	17.0
Chile	41.5	7.9	60.1	22.7	19.5	-2.5
Canada	35.4	6.7	7.8	14.5	25.4	-2.3
Russian Federation	25.5	4.8	5.5	13.3	28.9	-10.9
Brazil	25.3	4.8	12.8	20.8	19.0	34.1
China	23.5	4.4	1.6	22.7	5.3	7.1
South Africa	21.5	4.1	29.0	29.0	25.4	14.4
Japan	18.9	3.6	2.4	15.6	19.8	9.1
Peru	13.4	2.5	43.0	25.0	21.0	-1.8
India	11.7	2.2	6.4	32.9	16.2	3.4
Indonesia	10.8	2.1	7.9	17.2	21.6	-10.8
Norway	9.6	1.8	5.7	12.9	30.1	-15.5
Korea, Rep. of	9.3	1.8	2.2	20.3	14.0	1.6
Above 15	397.8	75.3	-	-	-	-
Importers						
World excl. EU-Intra	**555.8**	**100.0**	**4.6**	**16.9**	**20.7**	**10.9**
China	138.1	24.8	12.2	34.0	52.6	30.7
European Union (27)	107.9	19.4	4.7	14.1	22.6	0.3
Japan	59.8	10.8	7.8	14.0	23.6	9.0
United States	56.4	10.2	2.6	9.2	7.1	-0.8
Korea, Rep. of	32.7	5.9	7.5	17.8	20.2	8.8
Taipei, Chinese	18.9	3.4	7.9	14.7	16.7	1.4
India	17.3	3.1	5.5	27.9	28.7	26.7
Turkey	16.7	3.0	8.3	29.3	33.9	28.2
Canada	12.9	2.3	3.2	9.8	9.5	3.7
Thailand	9.1	1.6	5.1	21.8	19.3	18.3
Mexico	9.1	1.6	2.9	12.8	4.6	7.5
United Arab Emirates	9.0	1.6	5.1	42.1	52.7	66.3
Switzerland	8.1	1.5	4.4	6.9	-14.8	24.2
Malaysia	8.1	1.5	5.2	16.1	32.7	3.3
Saudi Arabia	7.5	1.4	6.5	30.2	19.5	82.0
Above 15	511.7	92.1	-	-	-	-

Source: UN Comtrade database and WTO Secretariat estimates.

Appendix Table 12: **Imports of natural resources by partner region and supplier for major economies, 2008**
(Billion dollars and percentage)

	European Union (27)				United States				
	Value	Share	Annual percentage change			Value	Share	Annual percentage change	
	2008	2008	2000-08	2008		2008	2008	2000-08	2008
World	**1,093.04**	**100.00**	**16**	**16**	**World**	**583.43**	**100.00**	**15**	**28**
Europe	510.90	46.74	15	15	North America	188.99	32.39	14	26
CIS	224.39	20.53	21	25	Africa	104.58	17.92	20	23
Africa	119.13	10.90	14	13	South and Central America	102.59	17.58	14	26
Middle East	65.73	6.01	10	6	Middle East	88.16	15.11	17	62
South and Central America	44.79	4.10	17	-1	Europe	45.40	7.78	11	13
North America	37.99	3.48	12	15	CIS	28.25	4.84	23	44
Asia	37.36	3.42	18	11	Asia	25.47	4.37	9	-1
Suppliers					**Suppliers**				
European Union (27)	399.48	36.55	16	12	Canada	141.99	24.34	13	29
Russian Federation	174.22	15.94	20	23	Saudi Arabia	56.28	9.65	19	54
Norway	92.83	8.49	14	30	Bolivarian Rep. of Venezuela	50.89	8.72	14	29
Libya	42.02	3.84	18	24	Mexico	46.99	8.05	15	20
United States	26.02	2.38	15	37	European Union (27)	40.27	6.90	14	16
Above 5	**734.57**	**67.20**	**-**	**-**	**Above 5**	**336.42**	**57.66**	**-**	**-**
Kazakhstan	23.38	2.14	29	37	Nigeria	38.99	6.68	17	16
Saudi Arabia	21.47	1.96	8	7	Iraq	22.71	3.89	17	100
Algeria	20.66	1.89	8	-2	Russian Federation	21.40	3.67	19	37
Brazil	15.91	1.46	19	16	Algeria	19.98	3.42	27	9
Nigeria	14.71	1.35	13	23	Angola	19.46	3.34	23	51
Azerbaijan	14.50	1.33	42	46	Brazil	11.95	2.05	21	56
Iran	13.19	1.21	9	-13	Colombia	8.91	1.53	9	58
Iraq	11.15	1.02	9	23	Ecuador	8.30	1.42	22	54
South Africa	10.78	0.99	14	5	China	7.52	1.29	17	33
Canada	10.54	0.96	9	12	Kuwait	6.96	1.19	11	71
Chile	9.84	0.90	14	-25	Congo	5.18	0.89	33	63
Angola	8.82	0.81	36	108	Chile	4.97	0.85	14	-17
Australia	8.60	0.79	13	-2	Trinidad and Tobago	4.96	0.85	16	-18
China	8.08	0.74	21	9	Azerbaijan	4.46	0.76	128	132
Switzerland	7.74	0.71	14	9	Norway	4.43	0.76	-0	-7
Kuwait	7.07	0.65	13	30	Libya	4.16	0.71	..	23
Bolivarian Rep. of Venezuela	6.31	0.58	15	5	South Africa	3.84	0.66	7	-23
Ukraine	5.88	0.54	17	39	Peru	3.66	0.63	16	19
Egypt	5.03	0.46	14	-3	Chad	3.45	0.59	..	55
Syria	4.62	0.42	6	12	Equatorial Guinea	3.27	0.56	46	102
India	4.52	0.41	29	16	Aruba	3.24	0.56	10	6
Colombia	3.98	0.36	21	41	Australia	2.85	0.49	5	59
Belarus	3.70	0.34	33	-3	Thailand	2.74	0.47	4	15
Turkey	3.48	0.32	19	-1	Argentina	2.68	0.46	9	15
United Arab Emirates	3.06	0.28	20	-15	Korea, Rep. of	2.60	0.45	13	-42
Above 30	**981.62**	**89.81**	**-**	**-**	**Above 30**	**559.08**	**95.83**	**-**	**-**

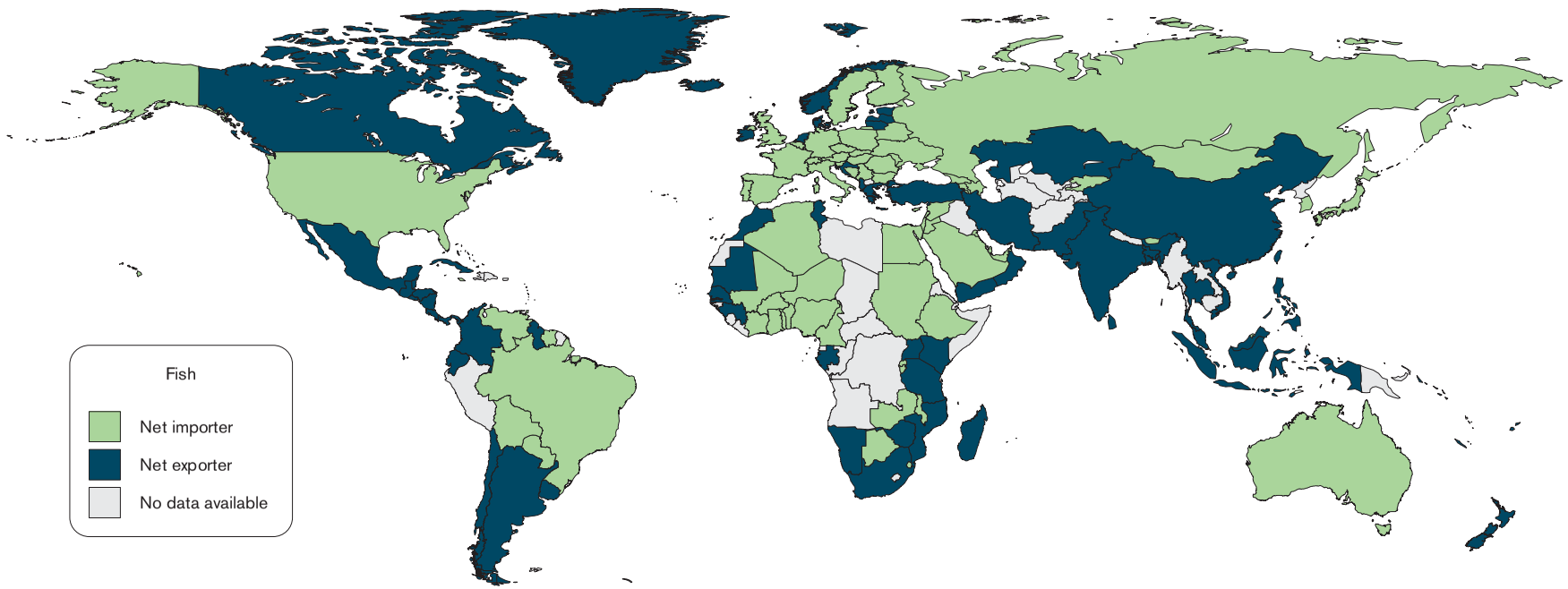
Source: UN Comtrade database.

