World Trade Organization
Economic Research and Statistics Division

A 'NEW TRADE' THEORY OF GATT/WTO NEGOTIATIONS

Ralph Ossa: University of Chicago

Manuscript date: February 2, 2009

A 'New Trade' Theory of GATT/WTO Negotiations[*]

Ralph Ossa[†]

University of Chicago

February 2, 2009

Abstract

I develop a novel theory of GATT/WTO negotiations. This theory provides new answers to two prominent questions in the trade policy literature: first, what is the purpose of trade negotiations? And second, what is the role played by the fundamental GATT/WTO principles of reciprocity and nondiscrimination? Relative to the standard terms-of-trade theory of GATT/WTO negotiations, my theory makes two main contributions: first, it builds on a 'new trade' model rather than the neoclassical trade model and therefore sheds new light on GATT/WTO negotiations between similar countries. Second, it relies on a production relocation externality rather than the terms-of-trade externality and therefore demonstrates that the terms-of-trade externality is not the only trade policy externality, which can be internalized in GATT/WTO negotiations.

JEL classification: F12, F13
Keywords: Trade negotiations; GATT/WTO; New trade theory

1 Introduction

International trade has been liberalized dramatically since the end of World War II. According to WTO estimates, the average ad valorem tariff on manufacturing goods has been reduced from over 40 percent to below 4 percent during this time period.

This dramatic liberalization was largely the result of a sequence of successful rounds of trade negotiations governed by the General Agreement on Tariffs and Trade (GATT) and later its successor the World Trade Organization (WTO).[1] The GATT/WTO is an institution regulating trade negotiations through a set of prenegotiated articles. The principles of reciprocity and nondiscrimination are usually considered to be the essence of these articles. Generally speaking, the former requires that trade policy changes keep changes in imports equal across trading partners and the latter stipulates that the same tariff must be applied against all trading partners for any given traded product.[2]

In this paper, I develop a novel theory of GATT/WTO negotiations. This theory provides new answers to two prominent questions in the trade policy literature: first, what is the purpose of trade negotiations? And second, what is the role played by the fundamental GATT/WTO principles of reciprocity and nondiscrimination?

My benchmark is, of course, the standard neoclassical theory of GATT/WTO negotiations. Its main idea goes back to Johnson (1953-54) and builds on the classic optimal tariff argument:[3] in a neoclassical environment, each country has an incentive to impose import tariffs in order to improve its terms-of-trade. However, if all countries impose import tariffs in an attempt to improve their terms-of-trade, no country actually

---

[1] According to WTO statistics, industrial countries have cut their tariffs on industrial products by an average 36 percent during the first five GATT rounds (1942-62), an average 37 percent in the Kennedy Round (1964-67), an average 33 percent in the Tokyo Round (1973-79), and an average 38 percent in the Uruguay Round (1986-94). There is some controversy about the scope of GATT/WTO negotiations. Rose (2004) finds that GATT/WTO members did not benefit more from GATT/WTO negotiations than non-members. However, Subramanian and Wei (2007), and Tomsz et al. (2007) argue that this finding is not robust.

[2] I adopt here Bagwell and Staiger's (1999) interpretation of the principles of reciprocity and nondiscrimination which I will discuss in more detail later on.

[3] The classic optimal tariff argument itself is actually much older than Johnson (1953-54). See Irwin (1996) for a history of thought.

succeeds and inefficiently high tariffs prevail. This inefficiency then creates incentives for cooperative trade policy setting. Essentially, tariffs entail an international terms-of-trade externality and trade negotiations serve to internalize this externality.[4] Grossman and Helpman (1995) extended this main argument to the case in which governments are subject to pressure from domestic interest groups. They demonstrated that tariffs continue to entail a terms-of-trade externality in this case, which can be internalized in trade negotiations. Bagwell and Staiger (1999) built on this literature and developed a unified framework of GATT/WTO negotiations. In a very general neoclassical trade model in which governments have preferences consistent with all leading political economy approaches, they showed that the fundamental GATT/WTO principles of reciprocity and nondiscrimination can be interpreted as simple negotiation rules, which help governments internalize the terms-of-trade externality. They also demonstrated that the terms-of-trade externality is the only trade policy externality, which can arise in this environment thus making it the only trade policy externality GATT/WTO negotiations can be about.[5]

Instead of analyzing GATT/WTO negotiations in a neoclassical environment, my 'new trade' theory of GATT/WTO negotiations builds on a Krugman (1980) 'new trade' model. While the argument can be made most cleanly in the context of the simple Krugman (1980) model, it generalizes to far more complicated environments. For example, the main results can also be derived in the Melitz and Ottaviano (2008) model, as I discuss in detail in appendix A3. This departure from the standard neoclassical theory of GATT/WTO negotiations allows me to make two main contributions. First,

---

[4]See also Kuga (1973), Mayer (1981), Riezman (1982), Dixit (1987), Kennan and Riezman (1988), Maggi (1999), and Syropoulos (2002) for other important contributions to that literature.

[5]An alternative theory of trade agreements was offered by Maggi and Rodriguez-Clare (1998). It stresses commitment considerations, pointing out that trade agreements may help governments commit vis-à-vis domestic special interest groups. It differs fundamentally both from the standard terms-of-trade theory of GATT/WTO negotiations as well as from my 'new trade' theory of GATT/WTO negotiations in that it does not view trade negotiations as a means to internalize an international trade policy externality. Maggi and Rodriguez-Clare (2007) show how this commitment theory can be combined with the standard terms-of-trade theory. See also Staiger and Tabellini (1987) and Mitra (2002).

my 'new trade' theory of GATT/WTO negotiations sheds new light on GATT/WTO negotiations between similar countries. The neoclassical trade model features constant returns to scale and perfect competition and is the leading explanation of trade in different goods between different countries. The Krugman (1980) model instead features increasing returns to scale and monopolistic competition and is the leading explanation of trade in similar goods between similar countries.[6] Both models thus address entirely distinct dimensions of international trade and it seems unnatural to confine attention to just one of these dimensions when studying the functioning of GATT/WTO negotiations. Most importantly, while a neoclassical theory of GATT/WTO negotiations seems well-suited for understanding GATT/WTO negotiations between different countries, it is not clear that this is also true for GATT/WTO negotiations between similar countries. Indeed, as I demonstrate in this paper, both the purpose of GATT/WTO negotiations as well as the role played by the fundamental GATT/WTO principles of reciprocity and nondiscrimination can be quite different in a 'new trade' environment. Second, my 'new trade' theory highlights a production relocation externality, which is independent of the terms-of-trade externality stressed in the standard theory. In fact, I make assumptions in my model, which serve to fix world prices and thus eliminate any role for terms-of-trade effects. I thereby demonstrate that, contrary to one of the standard theory's main conclusions, the terms-of-trade externality is not the only trade policy externality, which can be internalized in GATT/WTO negotiations. This is especially important given that some economists have questioned the real-world relevance of terms-of-trade effects. Bagwell and Staiger (2002: 181) summarize that "many economists are skeptical as to the practical relevance of terms-of-trade considerations for actual trade policy negotiations". Krugman (1997: 113), for example, argues that "this optimal tariff argument plays almost no role in real-world trade disputes".[7] Be that

---

[6]See Helpman (1987), Hummels and Levinsohn (1995), Antweiler and Trefler (2005), and Debaere (2005) for evidence on the importance of increasing returns to scale and monopolistic competition for explaining international trade flows.

[7]See Ethier (2002) and Regan (2006) for more examples.

as it may, I do not aim to disprove the importance of terms-of-trade effects.[8] Instead, I hope to strengthen the literature's most fundamental claim that economic logic can be used to make sense of GATT/WTO negotiations by providing an alternative and I think plausible economic explanation of GATT/WTO negotiations.

My main idea is that GATT/WTO negotiations governed by the principles of reciprocity and nondiscrimination help governments escape a production relocation driven prisoner's dilemma: in my model, each government has an incentive to impose import tariffs in order to expand the domestic manufacturing sector at the expense of foreign manufacturing sectors. In particular, a unilateral increase in import tariffs makes foreign manufacturing goods more expensive relative to domestic manufacturing goods in the domestic market so that domestic consumers shift expenditure towards domestic manufacturing goods. As a consequence, domestic manufacturing firms sell more thus making profits and foreign manufacturing firms sell less thus making losses. This triggers entry into the domestic manufacturing sector and exit out of foreign manufacturing sectors so that more of the world's manufacturing goods are produced by domestic firms. The domestic government values such production relocations since they increase domestic welfare. This is because they reduce the domestic price index by ensuring that less of the goods consumed by domestic consumers are subject to trade costs. However, if all governments impose import tariffs in an attempt to host more of the world's manufacturing firms, no government actually succeeds and inefficiently high tariffs prevail. This is why governments are stuck in a production relocation driven prisoner's dilemma if tariffs are set noncooperatively. GATT/WTO negotiations governed by the principles of reciprocity and nondiscrimination help governments escape this prisoner's dilemma. Essentially, the principles of reciprocity and nondiscrimination jointly ensure that tariff changes no longer entail production relocations and thereby neutralize this trade policy externality. This is because, under these principles, tariff-induced changes in domestic

---

[8]In fact, recent studies by Bagwell and Staiger (2006a) and Broda, Limao, and Weinstein (forthcoming) suggest that terms-of-trade considerations do play a role in governments' tariff choices.

consumer expenditure towards or away from domestic manufacturing goods are exactly offset by changes in foreign consumer expenditure away from or towards these goods. By neutralizing the production relocation externality, the principles of reciprocity and nondiscrimination not only guide countries away from the inefficient noncooperative equilibrium in a way, which monotonically increases welfare in all countries. But they also secure negotiated tariff concessions by eliminating all incentives to reverse them.