Appendix Table 12: **Imports of natural resources by partner region and supplier for major economies, 2008** (Billion dollars and percentage) continued

	Japan				China				
	Value	Share	Annual percentage change			Value	Share	Annual percentage change	
	2008	2008	2000-08	2008		2008	2008	2000-08	2008
World	**350.20**	**100.00**	**14**	**41**	**World**	**331.27**	**100.00**	**30**	**43**
Middle East	165.57	47.28	17	48	Asia	109.33	33.00	27	38
Asia	115.05	32.85	12	40	Middle East	72.14	21.78	30	75
Africa	18.14	5.18	22	47	Africa	50.59	15.27	35	57
South and Central America	15.98	4.56	15	11	South and Central America	42.52	12.84	45	39
North America	15.68	4.48	4	26	CIS	27.52	8.31	29	23
CIS	12.75	3.64	14	23	North America	15.92	4.81	24	15
Europe	6.99	2.00	8	24	Europe	13.24	4.00	24	17
Suppliers					**Suppliers**				
Saudi Arabia	50.49	14.42	17	45	Australia	32.88	9.93	39	53
United Arab Emirates	46.99	13.42	16	46	Saudi Arabia	27.26	8.23	43	96
Australia	41.83	11.95	19	60	Angola	22.36	6.75	37	74
Qatar	26.53	7.58	21	57	Russian Federation	19.60	5.92	27	21
Indonesia	24.59	7.02	10	26	Brazil	18.64	5.63	51	61
Above 5	**190.43**	**54.38**	**-**	**-**	**Above 5**	**120.75**	**36.45**	**-**	**-**
Iran	18.09	5.17	17	45	Iran	18.45	5.57	35	44
Kuwait	15.30	4.37	15	54	India	15.54	4.69	49	54
Russian Federation	12.61	3.60	14	26	Korea, Rep. of	13.68	4.13	22	33
Malaysia	11.38	3.25	13	58	Japan	12.99	3.92	30	40
China	10.19	2.91	7	20	Oman	11.49	3.47	17	72
United States	8.28	2.36	3	30	European Union (27)	10.97	3.31	24	16
Chile	7.12	2.03	14	-3	Chile	10.45	3.15	30	7
South Africa	6.98	1.99	15	18	United States	9.20	2.78	22	13
Canada	6.49	1.85	5	23	Taipei, Chinese	6.75	2.04	23	33
Korea, Rep. of	5.87	1.68	3	21	Kazakhstan	6.75	2.04	36	24
Oman	5.57	1.59	13	56	Indonesia	6.75	2.04	16	17
Brazil	5.56	1.59	17	58	Bolivarian Rep. of Venezuela	6.41	1.93	73	117
European Union (27)	4.83	1.38	9	21	Sudan	6.31	1.90	31	52
Brunei Darussalam	4.54	1.30	13	81	Canada	5.72	1.73	26	12
Sudan	4.23	1.21	41	58	South Africa	5.48	1.66	41	40
Viet Nam	3.85	1.10	16	88	Kuwait	4.84	1.46	51	130
Thailand	2.81	0.80	9	32	Singapore	4.53	1.37	22	129
India	2.53	0.72	9	24	United Arab Emirates	4.34	1.31	34	55
Peru	1.88	0.54	29	-5	Congo	3.73	1.13	36	32
Nigeria	1.69	0.48	31	166	Peru	3.55	1.07	52	-5
Singapore	1.67	0.48	12	22	Yemen	3.19	0.96	20	84
Egypt	1.56	0.44	36	94	Malaysia	2.81	0.85	15	15
Iraq	1.51	0.43	11	48	Thailand	2.65	0.80	21	27
Taipei, Chinese	1.46	0.42	3	8	Libya	2.59	0.78	79	67
Norway	1.38	0.39	6	33	Viet Nam	2.28	0.69	15	32
Above 30	**337.79**	**96.46**	**-**	**-**	**Above 30**	**302.18**	**91.22**	**-**	**-**

Source: UN Comtrade database.

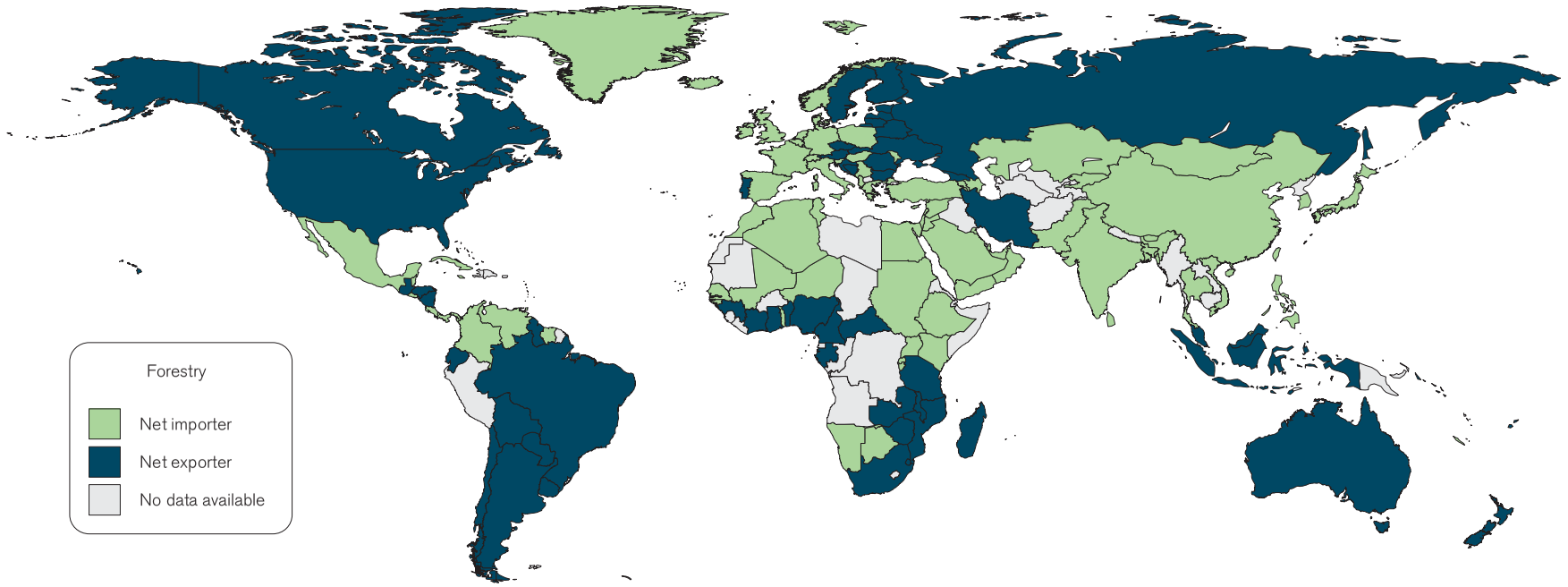
Appendix Map 1: **Net exporters of fish and fish products, 2008 or latest year**



Note: Colours and boundaries do not imply any judgement on the part of the WTO as to the legal status of any frontier or territory.

Source: UN Comtrade database.

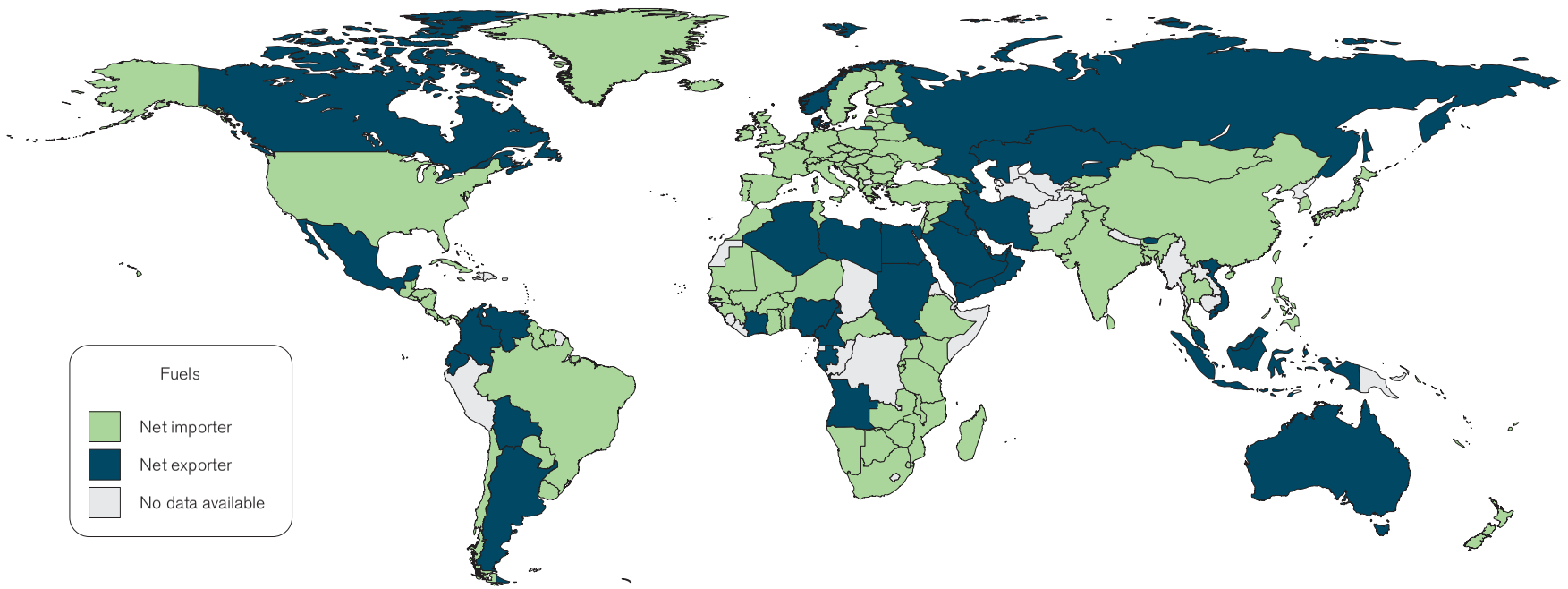
Appendix Map 2: **Net exporters of forestry products, 2008 or latest year**



Note: Colours and boundaries do not imply any judgement on the part of the WTO as to the legal status of any frontier or territory.

Source: UN Comtrade database.

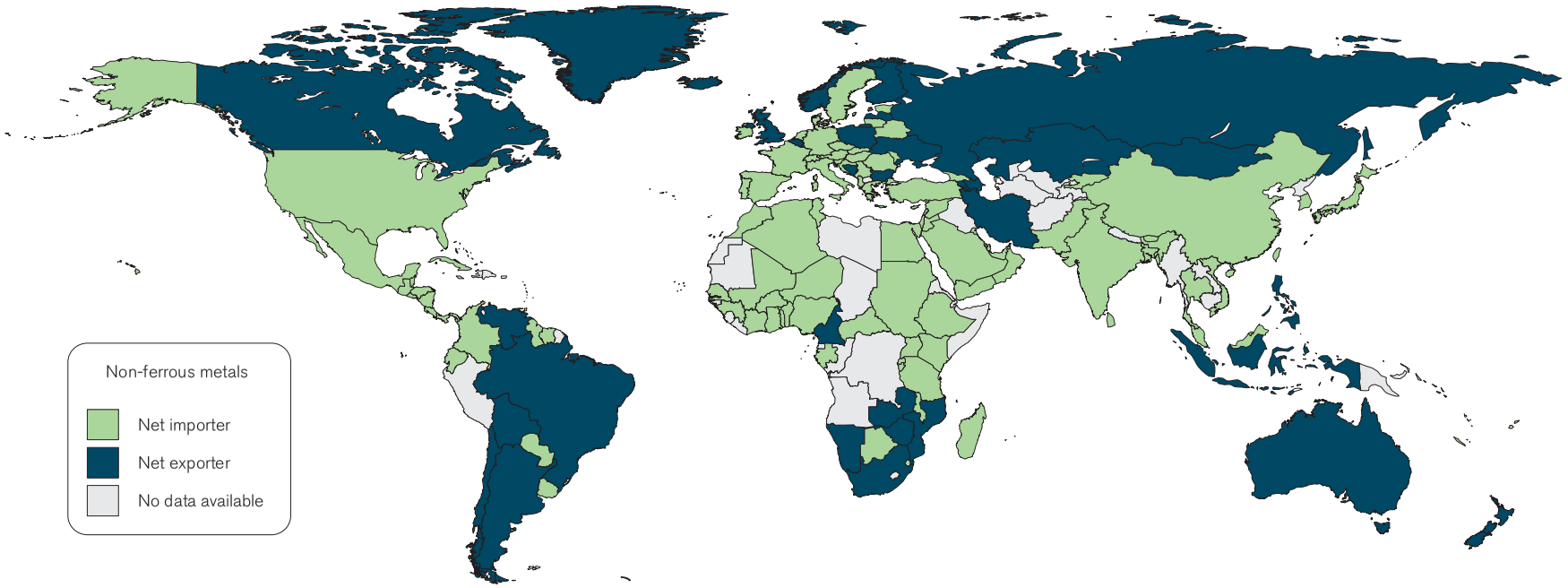
Appendix Map 3: **Net exporters of fuels, 2008 or latest year**



Note: Colours and boundaries do not imply any judgement on the part of the WTO as to the legal status of any frontier or territory.

Source: UN Comtrade database.

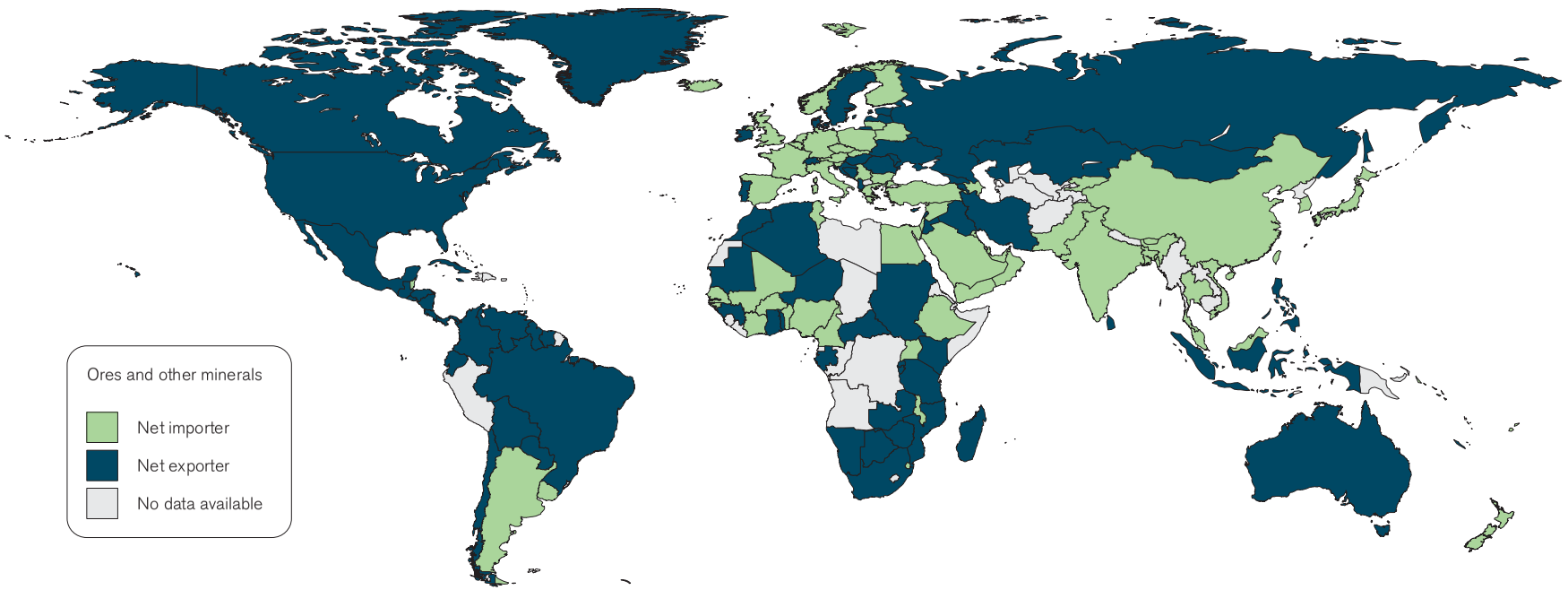
Appendix Map 4: **Net exporters of non-ferrous metals, 2008 or latest year**



Note: Colours and boundaries do not imply any judgement on the part of the WTO as to the legal status of any frontier or territory.