While I am, I believe, the first to study trade negotiations in a Krugman (1980) model, I am by no means the first to study trade policy in this model. In Krugman (1980) type environments, import tariffs can improve welfare in two ways. First, by reducing the domestic price index as I discussed above. This price index effect was first highlighted by Venables (1987). And second, by improving the terms-of-trade as in the neoclassical trade model. This terms-of-trade effect was first highlighted by Gros (1987).[9] As should be clear from the above discussion, the former channel underlies my 'new trade' theory of GATT/WTO negotiations. To isolate it, I follow Venables (1987) in developing a version of the Krugman (1980) model, which does not feature terms-of-trade effects.[10]

I develop my 'new trade' theory of GATT/WTO negotiations in the remainder of this paper. In the next section, I introduce the basic two-country model and establish that the noncooperative equilibrium is inefficient. I also demonstrate how trade negotiations governed by the principle of reciprocity help countries overcome the inefficient noncooperative equilibrium in a way, which monotonically increases welfare in both

---

[9]The mechanism is basically the same as in the neoclassical model. An extra twist is that a tariff can now also improve welfare by correcting the domestic distortion originating from the monopoly pricing of domestic manufacturing firms. Gros (1987) shows that therefore the optimal tariff is positive even if the country is so small that it has no market power in world markets. See also Flam and Helpman (1987) and Helpman and Krugman (1989).

[10]Venables (1987) considers a version of the Krugman (1980) model, which isolates the production relocation effect. Gros (1987) considers a version of the Krugman (1980) model, which isolates the terms-of-trade effect. As I demonstrate in appendix A3, a tariff generally has both a production relocation and a terms-of-trade effect in Krugman (1980) type environments. Venables (1987) studies unilateral trade policy only. Gros (1987) studies unilateral trade policy and also characterizes the noncooperative trade policy equilibrium. Neither Venables (1987) nor Gros (1987) consider trade negotiations.

countries. In the third section, I then develop a three-country extension of the basic model and show that the principle of reciprocity alone is no longer sufficient to help countries overcome the inefficient equilibrium in a way, which monotonically increases welfare in all countries. I also demonstrate that, if the principle of reciprocity is augmented with the principle of nondiscrimination, they then together serve this purpose. In the final section, I then conclude.

2   Basic model

The basic model is a variant of the standard Krugman (1980) 'new trade' model. While the argument can be made most cleanly in the context of this simple model, it generalizes to far more complicated environments. For example, the main results can also be derived in the Melitz and Ottaviano (2008) model, featuring variable instead of constant mark-ups, variable instead of constant expenditure shares, and heterogeneous instead of homogeneous firms, as I discuss in detail in appendix A3. This is not surprising since the production relocation effect I emphasize is closely related to the home market effect. The home market effect is generally considered to be a fundamental feature of environments with increasing returns to scale and transport costs (see, for example, Helpman and Krugman 1985: 209). It is also the basis of the 'new economic geography' literature initiated by Krugman (1991) and synthesized by Fujita et al. (1999).[11]

2.1   Setup

There are two countries: Home and Foreign. Variables relating to Foreign are identified by an asterisk. Consumers have access to a continuum of differentiated manufacturing goods and a single homogeneous 'outside good'.[12] Preferences over these goods are

---

[11] See Feenstra, Markusen, and Rose (1998), Davis and Weinstein (1999, 2003), Head and Ries (2001), and Hanson and Xiang (2004) for evidence on the home market effect.

[12] While the analysis focuses mostly on the manufacturing goods sector, the outside good sector plays two important roles. First, it permits changes in manufacturing production by permitting changes in manufacturing employment. Second, it helps rule out terms-of-trade effects by fixing wages in both

identical in both countries. They are given by the following utility functions

$$U = \left[\int_0^{n+n^*} m\left(i\right)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\mu\sigma}{\sigma-1}} Y^{1-\mu}, \qquad \sigma > 1 \tag{1}$$

$$U^* = \left[\int_0^{n+n^*} m^*\left(j\right)^{\frac{\sigma-1}{\sigma}} dj \right]^{\frac{\mu\sigma}{\sigma-1}} Y^{*1-\mu}, \qquad \sigma > 1 \tag{2}$$

where $m\left(i\right)$ denotes consumption of a differentiated manufacturing good, Y denotes consumption of the homogeneous outside good, n is the 'number' of manufacturing goods produced, σ is the elasticity of substitution between manufacturing goods, and μ is the share of income spent on manufacturing goods.[13] Since this is a model of trade in similar goods between similar countries, technologies are also identical in both countries. They are summarized by the following (inverse) production functions

$$l^M = f + cq^M \tag{3}$$

$$l^{*M} = f + cq^{*M} \tag{4}$$

$$l^Y = q^Y \tag{5}$$

$$l^{*Y} = q^{*Y} \tag{6}$$

where l^M is the labor requirement for producing q^M units of a manufacturing good, l^Y is the labor requirement for producing q^Y units of the outside good, f denotes the

---

countries. As I discuss in detail in appendix A3, only the former role is essential for the production relocation effect. The production relocation effect continues to operate even in the presence of wage effects/terms-of-trade effects.

[13] These specific preferences are useful for two main reasons. First, their Cobb-Douglas element ensures that world expenditure on manufacturing is constant thereby preventing changes in the world number of manufacturing firms. Second, their CES element ensures that mark-ups are constant thereby helping prevent terms-of-trade effects. As I discuss in detail in appendix A3, these specific preferences are not essential for the analysis. The main results can also be derived using preferences featuring variable expenditure shares and mark-ups.

fixed labor requirement of manufacturing production, and c denotes the marginal labor requirement of manufacturing production.[14] The manufacturing goods market is monopolistically competitive whereas the outside good market is perfectly competitive. Trade costs apply only to manufacturing goods and are of the Samuelson (1952) 'iceberg' type.[15] In particular, for one unit of a manufacturing good to arrive in the other country, ϕ units must be shipped and the remainder 'melts away' in transit. These iceberg trade costs ϕ are further decomposed into transport costs θ, which are identical across countries, and trade barriers τ, which may be different across countries. These trade barriers are policy instruments and the key variables of the analysis.[16] For concreteness, I refer to them as tariffs in the following but they can really reflect any policy-induced impediment to trade. Notice that these tariffs do not generate any revenue. This is essential for the model's tractability but naturally restricts tariffs to be nonnegative. The results presented in this paper are therefore best compared to a version of the standard neoclassical model of GATT/WTO negotiations in which tariffs are also restricted to be nonnegative.[17] Hence,

$$\phi = \theta + \tau, \qquad \theta > 1, \tau \geq 0 \tag{7}$$

---

[14]I assume technologies to be identical across firms. However, as I discuss in detail in appendix A3, the main results also extend to a framework featuring heterogeneous firms.

[15]As will become clear shortly, the production relocation effect is closely related to the home market effect. Davis (1999) shows that in simple setups like the one developed here, the home market effect disappears if outside good sector trade costs are sufficiently high. However, Krugman and Venables (1999) demonstrate that this no longer holds in more general environments. This is discussed further in appendix A3.

[16]I focus here on import barriers only and abstract from other trade policy instruments. Bagwell and Staiger (2008a, 2008b) have recently argued that an incomplete set of trade policy instruments is crucial to generate non-terms-of-trade rationales for trade agreements in non-neoclassical environments. However, GATT/WTO members only have access to an incomplete set of trade policy instruments in GATT/WTO practice since GATT article XVI prohibits export subsidies, at least for manufacturing products. By focusing on import barriers only, I thus implicitly take GATT article XVI as given, similar, in fact, to Bagwell and Staiger (1999).

[17]Otherwise, abstracting from tariff revenue does not appear to affect the argument in any major way. This is discussed in detail in appendix A3. Notice that the neoclassical theory of GATT/WTO negotiations cannot be simplified with iceberg tariffs since the terms-of-trade case for protection crucially relies on tariff revenue. This has been criticized by Regan (2006) who argues that tariff revenue considerations play almost no role in real-world trade negotiations.

$$\phi^* = \theta + \tau^{*,} \qquad \theta > 1, \, \tau^* \geq 0 \tag{8}$$

Finally, I also make the following two additional assumptions: first, I assume that the manufacturing sector is always active in both countries. This requires transport costs to be sufficiently large.[18] It ensures that countries can never attract all manufacturing firms through trade policy and thereby eliminates uninteresting corner solutions. Second, I assume that the outside good sector is always active in both countries. This requires the demand for manufacturing goods to be sufficiently small.[19] It ensures, together with the assumptions made on market structure, outside good technology, preferences, and trade costs that there is no role for terms-of-trade effects in this environment. I comment further on this latter point below.

2.2 No trade policy

Consider now the equilibrium at Home and Foreign, exogenously fixing tariffs at some level. Choose $p^Y = 1$ and notice that this implies $w = w^* = 1$, where p^Y is the price of the outside good and w is the wage rate, since the outside good sector is always active in both countries, the outside good market is perfectly competitive, the outside good is produced using the above technology, and is freely traded among countries. As is well-known, utility maximization with the above preferences then yields the following demands for the outside good

$$Y = (1 - \mu) L \tag{9}$$

$$Y^* = (1 - \mu) L^* \tag{10}$$

---

[18] In particular, the manufacturing sector is always active in both countries for all possible (τ, τ^*) if and only if $\theta > \left[\frac{\min(L, L^*)}{L + L^*} \right]^{\frac{1}{1-\sigma}}$.