Source: UN Comtrade database.

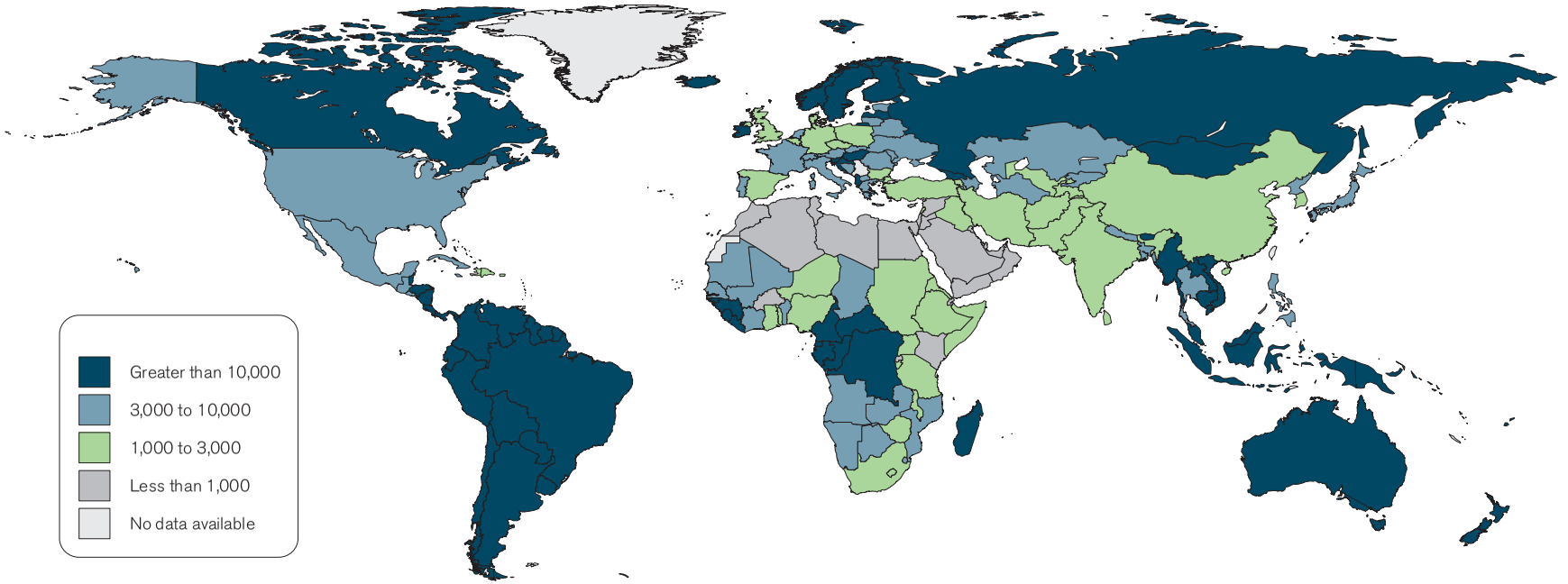
Appendix Map 5: **Net exporters of ores and other minerals, 2008 or latest year**



Note: Colours and boundaries do not imply any judgement on the part of the WTO as to the legal status of any frontier or territory.

Source: UN Comtrade database.

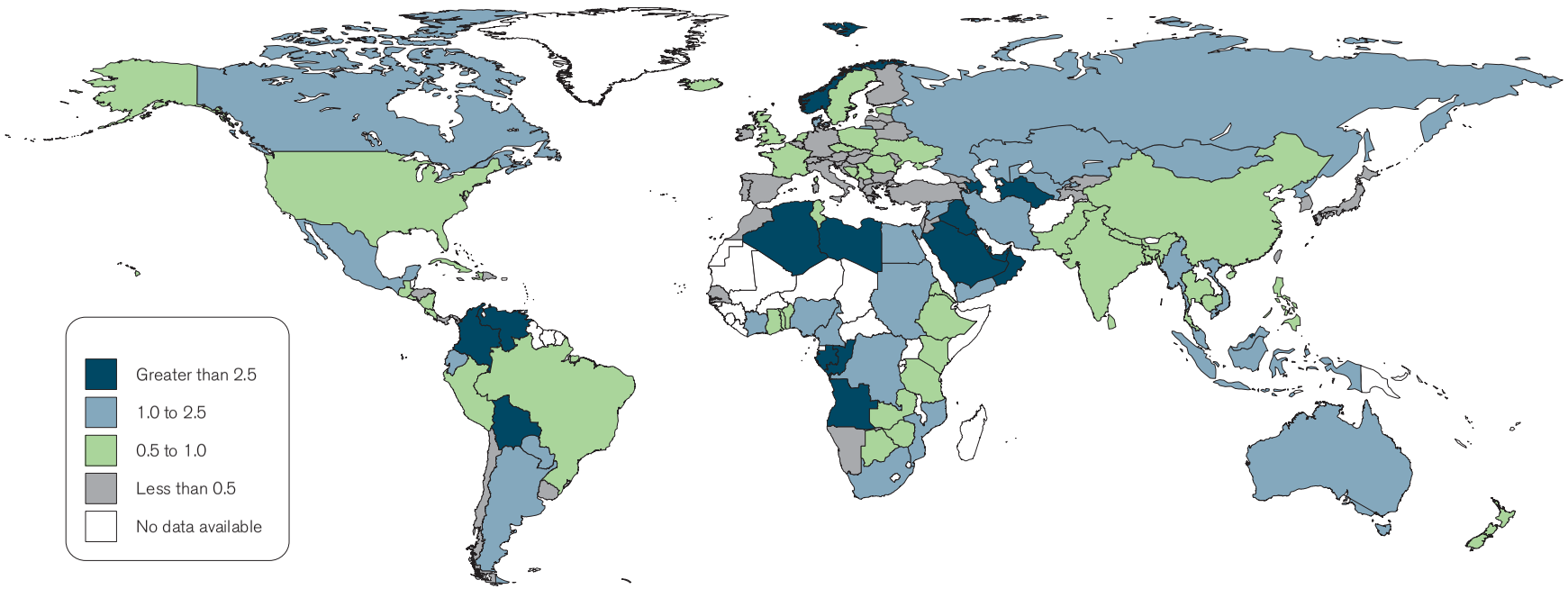
Appendix Map 6: **Total renewable fresh water resources per capita, 2008** (m^3 per inhabitant per year)



Note: Colours and boundaries do not imply any judgement on the part of the WTO as to the legal status of any frontier or territory.

Source: UN Food and Agriculture Organization (FAO), Aquastat database.

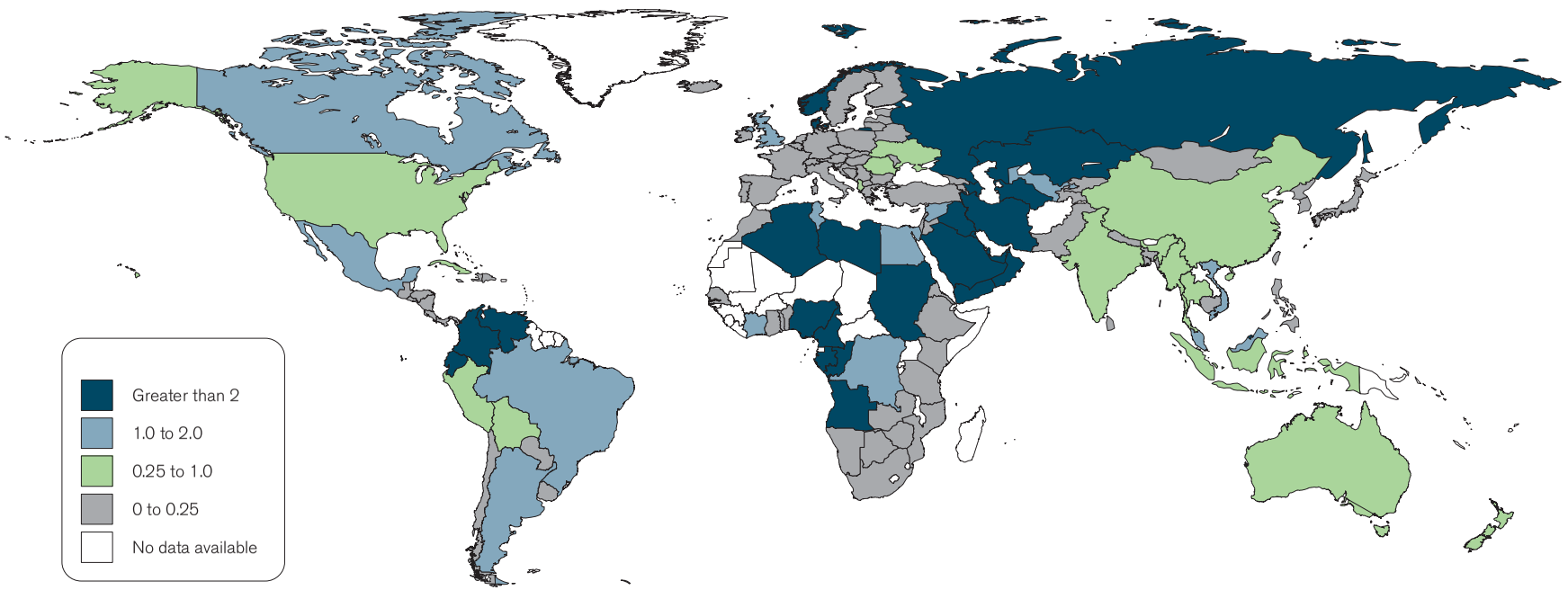
Appendix Map 7: **Energy production / total primary energy supply (energy self-sufficiency), 2007** (Ratio)



Note: Colours and boundaries do not imply any judgement on the part of the WTO as to the legal status of any frontier or territory.

Source: International Energy Anency, World Energy Statistics and Balances (2009).

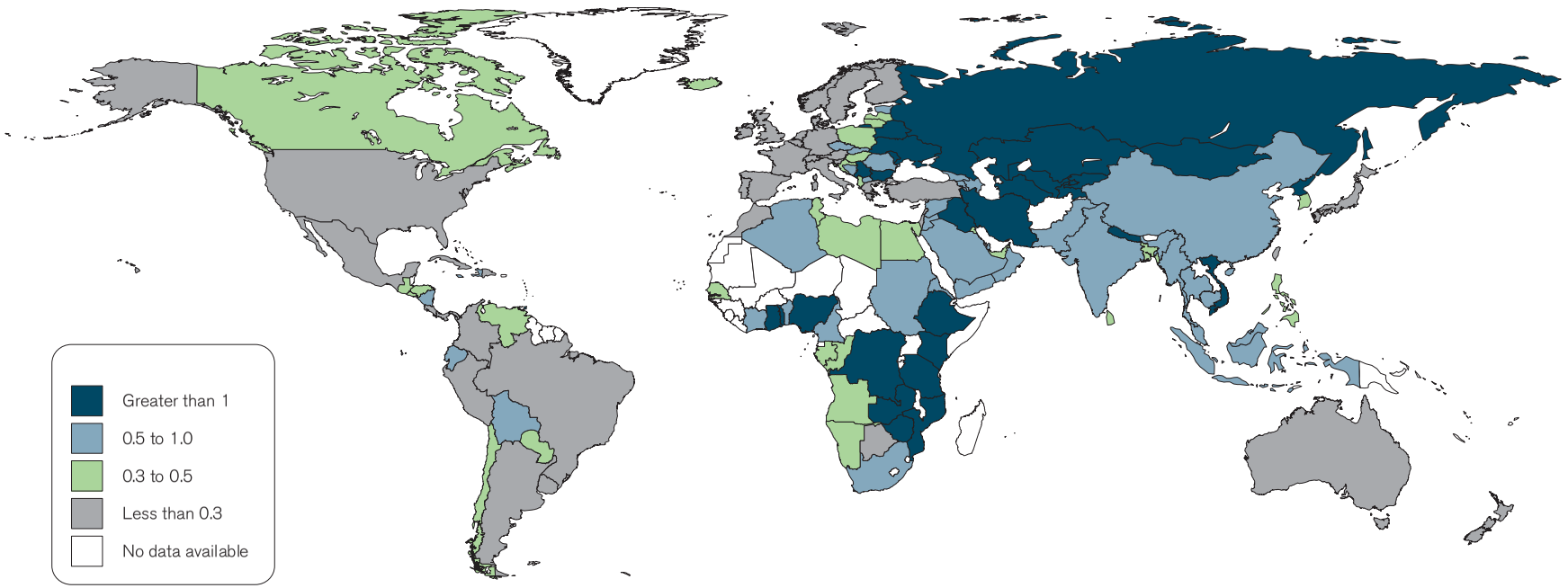
Appendix Map 8: **Oil production / total primary energy supply of oil (oil self-sufficiency), 2007** (Ratio)



Note: Colours and boundaries do not imply any judgement on the part of the WTO as to the legal status of any frontier or territory.

Source: International Energy Anency, World Energy Statistics and Balances (2009).

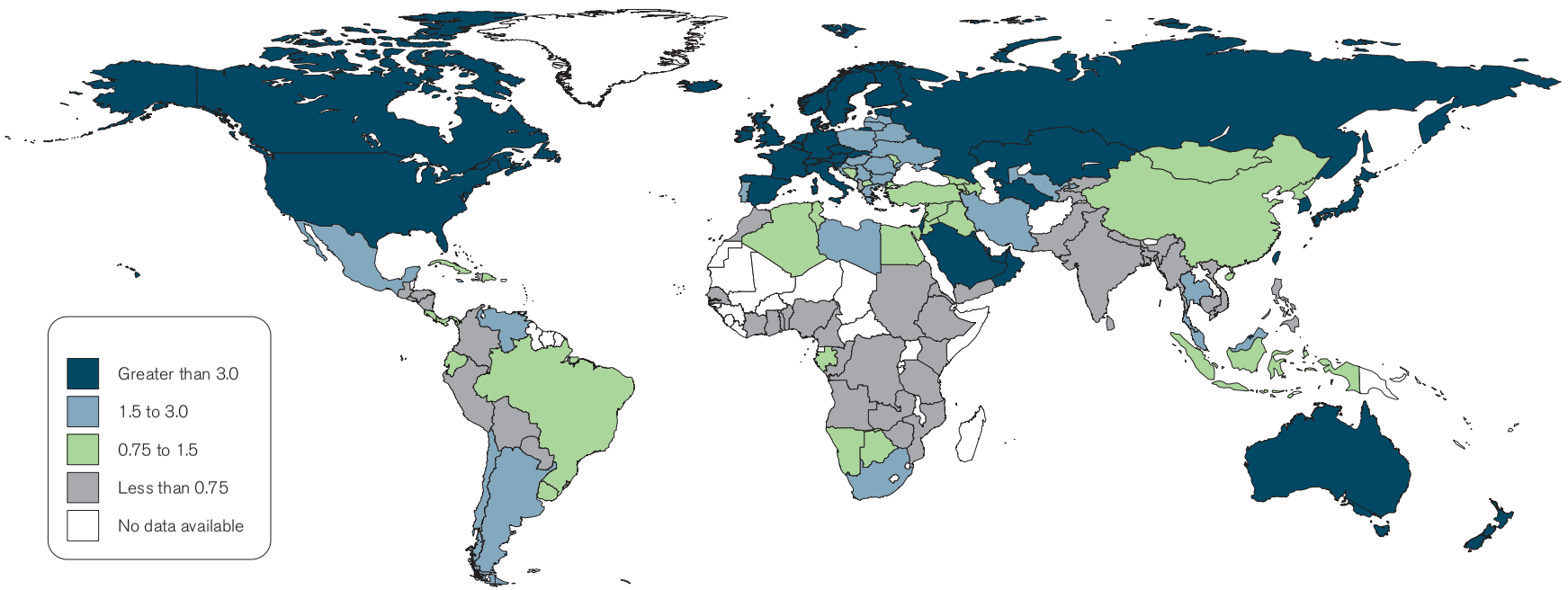
Appendix Map 9: **Total primary energy supply / GDP (energy intensity of GDP), 2007** (toe per thousand 2000 US dollars)



Note: Colours and boundaries do not imply any judgement on the part of the WTO as to the legal status of any frontier or territory.

Source: International Energy Anency, World Energy Statistics and Balances (2009).