[19] In particular, the outside good sector is always active in both countries for all possible (τ, τ^*) if and only if $\mu < 1 - \theta^{1-\sigma}$.

and the following demands for each manufacturing good

$$m(i) + \phi^* m^*(i) = \mu L p(i)^{-\sigma} G^{\sigma-1} + \mu L^* \phi^{*1-\sigma} p(i)^{-\sigma} G^{*\sigma-1} \tag{11}$$

$$\phi m(j) + m^*(j) = \mu L \phi^{1-\sigma} p^*(j)^{-\sigma} G^{\sigma-1} + \mu L^* p^*(j)^{-\sigma} G^{*\sigma-1} \tag{12}$$

where the former is the demand facing a Home manufacturing firm, the latter is the demand facing a Foreign manufacturing firm,[20] $p(i)$ denotes the ex-factory price of a manufacturing good, and the price indices are given by

$$G = \left[\int_0^n p(i)^{1-\sigma} \, di + \int_0^{n^*} [\phi p^*(j)]^{1-\sigma} \, dj \right]^{\frac{1}{1-\sigma}} \tag{13}$$

$$G^* = \left[\int_0^n [\phi^* p(i)]^{1-\sigma} \, di + \int_0^{n^*} p^*(j)^{1-\sigma} \, dj \right]^{\frac{1}{1-\sigma}} \tag{14}$$

Since these manufacturing demand functions have a constant price elasticity of σ, profit-maximization implies that manufacturing firms charge a constant mark-up over marginal costs so that

$$p(i) = p^*(j) = \frac{\sigma c}{\sigma - 1} \equiv p \tag{15}$$

which implies that the price indices simplify to

$$G = p \left[n + n^* \phi^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{16}$$

$$G^* = p \left[n \phi^{*1-\sigma} + n^* \right]^{\frac{1}{1-\sigma}} \tag{17}$$

---

[20] Notice that these expressions take into account the indirect demand created by the iceberg trade costs. Thanks to David DeRemer for pointing out a typo in an earlier version.

Free entry drives manufacturing firms' profits down to zero leading to the following break-even outputs

$$q = q^* = \frac{f(\sigma - 1)}{c} \tag{18}$$

and hence the following break-even labor demands

$$l = l^* = f\sigma \tag{19}$$

Manufacturing market clearing thus requires

$$q = \mu L p^{-\sigma} G^{\sigma-1} + \mu L^* \phi^{*1-\sigma} p^{-\sigma} G^{*\sigma-1} \tag{20}$$

$$q = \mu L \phi^{1-\sigma} p^{-\sigma} G^{\sigma-1} + \mu L^* p^{-\sigma} G^{*\sigma-1} \tag{21}$$

These manufacturing market clearing conditions can be solved for the equilibrium price indices

$$G = \left[\frac{q p^{\sigma} \left(1 - \phi^{*1-\sigma}\right)}{\mu L \left[1 - (\phi\phi^*)^{1-\sigma}\right]} \right]^{\frac{1}{\sigma-1}} \tag{22}$$

$$G^* = \left[\frac{q p^{\sigma} \left(1 - \phi^{1-\sigma}\right)}{\mu L^* \left[1 - (\phi\phi^*)^{1-\sigma}\right]} \right]^{\frac{1}{\sigma-1}} \tag{23}$$

These equilibrium price indices can then be solved for the equilibrium numbers of manufacturing firms

$$n = \frac{\mu}{qp} \left[\frac{L}{1 - \phi^{*1-\sigma}} - \frac{L^* \phi^{1-\sigma}}{1 - \phi^{1-\sigma}} \right] \tag{24}$$

$$n^* = \frac{\mu}{qp} \left[\frac{L^*}{1 - \phi^{1-\sigma}} - \frac{L \phi^{*1-\sigma}}{1 - \phi^{*1-\sigma}} \right] \tag{25}$$

12

Notice that this implies that the world number of manufacturing firms is always constant and given by[21]

$$n + n^* = \frac{\mu (L + L^*)}{qp} \tag{26}$$

Notice further that, given the above demands, the indirect utility functions are

$$V = \mu^{\mu} (1 - \mu)^{(1-\mu)} LG^{-\mu} \tag{27}$$

$$V^* = \mu^{\mu} (1 - \mu)^{(1-\mu)} L^* G^{*-\mu} \tag{28}$$

so that each country's welfare is decreasing in its manufacturing price index. Notice finally that, from equation (15), world prices are fixed in this environment so that there can be no role for terms-of-trade effects.[22] [23]

2.3 Import price effect and production relocation effect

Consider now the effects of trade policy. Notice first that a country's welfare is generally monotonically increasing in its own tariff. This is because a country's price index is generally monotonically decreasing in its own tariff, as can be seen from equations (22) and (23). Underlying this are two opposing effects of a tariff. In the following, I refer to these effects as import price effect and production relocation effect, respectively. I illustrate them using Home as an example but a symmetric argument also applies to Foreign. On the one hand, a tariff imposed by Home simply makes imported goods more expensive thereby increasing Home's price index and decreasing Home's welfare. This is because

---

[21] This is because world expenditure on manufacturing goods is constant and given by $\mu (L + L^*)$ and firm sales are constant and given by qp. This, of course, depends on the particular functional form assumptions made above. It is not essential for the main argument but serves to cleanly illustrate the tariff-induced production relocation effect. See also footnote 32.

[22] The goal is to isolate the production relocation effect, which cannot arise in neoclassical environments. As I explain in detail in appendix A3, a tariff generally has a terms-of-trade effect and a production relocation effect in Krugman (1980) type environments.

[23] I follow Helpman and Krugman (1989: 143) in defining Home's terms-of-trade as $\frac{p}{p^*}$. One may object that this is a too narrow definition since terms-of-trade effects should really operate through price indices in this environment. I show below that, even if such a wider definition is adopted, my results can still not be reinterpreted as terms-of-trade effects.

consumer preferences feature a love for variety, which is harder to satisfy the higher are import prices.[24] On the other hand, a tariff imposed by Home leads to a relocation of manufacturing production from Foreign's manufacturing sector towards Home's manufacturing sector thereby reducing Home's price index and increasing Home's welfare since a smaller number of products consumed in Home are now subject to trade costs. This relocation occurs because an increase in Home's tariff makes Home a more and Foreign a less attractive business location for manufacturing firms. In particular, a unilateral increase in Home's tariff implies that manufacturing goods imported from Foreign become more expensive relative to Home's manufacturing goods in Home's market so that Home's consumers shift expenditure towards Home's manufacturing goods. As a consequence, Home's manufacturing firms sell more thus making profits and Foreign's manufacturing firms sell less thus making losses. This triggers entry into Home's manufacturing sector and exit out of Foreign's manufacturing sector so that more of the world's manufacturing goods are produced by Home's firms.[25] [26] [27] In equilibrium, the production relocation effect more than offsets the import price effect if $\tau^* < \infty$ and exactly offsets the import price effect if $\tau^* = \infty$. To better understand the intuition

---

[24] This is essentially the well-known variety effect, which is the main source of gains from trade in Krugman (1980) type environments. As will become clear shortly, the existence of gains from trade is not inconsistent with unilateral incentives for protection. There is a crucial difference between a unilateral and a bilateral move from autarky to free trade in this environment.

[25] In general, the expansion of domestic manufacturing firms also bids up wages leading to a terms-of-trade effect. Here, however, the assumptions on the outside good sector ensure that wages and world prices are unchanged allowing me to isolate the production relocation effect. This is discussed in more detail in appendix A3.

[26] Notice that the production relocation effect depends crucially on increasing returns to scale. Essentially, it is a tariff-induced change in the pattern of specialization brought about by changes in relative market size which cannot arise in neoclassical models. It is closely related to the home market effect which is also a change in the pattern of specialization brought about by changes in relative market size.

[27] Notice that the production relocation effect cannot be reinterpreted as a terms-of-trade effect even if Home's terms-of-trade are not defined as $\frac{p}{p^*}$ but instead in terms of price indices. To see this, recall that $G^{1-\sigma} = p^{1-\sigma}n + (p\phi)^{1-\sigma}n^*$ and $G^{*1-\sigma} = (p\phi^*)^{1-\sigma}n + p^{1-\sigma}n^*$ from equations (16) and (17). It is therefore natural to define $G_{\exp}$ as a world price index of Home's manufacturing exports and G_{imp} as a world price index of Home's manufacturing imports, where $G_{\exp}^{1-\sigma} = p^{1-\sigma}n$ and $G_{imp}^{1-\sigma} = p^{1-\sigma}n^*$. In terms of these world price indices, Home's terms-of-trade are then given by $\frac{G_{\exp}}{G_{imp}} = \left(\frac{n}{n^*}\right)^{\frac{1}{1-\sigma}}$. Since this ratio is actually decreasing rather than increasing in Home's tariff because Home gains manufacturing firms at Foreign's expense, the tariff's effect can therefore not be reinterpreted as a terms-of-trade gain even using this wider definition of Home's terms-of-trade.

of this result, consider Home's manufacturing market clearing condition (20). If Home imposes a tariff against Foreign, this initially increases Home's price index because of the import price effect thereby boosting sales and profits of Home's firms. To restore equilibrium, firms have to relocate from Foreign to Home in the sense that Home's manufacturing sector expands at the expense of Foreign's manufacturing sector. Such a relocation reduces Home's price index and increases Foreign's price index. If $\tau^* < \infty$, this makes it harder for Home's firms to sell goods at Home but easier for Home's firms to sell goods at Foreign so that Home's post-tariff price index must then be below its pre-tariff level. If it merely returned to its pre-tariff level, Home's firms could still export more than before and would therefore make positive profits. If, however, $\tau^* = \infty$, this only makes it harder for Home's firm to sell goods at Home since Home's firms anyway have no access to Foreign's market so that Home's post-tariff price index must then exactly return to its pre-tariff level.