Appendix Map 10: **Total primary energy supply / population (per capita energy supply), 2007** (toe per capita)



Note: Colours and boundaries do not imply any judgement on the part of the WTO as to the legal status of any frontier or territory.

Source: International Energy Anency, World Energy Statistics and Balances (2009).

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Technical notes

Composition of regions and other economic groupings

Regions

North America				
Bermuda	Canada*	Mexico*	United States of America*	
Other territories in the region not elsewhere specified (n.e.s.)				
South and Central America and the Caribbean				
Antigua and Barbuda*	Brazil*	Ecuador*	Jamaica*	Saint Lucia*
Argentina*	Chile*	El Salvador*	Netherlands Antilles	Saint Vincent and the Grenadines*
Bahamas**	Colombia*	Grenada*	Nicaragua*	Suriname*
Barbados*	Costa Rica*	Guatemala*	Panama*	Trinidad and Tobago*
Belize*	Cuba*	Guyana*	Paraguay*	Uruguay*
Bolivia*	Dominica*	Haiti*	Peru*	
Bolivarian Rep. of Venezuela*	Dominican Republic*	Honduras*	Saint Kitts and Nevis*	
Other territories in the region n.e.s.				
Europe				
Andorra**	Denmark*	Iceland*	Montenegro**	Slovenia*
Austria*	Estonia*	Ireland*	Netherlands*	Spain*
Belgium*	Finland*	Italy*	Norway*	Sweden*
Bosnia and Herzegovina**	France*	Latvia*	Poland*	Switzerland*
Bulgaria*	FYR Macedonia*	Liechtenstein*	Portugal*	Turkey*
Croatia*	Germany*	Lithuania*	Romania*	United Kingdom*
Cyprus*	Greece*	Luxembourg*	Serbia**	
Czech Republic*	Hungary*	Malta*	Slovak Republic*	
Other territories in the region n.e.s.				
Commonwealth of Independent States (CIS) [a]				
Armenia*	Georgia [a]	Moldova*	Turkmenistan	
Azerbaijan**	Kazakhstan**	Russian Federation**	Ukraine*	
Belarus**	Kyrgyz Republic*	Tajikistan**	Uzbekistan**	
Other territories in the region n.e.s.				
Africa				
Algeria**	Congo*	Guinea*	Morocco*	South Africa*
Angola*	Congo, Dem. Rep. of*	Guinea-Bissau*	Mozambique*	Sudan**
Benin*	Côte d'Ivoire*	Kenya*	Namibia*	Swaziland*
Botswana*	Djibouti*	Lesotho*	Niger*	Tanzania*
Burkina Faso*	Egypt*	Liberia**	Nigeria*	Togo*
Burundi*	Equatorial Guinea**	Libyan Arab Jamahiriya**	Rwanda*	Tunisia*
Cameroon*	Eritrea	Madagascar*	São Tomé and Príncipe**	Uganda*
Cape Verde*	Ethiopia**	Malawi*	Senegal*	Zambia*
Central African Republic*	Gabon*	Mali*	Seychelles**	Zimbabwe*
Chad*	Gambia*	Mauritania*	Sierra Leone*	
Comoros**	Ghana*	Mauritius*	Somalia	
Other territories in the region n.e.s.				
Middle East				
Bahrain*	Israel*	Lebanon**	Saudi Arabia*	Yemen**
Iran, Islamic Rep. of**	Jordan*	Oman*	Syrian Arab Republic**	
Iraq**	Kuwait*	Qatar*	United Arab Emirates*	
Other territories in the region n.e.s.				
Asia				
Afghanistan**	Hong Kong, China*	Malaysia*	Papua New Guinea*	Tonga*
Australia*	India*	Maldives*	Philippines*	Tuvalu
Bangladesh*	Indonesia*	Mongolia*	Samoa**	Vanuatu**
Bhutan**	Japan*	Myanmar*	Singapore*	Viet Nam*

* WTO members

** Observer governments

[a] Georgia is not a member of the Commonwealth of Independent States but is included in this group for reasons of geography and similarities in economic structure.

Composition of regions and other economic groupings (cont'd)				
Regions				
Asia (cont'd)				
Brunei Darussalam*	Kiribati	Nepal*	Solomon Islands*	
Cambodia*	Korea, Republic of*	New Zealand*	Sri Lanka*	
China*	Lao People's Dem. Rep.**	Pakistan*	Taipei, Chinese*	
Fiji*	Macao, China*	Palau	Thailand*	
Other territories in the region n.e.s.				
Other Groups				
ACP (African, Caribbean and Pacific countries)				
Angola	Côte d'Ivoire	Haiti	Niger	South Africa
Antigua and Barbuda	Cuba	Jamaica	Nigeria	Sudan
Bahamas	Djibouti	Kenya	Niue	Suriname
Barbados	Dominica	Kiribati	Palau	Swaziland
Belize	Dominican Republic	Lesotho	Papua New Guinea	Timor Leste
Benin	Equatorial Guinea	Liberia	Rwanda	Togo
Botswana	Eritrea	Madagascar	Saint Kitts and Nevis	Tonga
Burkina Faso	Ethiopia	Malawi	Saint Lucia	Trinidad and Tobago
Burundi	Fiji	Mali	Saint Vincent and the Grenadines	Tuvalu
Cameroon	Gabon	Marshall Islands	Samoa	Uganda
Central African Republic	Gambia	Mauritania	São Tomé and Príncipe	United Republic of Tanzania
Chad	Ghana	Mauritius	Senegal	Vanuatu
Comoros	Grenada	Micronesia	Seychelles	Zambia
Congo	Guinea	Mozambique	Sierra Leone	Zimbabwe
Congo, Dem. Rep. of	Guinea-Bissau	Namibia	Solomon Islands	
Cook Islands	Guyana	Nauru	Somalia	
Africa				
North Africa				
Algeria	Egypt	Libyan Arab Jamahiriya	Morocco	Tunisia
Sub-Saharan Africa				
Western Africa				
Benin	Gambia	Guinea-Bissau	Mauritania	Senegal
Burkina Faso	Ghana	Liberia	Niger	Sierra Leone
Cape Verde	Guinea	Mali	Nigeria	Togo
Côte d'Ivoire				
Central Africa				
Burundi	Central African Republic	Congo	Equatorial Guinea	Rwanda
Cameroon	Chad	Congo, Dem. Rep. of	Gabon	São Tomé and Príncipe
Eastern Africa				
Comoros	Ethiopia	Mauritius	Somalia	Tanzania
Djibouti	Kenya	Seychelles	Sudan	Uganda
Eritrea	Madagascar			
Southern Africa				
Angola	Lesotho	Mozambique	South Africa	Zambia
Botswana	Malawi	Namibia	Swaziland	Zimbabwe
Territories in Africa not elsewhere specified				
Asia				
East Asia (including Oceania):				
Australia	Indonesia	Malaysia	Samoa	Tuvalu
Brunei Darussalam	Japan	Mongolia	Singapore	Vanuatu
Cambodia	Kiribati	Myanmar	Solomon Islands	Viet Nam
China	Korea, Rep. of	New Zealand	Taipei, Chinese	
Fiji	Lao People's Dem. Rep.	Papua New Guinea	Thailand	
Hong Kong, China	Macao, China	Philippines	Tonga	
West Asia:				
Afghanistan	Bhutan	Maldives	Pakistan	Sri Lanka
Bangladesh	India	Nepal		
Other countries and territories in Asia and the Pacific not elsewhere specified				

* WTO members

Composition of regions and other economic groupings (cont'd)

Other Groups

LDCs (Least-developed countries)				
Afghanistan	Comoros	Kiribati	Myanmar	Sudan
Angola	Congo, Dem. Rep. of	Lao People's Dem. Rep.	Nepal	Timor Leste
Bangladesh	Djibouti	Lesotho	Niger	Togo
Benin	Equatorial Guinea	Liberia	Rwanda	Tuvalu
Bhutan	Eritrea	Madagascar	Samoa	Uganda
Burkina Faso	Ethiopia	Malawi	São Tomé and Príncipe	United Republic of Tanzania
Burundi	Gambia	Maldives	Senegal	Vanuatu
Cambodia	Guinea	Mali	Sierra Leone	Yemen
Central African Republic	Guinea-Bissau	Mauritania	Solomon Islands	Zambia
Chad	Haiti	Mozambique	Somalia	