Notice second that a country's welfare is always monotonically decreasing in the other country's tariff. This is because a country's price index is always monotonically increasing in the other country's tariff, as can be seen from equations (22) and (23). This is, of course, a simple consequence of the production relocation effect. It emphasizes that countries can gain only at the expense of one another so that the production relocation effect is also a production relocation externality.

2.4   Noncooperative trade policy

Consider now trade policy if tariffs are set noncooperatively. I assume throughout that governments choose trade policy in an attempt to maximize their citizens' welfare. While this is first and foremost a simplifying assumption, it is actually more realistic than one might think. Maggi and Goldberg (1999), for example, find that the weight of welfare in the government's objective function is many times larger than the weight of trade policy influencing campaign contributions. In the following, I demonstrate that

the noncooperative equilibrium is inefficient.

Notice first that the only robust Nash equilibrium is autarky. While all (τ, τ^*) such that $(\tau, \tau^*) = (\text{any possible } \tau, \infty)$ or $(\tau, \tau^*) = (\infty, \text{any possible } \tau^*)$ are Nash equilibria, only $(\tau, \tau^*) = (\infty, \infty)$ is robust to small perturbations in the governments' strategies, as follows immediately from the discussion in the previous subsection. In other words, $(\tau, \tau^*) = (\infty, \infty)$ is the unique trembling-hand perfect Nash equilibrium. This finding is summarized in lemma 1. I refer to this equilibrium as noncooperative equilibrium henceforth:[28]

Lemma 1 *Suppose governments choose tariffs simultaneously, Home maximizing V and Foreign maximizing V^*. Then the unique trembling-hand perfect Nash equilibrium is autarky.*

Proof. See appendix A2 for a formal proof. ∎

Observe second that a tariff combination is efficient if and only if the tariff is zero in at least one of the countries. Intuitively, there generally exists a bilateral tariff reduction, which reduces one country's price index without affecting the other country's price index by appropriately balancing the import price effect and the production relocation effect. However, bilateral tariff reductions are only possible if tariffs are positive in both countries so that Pareto improvements cannot be achieved if the tariff is zero in at least one of the countries:[29]

Lemma 2 *The set of Pareto-efficient tariff combinations consists of all (τ, τ^*) such that $(\tau, \tau^*) = (\text{any possible } \tau, 0)$ or $(\tau, \tau^*) = (0, \text{ any possible } \tau^*)$.*

---

[28] This stark result emerges because production relocations are the only motivation for protection in this environment. As I discuss in detail in appendix A3, the noncooperative equilibrium can involve less than maximum protection if governments also collect tariff revenue. Nevertheless, the noncooperative equilibrium remains inefficient in this case since tariffs continue to entail a production relocation externality.

[29] Recall that the iceberg trade barriers assumption restricts tariffs to be nonnegative. Lemma 2 therefore characterizes a constrained efficiency frontier. This should be kept in mind when comparing this efficiency frontier to the Mayer locus featuring in the neoclassical theory of GATT/WTO negotiations. See also footnote 34.

Proof. See appendix A2 for a formal proof. ∎

Thus, the noncooperative equilibrium is inefficient. While the details of lemma 1 and 2 clearly reflect specific modeling assumptions, this result captures a first fundamental point: tariffs entail a production relocation externality, which governments fail to internalize when setting tariffs noncooperatively. It is therefore stated as proposition 1:

Proposition 1 *The noncooperative equilibrium is inefficient.*

Proof. Follows immediately from lemmas 1 and 2. ∎

2.5   Trade policy under the GATT/WTO: the principle of reciprocity

Consider now trade policy, if tariffs are set subject to GATT/WTO regulations. Since the principle of nondiscrimination is trivially satisfied in a two-country world, I focus only on the principle of reciprocity for now. I adopt Bagwell and Staiger's (1999) interpretation of this principle: generally speaking, reciprocity requires that trade policy changes keep changes in imports equal across trading partners. However, this principle has two particular applications in GATT/WTO practice and is not binding to the same degree in both these applications. First, governments are required to seek a 'balance of concessions' during rounds of trade liberalization in the sense that they cut tariffs reciprocally. While this application is considered to be important in practice it is actually not encoded in GATT/WTO articles and is therefore not binding in a legal sense. Second, governments are entitled to 'withdraw substantially equivalent concessions' if a trading partner increases previously bound tariffs in the sense that they retaliate reciprocally. This right is encoded in GATT/WTO articles and therefore has legal status.[30]

---

[30] The principle of reciprocity is not explicitly defined in GATT/WTO articles. Bagwell and Staiger's (1999) definition characterizes the ideal guiding GATT/WTO negotiations. Since this ideal is hard

In the following, I demonstrate that the principle of reciprocity can be viewed as helping countries overcome the inefficient noncooperative equilibrium in a way, which monotonically increases welfare in both countries. In light of the above discussion, I adopt the following formal definition of reciprocity:

Definition 1 *Define a tariff change to be reciprocal if it is such that $dTB_M = 0$, where $TB_M \equiv EXP_M - IMP_M$ and EXP_M (IMP_M) refers to the value of manufacturing exports (imports).*

Notice first that the principle of reciprocity neutralizes the production relocation effect. It can be shown that the number of manufacturing firms operating at Home can be decomposed as follows:[31]

$$n = \frac{\mu L}{qp} + \frac{TB_M}{qp} \tag{29}$$

The numerator is just the total expenditure on Home's manufacturing goods by Home's and Foreign's consumers, since this can be decomposed into the total expenditure on Home's and Foreign's manufacturing goods by Home's consumers (μL), plus the total expenditure on Home's manufacturing goods by Foreign's consumers (EXP_M), minus the total expenditure on Foreign's manufacturing goods by Home's consumers (IMP_M). The denominator is just the (constant) sales of Home's manufacturing firms. Hence, if TB_M is fixed by reciprocity, Home's (and hence also Foreign's) number of manufacturing firms is fixed as well. Intuitively, tariff-induced changes in Home's consumer expenditure towards or away from Home's manufacturing goods are then exactly offset by tariff-induced changes in Foreign's consumer expenditure away from or towards

to implement in practice, governments often approximate it by using simple rules of thumb. See also Bagwell and Staiger (2002: chapter 3), Dam (1970: 58-61, 87-91), Enders (2002), and Hoekman and Kostecki (1995: 68-76).

[31]For details, see the proof of lemma 3.

these goods. This result is summarized as lemma 3:[32] [33]

Lemma 3 *Tariff changes leave the number of firms unchanged in both countries if and only if they are reciprocal.*

Proof. See appendix A2 for a formal proof. ∎

Observe second that reciprocal tariff concessions increase welfare monotonically in both countries. To see this, recall that tariffs affect a country's welfare through two opposing effects: the import price effect, which tends to make a country's price index increasing in its own tariff; and the production relocation effect, which tends to make a country's price index decreasing in its own tariff. As was discussed above, the production relocation effect generally dominates the import price effect so that a country's price index is generally decreasing in its own tariff. However, if the production relocation effect is neutralized by reciprocity, only the import price effect remains so that a country's price index then always becomes increasing in its own tariff. While the details of lemma 3 again reflect specific modeling assumptions, this result captures a second fundamental point: the principle of reciprocity makes countries internalize the production relocation externality by ruling out changes in the manufacturing trade balance, which shift expenditure away from one country's manufacturing sector towards the other country's manufacturing sector. It is therefore stated as proposition 2:

Proposition 2 *Reciprocal trade liberalization (trade protection) monotonically increases (decreases) welfare in both countries.*

---

[32] Of course, reciprocal tariff changes only leave the number of firms unchanged in both countries if the world number of manufacturing firms is independent of trade policy. This is the case in this environment but depends on functional form assumptions (c.f. footnote 21). More generally, the principle of reciprocity prevents countries from gaining at the expense of one another by ruling out changes in the manufacturing trade balance, which shift expenditure away from one country's manufacturing sector towards the other country's manufacturing sector.

[33] This discussion is related to the analysis of Baldwin and Robert-Nicoud (2000) who study Venables (1987) type trade policy effects in an economic geography model developed by Martin and Rogers (1995). They show that symmetric liberalization between asymmetric countries leads to international firm relocations from the small to the large country. They also show that the large country needs to liberalize faster than the small country if international firm relocations are to be prevented. See also Baldwin et al. (2003).

Proof. See appendix A2 for a formal proof. ∎

Notice finally that the principle of reciprocity therefore not only guides countries away from the inefficient noncooperative equilibrium in a way, which monotonically increases welfare in all countries but also secures negotiated tariff concessions by eliminating all incentives to reverse them. To see this, suppose that, starting at the noncooperative equilibrium, Home assumes the leadership in trade negotiations. Then, since Foreign is required to respond reciprocally to any tariff reduction by Home, i.e. since Foreign is required to seek a 'balance of concessions', Home immediately has an incentive to initiate reciprocal trade liberalization, which monotonically increases welfare in both countries. Also, since Foreign is entitled to respond reciprocally to any tariff increase by Home, i.e. since Foreign is entitled to 'withdraw substantially equivalent concessions', Home never has an incentive to increase its tariff so that negotiated tariff concessions can be secured.[34] In summary, the principle of reciprocity can thus be seen as helping governments escape the inefficient noncooperative equilibrium in a way, which monotonically increases welfare in all countries. In fact, the principle of reciprocity not only helps governments escape the inefficient equilibrium but also directly guides them to efficient tariffs. This is because countries can liberalize their trade reciprocally unless one country has completely eliminated all its tariffs, which is sufficient for efficiency, from lemma 2.

---

[34]Thus, any tariff combination can be sustained under reciprocity in this environment. Together with lemma 2, this implies that all efficient tariff combinations can be sustained under reciprocity. This differs from the finding of Bagwell and Staiger (1999) that, absent political economy forces, free trade is the only efficient tariff combination, which can be sustained under reciprocity. Recall, however, that lemma 2 characterizes constrained efficient tariffs so that this difference should not be overemphasized (c.f. footnote 29).

3 Three-country model

3.1 Setup

While the basic two-country model is thus useful to illustrate the overall purpose of trade negotiations and the role played by the GATT/WTO principle of reciprocity, it is too simple to shed light on the role played by the principle of nondiscrimination. For this reason, I develop an extension of the basic model in this section. In particular, I focus on the simplest possible setup that allows for discriminatory tariff setting. There are now three countries: Home, Foreign 1, and Foreign 2. Home trades with both Foreign 1 and Foreign 2, but Foreign 1 and Foreign 2 trade with Home only so that only Home can set discriminatory tariffs. For simplicity, I now also assume that countries are symmetric. Everything else is just as in the basic model. The notation is a straightforward generalization of the one used before. For example, τ_1 is now the tariff imposed by Home against imports from Foreign 1, τ_2^* is now the tariff imposed by Foreign 2 against imports from Home, and G_1^* is the manufacturing price index of Foreign 1. The derivation of the equilibrium proceeds exactly as before and is thus moved to appendix A1.

3.2 Noncooperative trade policy

Consider now again trade policy if tariffs are set noncooperatively. All results from the basic model naturally generalize to the three-country case. As in lemma 1, the only robust Nash equilibrium is autarky:

Lemma 4 *Suppose governments choose tariffs simultaneously, Home maximizing V, Foreign 1 maximizing V_1^*, and Foreign 2 maximizing V_2^*. Then the unique trembling-hand perfect Nash equilibrium is autarky.*

Proof. See appendix A2 for a formal proof. ■

Similar to lemma 2, a tariff combination is efficient if and only if Home and/or both Foreign countries charge zero tariffs:

Lemma 5 *The set of Pareto-efficient tariff combinations consists of all* $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ *such that* $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = ($ *any possible* τ_1, *any possible* $\tau_2, 0, 0)$ *or* $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, 0,$ *any possible* τ_1^*, *any possible* $\tau_2^*)$.

Proof. See appendix A2 for a formal proof. ∎

As a consequence, the noncooperative equilibrium is inefficient:

Proposition 3 *The noncooperative equilibrium is inefficient.*

Proof. Follows immediately from lemmas 4 and 5. ∎

However, the fact that these results generalize so naturally to the three-country model conceals that tariffs now have more complicated international implications. Besides the import price effect, there is now generally both a bilateral as well as a multilateral production relocation effect. The bilateral production relocation effect is an effect between the two countries directly affected by the tariff and is just the production relocation effect familiar from the basic model: for example, a tariff imposed by Home against Foreign i leads to production relocations from Foreign i to Home since this increases the sales of firms at Home and reduces the sales of firms at Foreign i thereby making Home a more attractive business location for manufacturing firms. The multilateral production relocation effect is an additional effect on the third country, which is not directly affected by the tariff. This multilateral production relocation effect works through changes in Home's price index: for example, since a tariff imposed by Home against Foreign i leads to production relocations from Foreign i towards Home, Home's price index generally falls. If Home's price index falls, Home's market becomes more competitive, which generally makes it harder for firms in Foreign j to sell their products

to Home. If it becomes harder for firms in Foreign j to sell their products to Home, the number of firms operating in Foreign j has to fall in equilibrium so that a tariff imposed by Home against Foreign i generally does not only lead to production relocations from Foreign i to Home but also from Foreign j to Home.

3.3 Trade policy under the GATT/WTO: the principle of nondiscrimination

Consider now again trade policy, if tariffs are set subject to GATT/WTO regulations. In the following, I demonstrate that the principle of reciprocity alone is now no longer sufficient to help countries overcome the inefficient noncooperative equilibrium in a way, which monotonically increases welfare in all countries. However, if the principle of reciprocity is augmented with the principle of nondiscrimination, they then together serve this purpose. Adapting the earlier definition of reciprocity to the three country case, tariff changes are now required to be bilaterally reciprocal in bilateral trade negotiations and multilaterally reciprocal in multilateral trade negotiations, where bilaterally reciprocal and multilaterally reciprocal tariff changes are formally defined as follows:

Definition 2 *Define a tariff change to be bilaterally reciprocal between Home and Foreign i if it is such that $dTB^*_{Mi} = 0$, where $TB^*_{Mi} \equiv EXP^*_{Mi} - IMP^*_{Mi}$ and EXP^*_{Mi} (IMP^*_{Mi}) refers to the value of manufacturing exports (imports) in Foreign i. Define a tariff change to be multilaterally reciprocal if it is such that $dTB^*_{M1} = dTB^*_{M2} = 0$.*

Notice first that reciprocity always neutralizes the bilateral production relocation effect but generally not the multilateral production relocation effect if it is applied in bilateral trade negotiations but that it always neutralizes both effects if it is applied in multilateral trade negotiations. To see this, observe that the number of manufacturing

firms operating in Foreign i can again be decomposed as follows:[35]

$$n_i^* = \frac{\mu L_i^*}{qp} + \frac{TB_{Mi}^*}{qp} \tag{30}$$

Hence, if Home and Foreign i change tariffs in a bilaterally reciprocal way, the number of firms in Foreign i remains unchanged. Therefore, the principle of reciprocity always serves to eliminate the bilateral production relocation effect if it is applied in bilateral trade negotiations. Also, if Home, Foreign 1, and Foreign 2 change tariffs in a multilaterally reciprocal way, the number of firms in Foreign 1 and Foreign 2 (and hence also Home) remains unchanged. Therefore, the principle of reciprocity always serves to eliminate both the bilateral as well as the multilateral production relocation effect if it is applied in multilateral trade negotiations. Although not obvious from equation (30), the principle of reciprocity is generally not sufficient to also eliminate the multilateral production relocation effect if it is applied in bilateral trade negotiations. This is because bilaterally reciprocal tariff changes between Home and Foreign i change Home's price index thereby generally affecting the sales of firms in Foreign j. In particular, if Home and Foreign i liberalize in a bilaterally reciprocal way, Home's price index falls, which generally makes it harder for firms in Foreign j to export their goods to Home. As a consequence, firms in Foreign j generally make losses unless some production relocates to Home.[36] This is summarized in lemma 6:

Lemma 6 *Tariff changes leave the number of firms unchanged in all countries if and only if they are multilaterally reciprocal. Moreover, bilaterally reciprocal trade liberalization (trade protection) between Home and Foreign i leaves the number of firms unchanged in Foreign i but monotonically increases (decreases) the number of firms in Home at the expense of (to the benefit of) Foreign j, if $\tau_j < \infty$.*

---

[35] For details, see the proof of lemma 6.

[36] Of course, firms in Foreign j are only affected by changes in Home's price index if they have access to Home's market. Therefore, bilaterally reciprocal trade liberalization (trade protection) between Home and Foreign i leaves the number of firms unchanged in all countries, in the special case of $\tau_j = \infty$.

Proof. See appendix A2 for a formal proof. ■

Observe second that reciprocity only always ensures that negotiated tariff concessions increase welfare monotonically in all countries if it is applied in multilateral trade negotiations. If Home and Foreign i liberalize in a bilaterally reciprocal way, generally only the bilateral production relocation effect is neutralized so that Foreign i gains because of the import price effect, Home gains because of the import price effect and the multilateral production relocation effect, but Foreign j loses because of the multilateral production relocation effect. If, instead, Home, Foreign 1, and Foreign 2 liberalize in a multilaterally reciprocal way, the multilateral production relocation effect is also always neutralized so that all countries always gain because of the import price effect.[37] This is summarized in proposition 4:

Proposition 4 *Multilaterally reciprocal trade liberalization (trade protection) monotonically increases (decreases) welfare in all countries. Bilaterally reciprocal trade liberalization (trade protection) between Home and Foreign i monotonically increases (decreases) welfare in Home and Foreign i but monotonically decreases (increases) welfare in Foreign j, if $\tau_j < \infty$.*

Proof. See appendix A2 for a formal proof. ■

Notice third that Home always prefers sequential bilateral trade negotiations to simultaneous multilateral trade negotiations so that the principle of reciprocity alone is no longer sufficient to ensure that negotiated tariff concessions increase welfare monotonically in all countries. To see this, suppose again that, starting at the noncooperative equilibrium, Home assumes the leadership in trade negotiations. Moreover, suppose that Home can choose whether to proceed in simultaneous multilaterally reciprocal