Regional Integration Agreements

Andean Community (CAN)				
Bolivia	Colombia	Ecuador	Peru	
ASEAN (Association of South East Asian Nations) / AFTA (ASEAN Free Trade Area)				
Brunei Darussalam	Indonesia	Malaysia	Philippines	Thailand
Cambodia	Lao People's Dem. Rep.	Myanmar	Singapore	Viet Nam
CACM (Central American Common Market)				
Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua
CARICOM (Caribbean Community and Common Market)				
Antigua and Barbuda	Belize	Guyana	Montserrat	Saint Vincent and the Grenadines
Bahamas	Dominica	Haiti	Saint Kitts and Nevis	Suriname
Barbados	Grenada	Jamaica	Saint Lucia	Trinidad and Tobago
CEMAC (Economic and Monetary Community of Central Africa)				
Cameroon	Chad	Congo	Equatorial Guinea	Gabon
Central African Republic				
COMESA (Common Market for Eastern and Southern Africa)				
Burundi	Egypt	Libyan Arab Jamahiriya	Rwanda	Uganda
Comoros	Eritrea	Madagascar	Seychelles	Zambia
Congo, Dem. Rep. of	Ethiopia	Malawi	Sudan	Zimbabwe
Djibouti	Kenya	Mauritius	Swaziland	
ECCAS (Economic Community of Central African States)				
Angola	Central African Republic	Congo, Dem. Rep. of	Gabon	São Tomé and Príncipe
Burundi	Chad	Equatorial Guinea	Rwanda	
Cameroon	Congo			
ECOWAS (Economic Community of West African States)				
Benin	Côte d'Ivoire	Guinea	Mali	Senegal
Burkina Faso	Gambia	Guinea- Bissau	Niger	Sierra Leone
Cape Verde	Ghana	Liberia	Nigeria	Togo
EFTA (European Free Trade Association)				
Iceland	Liechtenstein	Norway	Switzerland	
European Union (27)				
Austria	Estonia	Ireland	Netherlands	Spain
Belgium	Finland	Italy	Poland	Sweden
Bulgaria	France	Latvia	Portugal	United Kingdom
Cyprus	Germany	Lithuania	Romania	
Czech Republic	Greece	Luxembourg	Slovak Republic	
Denmark	Hungary	Malta	Slovenia	
GCC (Gulf Cooperation Council)				
Bahrain	Oman	Qatar	Saudi Arabia	United Arab Emirates
Kuwait				
MERCOSUR (Southern Common Market)				
Argentina	Brazil	Paraguay	Uruguay	
NAFTA (North American Free Trade Agreement)				
Canada	Mexico	United States		
SAPTA (South Asian Preferential Trade Arrangement)				
Bangladesh	India	Nepal	Pakistan	Sri Lanka
Bhutan	Maldives			

Composition of regions and other economic groupings (cont'd) Regional Integration Agreements				
SADC (Southern African Development Community)				
Angola	Lesotho	Mauritius	South Africa	Zambia
Botswana	Madagascar	Mozambique	Swaziland	Zimbabwe
Congo, Dem. Rep. of	Malawi	Namibia	United Republic of Tanzania	
WAEMU (West African Economic and Monetary Union)				
Benin	Côte d'Ivoire	Mali	Senegal	Togo
Burkina Faso	Guinea-Bissau	Niger		

WTO members are frequently referred to as "countries", although some members are not countries in the usual sense of the word but are officially "customs territories". The definition of geographical and other groupings in this report does not imply an expression of opinion by the Secretariat concerning the status of any country or territory, the delimitation of its frontiers, nor the rights and obligations of any WTO member in respect of WTO agreements. The colours, boundaries, denominations and classifications in the maps of the publication do not imply, on the part of the WTO, any judgement on the legal or other status of any territory, or any endorsement or acceptance of any boundary.

Throughout this report, South and Central America and the Caribbean is referred to as South and Central America. The Bolivarian Republic of Venezuela; Hong Kong Special Administrative Region of China; the Republic of Korea; and the Separate Customs Territory of Taiwan, Penghu, Kinmen and Matsu are referenced as Bolivarian Rep. of Venezuela; Hong Kong, China; Korea, Republic of; and Taipei, Chinese respectively.

Glossary [1]

Autarky: The situation of not engaging in international trade; self-sufficiency.

Comparative advantage: The ability to produce a good at lower cost, relative to other goods, compared to another country. In a Ricardian model, comparison is of unit labour requirements; more generally it is of relative autarky prices.

Correlation: A measure of the extent to which two economic or statistical variables move together, normalized so that their values range from -1 to +1. The correlation is used in trade theory to express weak relationships among economic variables.

Demand Shock: A shock on the demand side of a market. Thus an unexpected shift, up or down, in the demand curve.

Economies of scale: See increasing returns to scale.

Elasticity: A measure of responsiveness of one economic variable to another – usually the responsiveness of quantity to price along a supply or demand curve.

Exchange rate: The price at which one country's currency trades for another, typically on the exchange market.

Externality: An effect of one economic agent's actions on another which is not transmitted through prices, such that one agent's decisions make another better or worse off by changing their utility or cost. Beneficial effects are positive externalities; harmful ones are negative externalities. In the presence of externalities, market prices do not reflect the full cost or benefit of producing or consuming a good.

Factor of production: An input that exists as a stock providing services that contribute to production. The stock is not used up in production, although it may deteriorate with use, providing a smaller flow of services later. The major primary factors are labor, capital, human capital (or skilled labour), land, and sometimes natural resources.

Expectation (or expected value): Anticipation of the value of a random variable in future time periods. The mathematical expected value of a random variable equals the sum of the values that are possible for it, each multiplied by its probability.

Hedge: To offset risk.

Increasing/decreasing returns to scale: A property of a production function such that changing all inputs by the same proportion changes output more/less than in proportion. Under increasing returns to scale (also called economies of scale) average costs decrease as output increases. Economies of scale tend to occur in industries with high capital costs in which those costs can be distributed across a large number of units of production.

Inter-industry trade: Trade in which a country's exports and imports are in different industries.

Intra-industry trade: Trade in which a country exports and imports in the same industry, in contrast to inter-industry trade.

Learning by doing: Refers to the improvement in technology or know-how that takes place in some industries, early in their history, as they learn by experience, so that average cost falls as accumulated output rises.

Marginal cost: The increase in cost that accompanies a unit increase in output; the partial derivative of the cost function with respect to output.

Marginal revenue: The amount by which a firm's revenue increases when it expands output by one unit, taking into account that to sell one more unit it may need to reduce price on all units.

Monopoly: A market structure in which there is a single seller.

Monopsony: A market structure in which there is a single buyer.

Oligopoly: A market structure in which there are a small number of sellers, at least some of whose individual decisions about price or quantity matter to the others.

Perfect competition: An idealized market structure in which there are large numbers of both buyers and sellers, all of them small, so that they act as price takers. Perfect competition also assumes homogeneous products, free entry and exit, and complete information.

Property rights: The legally defined and enforced rules of ownership, specifying who has the right to buy, sell, and use anything.

Rate of return: The percentage of an asset's value that the owner of the asset earns, usually per year.

Real exchange rate: 1. The nominal exchange rate adjusted for inflation. 2. The real price of foreign goods; i.e., the quantity of domestic goods needed to purchase a unit of foreign goods. Equals the reciprocal of the terms of trade. 3. The relative price of traded goods in terms of non-traded goods.

Relative price: The price of one good in terms of another; i.e., the ratio of two prices.

Rent: The premium that the owner of a resource receives over and above its opportunity cost.

Rent-seeking: The using up of real resources in an effort to secure the rights to rents that arise from government policies.

Speculation: The purchase or sale of an asset (or acquisition otherwise of an open position) in hopes that its price will rise or fall respectively, in order to make a profit.

Supply chain: The sequence of steps, often done in different firms and/or locations, needed to produce a final good from primary factors, starting with processing of raw materials, continuing with production of perhaps a series of intermediate inputs, and ending with final assembly and distribution.

Supply shock: A shock on the supply side of a market. Thus an unexpected shift, up or down, in the supply curve.

Terms of trade: The relative price, on world markets, of a country's exports compared to its imports.

Vertical integration: Production of different stages of processing of a product within the same firm.

1. The glossary definitions are largely attributed to Deardorff's Glossary of International Economics, available online at http://www-personal.umich.edu/~alandear/glossary/.