---

[37] Again, firms in Foreign j are only affected by changes in Home's price index if they have access to Home's market. Therefore, bilaterally reciprocal trade liberalization (trade protection) between Home and Foreign i monotonically increases (decreases) welfare in Home and Foreign i but leaves welfare unaffected in Foreign j, in the special case of $\tau_j = \infty$.

trade negotiations, both with Foreign 1 and Foreign 2, or in sequential bilaterally reciprocal trade negotiations, first with Foreign 1 and second with Foreign 2. Recalling that the noncooperative equilibrium is autarky and therefore features $\tau_1 = \tau_2 = \tau_1^* = \tau_2^* = \infty$ and $n = n_1^* = n_2^* = \frac{\mu L}{qp}$, the following can then be verified (see appendix A2 for details): if Home negotiates multilaterally simultaneously with Foreign 1 and Foreign 2, i.e. if Home changes τ_1 and τ_2 simultaneously thereby making Foreign 1 and Foreign 2 respond in a multilaterally reciprocal way, Home maximizes welfare by setting $\tau_1 = \tau_2 = 0$ simultaneously. The final outcome is then $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, 0, \text{some } \tau_1^* : \ 0 < \tau_1^* < \infty, \ \text{some } \tau_2^* : \ 0 < \tau_2^* < \infty)$, and $n = n_1^* = n_2^* = \frac{\mu L}{qp}$. All countries gain monotonically throughout the liberalization process. If Home instead negotiates bilaterally first with Foreign 1 and second with Foreign 2, i.e. if Home changes first τ_1 and second τ_2, thereby making first Foreign 1 and second Foreign 2 respond in a bilaterally reciprocal way, Home can do better by simply implementing $\tau_1 = \tau_2 = 0$ sequentially. This is because then the first stage outcome is $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, \infty, 0, \infty)$, and $n = n_1^* = n_2^* = \frac{\mu L}{qp}$, and the second stage and final outcome is $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, 0, 0, \text{some } \tau_2^* : \ 0 < \tau_2^* < \infty)$, and $(n, n_1^*, n_2^*) = \left(\text{some } n : \frac{\mu L}{qp} < n, \text{some } n_1^* : 0 < n_1^* < \frac{\mu L}{qp}, \frac{\mu L}{qp}\right)$, which Home prefers to $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, 0, \text{some } \tau_1^* : \ 0 < \tau_1^* < \infty, \ \text{some } \tau_2^* : \ 0 < \tau_2^* < \infty)$, and $n = n_1^* = n_2^* = \frac{\mu L}{qp}$ since $G = p \left[n + n_1^* \phi_1^{1-\sigma} + n_2^* \phi_2^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$. Intuitively, Home gains only because of the import price effect in simultaneous multilateral trade negotiations but also because of the multilateral production relocation effect at the expense of Foreign 1 in the second stage of sequential bilateral trade negotiations.[38] Home gains monotonically throughout all stages of the liberalization process, Foreign 1 gains monotonically during the first stage but loses monotonically during the second stage, and Foreign 2 neither gains nor loses during the first stage but gains monotonically during the second stage.

---

[38]Notice that the multilateral production relocation effect only operates in the second stage, since $\tau_2 = \infty$ in the first stage.

Observe finally that the principle of nondiscrimination is a simple rule forcing Home to engage in multilateral trade negotiations so that both principles jointly ensure that negotiated tariff concessions increase welfare monotonically in all countries.[39] The reasoning for this is straightforward: if Home is required to impose nondiscriminatory tariffs, Home has to change τ_1 and τ_2 simultaneously so that both Foreign 1 and Foreign 2 are then required to seek a 'balance of concessions' if Home reduces its tariffs and entitled to 'withdraw substantially equivalent concessions' if Home increases its tariffs. The outcome is then also $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, 0, \text{some } \tau_1^* : \ 0 < \tau_1^* < \infty, \ \text{some } \tau_2^* : \ 0 < \tau_2^* < \infty)$ and $n = n_1^* = n_2^* = \frac{\mu L}{qp}$, just as above.

Overall, the principles of reciprocity and nondiscrimination therefore again help countries overcome the inefficient noncooperative equilibrium in a way, which monotonically increases welfare in all countries. Also, both principles again directly guide them to efficient tariffs since $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, 0, \text{some } \tau_1^* : \ 0 < \tau_1^* < \infty, \ \text{some } \tau_2^* : \ 0 < \tau_2^* < \infty)$ is efficient, from lemma 5.[40] It is important to emphasize, however, that the principle of reciprocity alone continues to reverse Home's incentives for protection both in multilateral as well as in bilateral trade negotiations so that the principle of nondiscrimination plays no efficiency enhancing role.[41] Instead, it only serves to multilateralize trade negotiations thereby ensuring that all trade policy externalities are eliminated so that governments cannot gain at the expense of one another and welfare increases monoton-

---

[39]Tariffs are defined to be nondiscriminatory if $\tau_1 = \tau_2 \equiv \tau$. GATT/WTO articles allow countries to sign preferential trade agreements as an important exception to the principle of nondiscrimination. This has generated a debate on whether preferential trade agreements are 'building blocs' or 'stumbling blocs' on the way to multilateral free trade. See Panagariya (2000) for a survey of the literature.

[40]Notice, however, that this is not necessarily true if countries are asymmetric. Reciprocity and nondiscrimination can only be satisfied if all tariffs are lowered simultaneously, as can be easily verified from differentiating the manufacturing market clearing conditions. But this is impossible if at least one of the tariffs is equal to zero, which is not sufficient for efficiency, from lemma 5. Recall, however, that the requirement to liberalize reciprocally is not binding in a legal sense so that this feature of nondiscrimination should not be overemphasized.

[41]Together with lemma 5 this implies that efficient tariffs can be implemented under reciprocity even if tariffs are discriminatory which differs from the finding of Bagwell and Staiger (1999). Just like lemma 2, however, lemma 5 characterizes constrained efficient tariffs so that this difference should not be overemphasized.

ically in all countries during all stages of the liberalization process.[42]

4 Conclusion

In this paper, I developed a 'new trade' theory of GATT/WTO negotiations. I first demonstrated that tariffs are inefficiently high in the noncooperative equilibrium since trade policy entails an international production relocation externality. I then showed that GATT/WTO negotiations governed by the principles of reciprocity and nondiscrimination help countries overcome this inefficiency by making them internalize this externality.

This 'new trade' theory builds on a rationale for unilateral protection, which can be linked directly to trade policy debates. In the model, the higher the import tariff, the larger is the number of domestic manufacturing firms; the larger the number of domestic manufacturing firms, the lower is the domestic price index; and the lower the domestic price index, the higher is domestic welfare. Therefore, while trade policymakers are assumed to maximize domestic welfare in the model, their tariff choices are exactly as if they maximized the number of domestic manufacturing firms. And since the number of domestic manufacturing firms translates directly into the number of domestic manufacturing jobs, this is equivalent to maximizing the number of domestic manufacturing jobs. Of course, the model cannot capture the differential role played by exporting and import-competing interests in real-world GATT/WTO negotiations. This is because all firms are simultaneously exporting and import-competing in this simple 'new trade' environment.

---

[42]Notice that the principle of nondiscrimination plays a different role in Bagwell and Staiger (1999). There, it does not neutralize the multilateral terms-of-trade effect by multilateralizing trade negotiations but instead by equalizing all bilateral terms-of-trade. In fact, multilateralizing trade negotiations would not be sufficient to neutralize the multilateral terms-of-trade effect because the multilateral terms-of-trade are a trade-weighted average of the bilateral terms-of-trade and thus depend on trade shares unless the bilateral terms-of-trade are equalized. One implication of this difference is that the principles of reciprocity and nondiscrimination neutralize all third party externalities without requiring any third party response in Bagwell and Staiger (1999).

Many of the arguments made in the context of the neoclassical theory of GATT/WTO negotiations could be revisited in the context of this 'new trade' theory of GATT/WTO negotiations. For example, one could introduce political economy forces into the model as in Bagwell and Staiger (1999) to see whether GATT/WTO negotiations can be viewed as a response to politically motivated protectionism. Or one could consider labor and environmental standards as in Bagwell and Staiger (2001) to assess whether they should be part of the GATT/WTO agreement. Or one could introduce domestic production subsidies into the model as in Bagwell and Staiger (2006b) to evaluate the GATT/WTO rules on production subsidies.

References

[1] Antweiler, Werner, and Daniel Trefler. 2002. "Increasing Returns and All That: A View from Trade." *American Economic Review*, 92(1): 93-119.

[2] Bagwell, Kyle, and Robert W. Staiger. 1999. "An Economic Theory of GATT." *American Economic Review*, 89(1): 215-248.

[3] Bagwell, Kyle, and Robert W. Staiger. 2001. "Domestic Policies, National Sovereignty, and International Economic Institutions." *Quarterly Journal of Economics*, 116(2): 519-562.

[4] Bagwell, Kyle, and Robert W. Staiger. 2002. *The Economics of the World Trading System*. Cambridge, MA: MIT Press.

[5] Bagwell, Kyle, and Robert W. Staiger. 2006a. "What Do Trade Negotiators Negotiate About? Evidence from the World Trade Organization." National Bureau of Economic Research Working Paper 12727.

[6] Bagwell, Kyle, and Robert W. Staiger. 2008a. "Profit Shifting and Trade Agreements in Imperfectly Competitive Markets." Unpublished.

[7] Bagwell, Kyle, and Robert W. Staiger. 2008b. "Firm Delocation and Trade Agreements in Imperfectly Competitive Markets." Unpublished.

[8] Bagwell, Kyle, and Robert W. Staiger. 2006b. "Will International Rules on Subsidies Disrupt the World Trading System?" *American Economic Review*, 96(3): 877-895.

[9] Baldwin, Richard E., and Frederic Robert-Nicoud. 2000. "Free Trade Agreements without Delocation." *Canadian Journal of Economics*, 33(3): 766-786.

[10] Baldwin, Richard E., Rikard Forslid, Philippe Martin, Gianmarco I. P. Ottaviano, and Frederic Robert-Nicoud. 2003. *Economic Geography and Public Policy.* Princeton, NJ: Princeton University Press.

[11] Broda, Christian, Nuno Limao, and David Weinstein. Forthcoming. "Optimal Tariffs and Market Power: The Evidence." *American Economic Review.*

[12] Dam, Kenneth W. 1970. *The GATT: Law and International Economic Organization.* Chicago, IL: Chicago University Press.

[13] Davis, Donald R. 1999. "The Home Market, Trade, and Industrial Structure." *American Economic Review*, 88(5): 1264-1276.

[14] Davis, Donald R., and David Weinstein. 2003. "Market Access, Economic Geography, and Comparative Advantage: An Empirical Assessment." *Journal of International Economics*, 59(1): 1-23.

[15] Davis, Donald R., and David Weinstein. 1999. "Economic Geography and Regional Production Structure: An Empirical Investigation." *European Economic Review*, 43(2): 379-407.

[16] Debaere, Peter. 2005. "Monopolistic Competition and Trade, Revisited: Testing the Model without Testing for Gravity." *Journal of International Economics*, 66(1): 249-266.

[17] Dixit, Avinash. 1987. "Strategic Aspects of Trade Policy." In *Advances in Economic Theory: Fifth World Congress*, ed. Truman F. Bewley, 329-362. Cambridge, UK: Cambridge University Press.

[18] Enders, Alice. 2002. "Reciprocity in GATT 1947: From 1942 to the Kennedy Round." In *Going Alone: The Case for Relaxed Reciprocity in Freeing Trade, ed.* Jagdish Bhagwati, 85-110. Cambridge, MA: MIT Press.

[19] Ethier, Wilfred J. 2002. "Political Externalities, Nondiscrimination, and a Multi-lateral World." Penn Institute for Economic Research Working Paper 02-030.

[20] Feenstra, Robert C., James R. Markusen, and Andrew K. Rose. 1998. "Understand-ing the Home Market Effect and the Gravity Equation: The Role of Differentiating Goods." National Bureau of Economic Research Working Paper 6804.

[21] Flam, Harry, and Elhanan Helpman. 1987. "Industrial Policy under Monopolistic Competition." *Journal of International Economics*, 22(1-2): 79-102.

[22] Fujita, Masahisa, Paul Krugman, and Anthony J. Venables. 1999. *The Spatial Economy: Cities, Regions, and International Trade.* Cambridge, MA: MIT Press.

[23] Gros, Daniel. 1987. "A Note on the Optimal Tariff, Retaliation and the Welfare Loss from Tariff Wars in a Framework with Intra-Industry Trade." *Journal of International Economics*, 23(3-4): 357-367.

[24] Grossman, Gene, and Elhanan Helpman. 1995. "Trade Wars and Trade Talks." *Journal of Political Economy*, 103(4): 675-708.

[25] Hanson, Gordon H., and Chong Xiang. 2004. "The Home Market Effect and Bilat-eral Trade Patterns." *American Economic Review*, 94(4): 1108-1129.

[26] Helpman, Elhanan. 1987. "Imperfect Competition and International Trade: Evi-dence from Fourteen Industrial Countries." *Journal of the Japanese and Interna-tional Economies*, 1(1): 62-81.

[27] Helpman, Elhanan, and Paul Krugman. 1985. *Market Structure and Foreign Trade.* Cambridge, MA: MIT Press.

[28] Helpman, Elhanan, and Paul Krugman. 1989. *Trade Policy and Market Structure.* Cambridge, MA: MIT Press.

[29] Hoekman, Bernard M., and Michel M. Kostecki. 1995. *The Political Economy of the World Trading System: From GATT to WTO.* Oxford, UK: Oxford University Press.

[30] Horn, Henrik. 2006. "National Treatment in the GATT." *American Economic Review*, 96(1): 394-404.

[31] Hummels, David, and James Levinsohn. 1995. "Monopolistic Competition and International Trade: Reconsidering the Evidence." *Quarterly Journal of Economics*, 110(3): 799-836.

[32] Irwin, Douglas A. 1996. *Against the Tide: An Intellectual History of Free Trade.* Princeton, NJ: Princeton University Press.

[33] Johnson, Harry G. 1953-1954. "Optimum Tariffs and Retaliation." *Review of Economic Studies*, 21(2): 142-53.

[34] Kennan, John, and Raymond Riezman. 1988. "Do Big Countries win Tariff Wars?" *International Economic Review*, 29(1): 81-85.

[35] Krugman, Paul. 1980. "Scale Economies, Product Differentiation, and the Pattern of Trade." *American Economic Review,* 70(5): 950-959.

[36] Krugman, Paul. 1991. "Increasing Returns and Economic Geography." *Journal of Political Economy,* 99(3): 483-499.

[37] Krugman, Paul. 1997. "What Should Trade Negotiators Negotiate About?" *Journal of Economic Literature*, 35(1): 113-120.

[38] Krugman, Paul, and Anthony J. Venables. 1999. "How Robust is the Home Market Effect?" Unpublished.

[39] Kuga, Kiyoshi. 1973. "Tariff Retaliation and Policy Equilibrium." *Journal of International Economics*, 3(4): 351-366.

[40] Maggi, Giovanni. 1999. "The Role of Multilateral Institutions in International Trade Cooperation." *American Economic Review*, 89(1): 190-214.

[41] Maggi, Giovanni, and Pinelopi K. Goldberg. 1999. "Protection for Sale: An Empirical Investigation." *American Economic Review*, 89(5): 1135-1155.

[42] Maggi, Giovanni, and Andres Rodriguez-Clare. 1998. "The Value of Trade Agreements in the Presence of Political Pressures." *Journal of Political Economy*, 106(3): 574-601.

[43] Maggi, Giovanni, and Andres Rodriguez-Clare. 2007. "A Political-Economy Theory of Trade Agreements." *American Economic Review*, 97(4): 1374-1406.

[44] Martin, Philippe, and Carol A. Rogers. 1995. "Industrial Location and Public Infrastructure." *Journal of International Economics*, 39(3): 335-351.

[45] Mayer, Wolfgang. 1981. "Theoretical Considerations on Negotiated Tariff Adjustments." *Oxford Economic Papers*, 33(1), 135-53.

[46] Melitz, Marc J., and Gianmarco I. P. Ottaviano. 2008. "Market Size, Trade, and Productivity." *Review of Economic Studies*, 75(1)": 295-316.

[47] Mitra, Devashish. 2002. "Endogenous Political Organization and the Value of Trade Agreements." *Journal of International Economics*, 57(2): 473-485.

[48] Panagariya, Arvind. 2000. "Preferential Trade Liberalization: The Traditional Theory and New Developments." *Journal of Economic Literature*, 38(2): 287-331.

[49] Regan, Donald H. 2006. "What Are Trade Agreements For? Two Conflicting Stories Told by Economists, With a Lesson for Lawyers." *Journal of International Economic Law*, 9(4): 951-988.

[50] Riezman, Raymond. 1982. "Tariff Retaliation from a Strategic Viewpoint." *Southern Economic Journal*, 48(3): 583-593.

[51] Rose, Andrew K. 2004. "Do We Really Know That the WTO Increases Trade?" *American Economic Review*, 94(1): 98-114.

[52] Samuelson, Paul A. 1952. "The Transfer Problem and Transport Costs: The Terms of Trade When Impediments are Absent." *Economic Journal.* 62(246): 278-304.

[53] Staiger, Robert W., and Guido Tabellini. 1987. "Discretionary Trade Policy and Excessive Protection." *American Economic Review*, 77(5): 823-837.

[54] Subramanian, Arvind, and Shang-Jin Wei. 2007. "The WTO Promotes Trade, Strongly but Unevenly." *Journal of International Economics*, 72(1): 151-175.

[55] Syropoulos, Constantinos. 2002. "Optimum Tariffs and Retaliation Revisited: How Country Size Matters." *Review of Economics Studies*, 69(3): 707-727.

[56] Tomz, Michael, Judith L. Goldstein, and Douglas Rivers. 2007. "Do We Really Know That the WTO Increases Trade? Comment." *American Economic Review*, 97(5): 2005-2018.

[57] Venables, Anthony J. 1987. "Trade and Trade Policy with Differentiated Products: A Chamberlinian-Ricardian Model." *The Economic Journal*, 97(387): 700-717.