Abbreviations and symbols

AC	alternating current
ASEAN	Association of Southeast Asian Nations
BITs	bilateral investment treaties
BTU	British thermal unit
CAREC	Central Asian Regional Economic Cooperation
CECA	Comprehensive Economic Cooperation Agreement
CEQ	Council on Environmental Quality
CFP	Common Fisheries Policy
CIS	Commonwealth of Independent States
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO_2	carbon dioxide
CPI	Consumer Price Index
CRRA	constant relative risk aversion
CTS	Council for Trade in Services
DC	direct current
DWFN	distant waters fishing nation
dwt	deadweight tonne
EAEC	Eurasian Economic Community
ECT	Energy Charter Treaty
EEZ	Exclusive Economic Zone
EITI	Extractive Industries Transparency Initiative
EKC	environmental Kuznets curve
EMH	Efficient Market Hypothesis
EU	European Union
FAO	Food and Agriculture Organization
FDI	foreign direct investment
FTAs	free trade agreements
GATS	General Agreement on Trade in Services
GATT	General Agreement on Tariffs and Trade
GDP	gross domestic product
GEF	Global Environment Fund
GFTs	government financial transfers
GL index	Grubel-Lloyd index
GPA	Agreement on Government Procurement
HS	Harmonized System
ICA	international commodity agreement
IDB	Integrated Database
IEA	International Energy Agency
IMF	International Monetary Fund
ITQs	individual transferable quotas
ITTA	International Tropical Timber Agreement
kt	kilotonne
LNG	liquified natural gas
LPG	liquified petroleum gas
m^3	cubic metre
MEA	multilateral environmental agreement
MERCOSUR	Southern Common Market
MFN	most-favoured nation
MoU	Memorandum of Understanding
NAFTA	North American Free Trade Agreement
NRBPs	natural resource-based products
NTM	non-tariff measure
NYMEX	New York Mercantile Exchange
OECD	Organization for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
OTC	over-the-counter
PPMs	process and production methods
PTAs	Preferential trade agreements
R&D	research and development
RFMOs	Regional Fisheries Management Organisations
SAFEX	South African Futures Exchange
SCMs	Subsidies and Countervailing Measures
TAC	total allowable catch
TBT	Technical Barriers to Trade
TIFA	Trade and Investment Framework Agreement
TJ	terajoule
ToP	take-or-pay

TPR	Trade Policy Review
TRIPS	Trade-Related Aspects of Intellectual Property Rights
UK	United Kingdom
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Change
VMS	vessel monitoring systems

The following symbols are used in this publication:

...	not available
0	figure is zero or became zero due to rounding
-	not applicable
$	United States dollars
€	euro
£	UK pound

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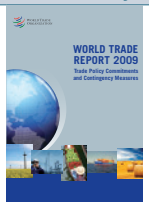
WTO members

(As of end June 2010)

Albania
Angola
Antigua and Barbuda
Argentina
Armenia
Australia
Austria
Bahrain, Kingdom of
Bangladesh
Barbados
Belgium
Belize
Benin
Bolivia
Botswana
Brazil
Brunei Darussalam
Bulgaria
Burkina Faso
Burundi
Cambodia
Cameroon
Canada
Cape Verde
Central African Republic
Chad
Chile
China
Colombia
Congo
Costa Rica
Côte d'Ivoire
Croatia
Cuba
Cyprus
Czech Republic
Democratic Republic of the Congo
Denmark
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Estonia
European Union
Fiji
Finland
Former Yugoslav Republic of Macedonia
France
Gabon
The Gambia
Georgia
Germany
Ghana
Greece
Grenada
Guatemala
Guinea
Guinea Bissau
Guyana
Haiti
Honduras
Hong Kong, China
Hungary
Iceland
India
Indonesia
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kenya
Korea, Republic of
Kuwait
Kyrgyz Republic
Latvia
Lesotho
Liechtenstein
Lithuania
Luxembourg
Macao, China
Madagascar
Malawi
Malaysia
Maldives
Mali
Malta
Mauritania
Mauritius
Mexico
Moldova
Mongolia
Morocco
Mozambique
Myanmar
Namibia
Nepal
Netherlands
New Zealand
Nicaragua
Niger
Nigeria
Norway
Oman
Pakistan
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Romania
Rwanda
Saint Kitts and Nevis
Saint Lucia
Saint Vincent & the Grenadines
Saudi Arabia
Senegal
Sierra Leone
Singapore
Slovak Republic
Slovenia
Solomon Islands
South Africa
Spain
Sri Lanka
Suriname
Swaziland
Sweden
Switzerland
Chinese Taipei
Tanzania
Thailand
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkey
Uganda
Ukraine
United Arab Emirates
United Kingdom
United States of America
Uruguay
Venezuela (Bolivarian Republic of)
Viet Nam
Zambia
Zimbabwe

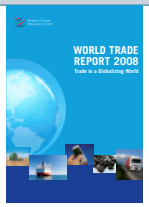
Previous World Trade Reports

2009 — Trade Policy Commitments and Contingency Measures



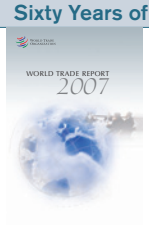
The 2009 Report examines the range and role of contingency measures available in trade agreements. One of the Report's main objectives is to analyse whether WTO provisions provide a balance between supplying governments with the necessary flexibility to face difficult economic situations and adequately defining these in a way that limits their use for protectionist purposes.

2008 — Trade in a Globalizing World



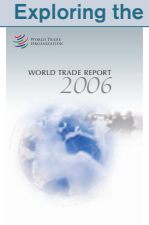
The 2008 Report provides a reminder of what we know about the gains from international trade and highlights the challenges arising from higher levels of integration. It addresses the question of what constitutes globalization, what drives it, what benefits it brings, what challenges it poses and what role trade plays in this world of ever-growing inter-dependency.

2007 — Sixty Years of the Multilateral Trading System : Achievements and Challenges



On 1 January 2008 the multilateral trading system celebrated its 60th anniversary. The World Trade Report 2007 celebrates this landmark anniversary with an in-depth look at the General Agreement on Tariffs and Trade (GATT) and its successor the World Trade Organization — their origins, achievements, the challenges they have faced and what the future holds.

2006 — Exploring the Links between Subsidies, Trade and the WTO



The World Trade Report 2006 focuses on how subsidies are defined, what economic theory can tell us about subsidies, why governments use subsidies, the most prominent sectors in which subsidies are applied and the role of the WTO Agreement in regulating subsidies in international trade. The Report also provides brief analytical commentaries on certain topical trade issues.

2005 — Trade, Standards and the WTO

The World Trade Report 2005 seeks to shed light on the various functions and consequences of standards, focusing on the economics of standards in international trade, the institutional setting for standard-setting and conformity assessment, and the role of WTO agreements in reconciling the legitimate policy uses of standards with an open, non-discriminatory trading system.

2004 — Coherence

The World Trade Report 2004 focuses on the notion of coherence in the analysis of interdependent policies: the interaction between trade and macroeconomic policy, the role of infrastructure in trade and economic development, domestic market structures, governance and institutions, and the role of international cooperation in promoting policy coherence.

2003 — Trade and Development

The World Trade Report 2003 focuses on development. It explains the origin of this issue and offers a framework within which to address the question of the relationship between trade and development, thereby contributing to more informed discussion.

This report is also available in
French and Spanish.

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World Trade Organization
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Online WTO bookshop:
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ISBN 978-92-870-3708-4
Printed in Switzerland
Report designed by Services Concept

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World Trade Report

The World Trade Report 2010 focuses on trade in natural resources, such as fuels, forestry, mining and fisheries. The Report examines the characteristics of trade in natural resources, the policy choices available to governments and the role of international cooperation, particularly of the WTO, in the proper management of trade in this sector.

A key question is to what extent countries gain from open trade in natural resources. Some of the issues examined in the Report include the role of trade in providing access to natural resources, the effects of international trade on the sustainability of natural resources, the environmental impact of resources trade, the so-called natural resources curse, and resource price volatility.

The Report examines a range of key measures employed in natural resource sectors, such as export taxes, tariffs and subsidies, and provides information on their current use. It analyses in detail the effects of these policy tools on an economy and on its trading partners.

Finally, the Report provides an overview of how natural resources fit within the legal framework of the WTO and discusses other international agreements that regulate trade in natural resources. A number of challenges are addressed, including the regulation of export policy, the treatment of subsidies, trade facilitation, and the relationship between WTO rules and other international agreements.

"I believe not only that there is room for mutually beneficial negotiating trade-offs that encompass natural resources trade, but also that a failure to address these issues could be a recipe for growing tension in international trade relations. Well designed trade rules are key to ensuring that trade is advantageous, but they are also necessary for the attainment of objectives such as environmental protection and the proper management of natural resources in a domestic setting."

Pascal Lamy, WTO Director-General

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