5 Appendix

5.1 Appendix A1: Three-country model

The manufacturing sector is always active in all countries for all possible $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ if and only if $\theta > \left(\frac{1}{3}\right)^{\frac{1}{1-\sigma}}$. The outside good sector is always active in all countries for all possible $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ if and only if $\mu < 1 - 2\theta^{1-\sigma}$. As before, all firms charge $\frac{\sigma c}{\sigma-1} \equiv p$ in equilibrium and the price indices can be written as

$$G = p\left[n + n_1^* \phi_1^{1-\sigma} + n_2^* \phi_2^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{31}$$

$$G_1^* = p\left[n\phi_1^{*1-\sigma} + n_1^*\right]^{\frac{1}{1-\sigma}} \tag{32}$$

$$G_2^* = p\left[n\phi_2^{*1-\sigma} + n_2^*\right]^{\frac{1}{1-\sigma}} \tag{33}$$

Manufacturing market clearing requires

$$q = \mu L p^{-\sigma} G^{\sigma-1} + \mu L \phi_1^{*1-\sigma} p^{-\sigma} G_1^{*\sigma-1} + \mu L \phi_2^{*1-\sigma} p^{-\sigma} G_2^{*\sigma-1} \tag{34}$$

$$q = \mu L \phi_1^{1-\sigma} p^{-\sigma} G^{\sigma-1} + \mu L p^{-\sigma} G_1^{*\sigma-1} \tag{35}$$

$$q = \mu L \phi_2^{1-\sigma} p^{-\sigma} G^{\sigma-1} + \mu L p^{-\sigma} G_2^{*\sigma-1} \tag{36}$$

where the equations refer to Home, Foreign 1, and Foreign 2, respectively. These equations can be solved for the equilibrium price indices

$$G = \left[\frac{qp^\sigma \Phi}{\mu L \Omega}\right]^{\frac{1}{\sigma-1}} \tag{37}$$

$$G_1^* = \left[\frac{qp^\sigma \Phi_1}{\mu L \Omega}\right]^{\frac{1}{\sigma-1}} \tag{38}$$

$$G_2^* = \left[\frac{qp^\sigma \Phi_2}{\mu L \Omega}\right]^{\frac{1}{\sigma-1}} \tag{39}$$

where

$$\Phi \equiv 1 - \phi_1^{*1-\sigma} - \phi_2^{*1-\sigma} \tag{40}$$

$$\Phi_1 \equiv 1 - \phi_1^{1-\sigma} - \phi_2^{*1-\sigma}\left(\phi_2^{1-\sigma} - \phi_1^{1-\sigma}\right) \tag{41}$$

$$\Phi_2 \equiv 1 - \phi_2^{1-\sigma} - \phi_1^{*1-\sigma}\left(\phi_1^{1-\sigma} - \phi_2^{1-\sigma}\right) \tag{42}$$

$$\Omega \equiv 1 - (\phi_1\phi_1^*)^{1-\sigma} - (\phi_2\phi_2^*)^{1-\sigma} \tag{43}$$

It is easy to verify that $\Phi, \Phi_1, \Phi_2, \Omega > 0$. These price indices can then be solved for the equilibrium numbers of manufacturing firms

$$n = \frac{\mu L}{qp}\left[\frac{1}{\Phi} - \frac{\phi_1^{1-\sigma}}{\Phi_1} - \frac{\phi_2^{1-\sigma}}{\Phi_2}\right] \tag{44}$$

$$n_1^* = \frac{\mu L}{qp}\left[\frac{1 - (\phi_2\phi_2^*)^{1-\sigma}}{\Phi_1} + \frac{(\phi_1^*\phi_2)^{1-\sigma}}{\Phi_2} - \frac{\phi_1^{*1-\sigma}}{\Phi}\right] \tag{45}$$

$$n_2^* = \frac{\mu L}{qp}\left[\frac{1 - (\phi_1\phi_1^*)^{1-\sigma}}{\Phi_2} + \frac{(\phi_1\phi_2^*)^{1-\sigma}}{\Phi_1} - \frac{\phi_2^{*1-\sigma}}{\Phi}\right] \tag{46}$$

These expressions again imply that the world number of manufacturing firms is constant. Since there are now three symmetric countries, it is given by

$$n + n_1^* + n_2^* = \frac{3\mu L}{qp} \tag{47}$$

5.2   Appendix A2: Proofs

5.2.1   Proof of lemma 1

Proof. Given the form of V, V is maximized when G is minimized. Also, $\frac{\partial G}{\partial \tau} = -\frac{\phi^*(\phi\phi^*)^{-\sigma}}{\left[1-(\phi\phi^*)^{1-\sigma}\right]}G$ so that G is monotonically decreasing in τ for all $\tau^* \in [0, \infty)$ and constant in τ for $\tau^* = \infty$. Hence, Home maximizes V by choosing $\tau = \infty$ if $\tau^* \in [0, \infty)$ and any possible τ if $\tau^* = \infty$. Similarly, Foreign maximizes V^* by choosing $\tau^* = \infty$

37

if $\tau \in [0,\infty)$ and any possible τ^* if $\tau = \infty$. Thus, the set of Nash equilibrium tariffs consists of all (τ, τ^*) such that either $(\tau, \tau^*) = (\infty, \text{any possible } \tau^*)$ or $(\tau, \tau^*) = (\text{any possible } \tau, \infty)$. However, if the governments' strategies are subject to small perturbations, Home's (Foreign's) best response is always to choose $\tau = \infty$ ($\tau^* = \infty$). Therefore, $(\tau, \tau^*) = (\infty, \infty)$ is the unique trembling-hand perfect Nash equilibrium. ∎

5.2.2 Proof of lemma 2

Proof. A tariff combination (τ, τ^*) cannot be Pareto efficient if there exist feasible Pareto improving tariff changes $(d\tau, d\tau^*)$ at (τ, τ^*). This includes tariff changes $(d\tau, d\tau^*)$ such that $dG^* < 0$ and $dG = 0$. From total differentiation, $dG = \frac{\partial G}{\partial \tau}d\tau + \frac{\partial G}{\partial \tau^*}d\tau^*$ and $dG^* = \frac{\partial G^*}{\partial \tau}d\tau + \frac{\partial G^*}{\partial \tau^*}d\tau^*$. Therefore, $dG = 0$ if $d\tau = -\frac{\partial \tau}{\partial G}\frac{\partial G}{\partial \tau^*}d\tau^*$ so that $dG^* = \left(\frac{\partial G^*}{\partial \tau^*} - \frac{\partial G^*}{\partial \tau}\frac{\partial \tau}{\partial G}\frac{\partial G}{\partial \tau^*}\right)d\tau^*$ along $dG = 0$. Notice that $\frac{\partial G^*}{\partial \tau^*} - \frac{\partial G^*}{\partial \tau}\frac{\partial \tau}{\partial G}\frac{\partial G}{\partial \tau^*} > 0$ for all possible finite (τ, τ^*). This is because $\frac{\partial G}{\partial \tau} = -\frac{(\phi\phi^*)^{-\sigma}\phi^*}{1-(\phi\phi^*)^{1-\sigma}}G$, $\frac{\partial G}{\partial \tau^*} = \frac{\left(1-\phi^{1-\sigma}\right)\phi^{*-\sigma}}{\left(1-\phi^{*1-\sigma}\right)\left[1-(\phi\phi^*)^{1-\sigma}\right]}G$, $\frac{\partial G^*}{\partial \tau} = \frac{\left(1-\phi^{*1-\sigma}\right)\phi^{-\sigma}}{\left(1-\phi^{1-\sigma}\right)\left[1-(\phi\phi^*)^{1-\sigma}\right]}G^*$, and $\frac{\partial G^*}{\partial \tau^*} = -\frac{(\phi\phi^*)^{-\sigma}\phi}{1-(\phi\phi^*)^{1-\sigma}}G^*$ so that $\frac{\partial G^*}{\partial \tau^*} - \frac{\partial G^*}{\partial \tau}\frac{\partial \tau}{\partial G}\frac{\partial G}{\partial \tau^*} = \frac{G^*}{\phi^*}$. Hence, there exist Pareto improving tariff changes $(d\tau, d\tau^*)$ for all possible finite (τ, τ^*). These $(d\tau, d\tau^*)$ are such that $d\tau < 0$ and $d\tau^* < 0$ and are thus feasible if and only if $\tau > 0$ and $\tau^* > 0$. Therefore, only (τ, τ^*) such that $(\tau, \tau^*) = (\text{any possible finite } \tau, 0)$ or $(\tau, \tau^*) = (0, \text{any possible finite } \tau^*)$ can be Pareto efficient among all possible finite (τ, τ^*). It is easy to verify that this conclusion extends beyond all possible finite (τ, τ^*) so that only (τ, τ^*) such that $(\tau, \tau^*) = (\text{any possible } \tau, 0)$ or $(\tau, \tau^*) = (0, \text{any possible } \tau^*)$ can be Pareto efficient. It is also easy to verify that for none of these (τ, τ^*) there exists another (τ, τ^*), which makes one country better off without making the other country worse off. Therefore, they are also indeed Pareto efficient. ∎

5.2.3 Proof of lemma 3

Proof. By definition, $TB_M = \mu p^{1-\sigma}\left(n\phi^{*1-\sigma}L^*G^{*\sigma-1} - n^*\phi^{1-\sigma}LG^{\sigma-1}\right)$ so that $\frac{TB_M}{\mu} = \frac{n\phi^{*1-\sigma}L^*}{n\phi^{*1-\sigma}+n^*} - \frac{n^*\phi^{1-\sigma}L}{n+n^*\phi^{1-\sigma}}$. Also, $\frac{nqp}{\mu} = \frac{nL}{n+n^*\phi^{1-\sigma}} + \frac{n\phi^{*1-\sigma}L^*}{n\phi^{*1-\sigma}+n^*}$ from Home's manufacturing

38

market clearing condition. Hence, $n = \frac{\mu L}{qp} + \frac{TB_M}{qp}$, which implies that $dn = 0$ if and only if $dTB_M = 0$. Finally, since $n + n^* = \frac{\mu(L+L^*)}{qp}$, $dn^* = 0$ if and only if $dn = 0$. ∎

5.2.4   Proof of proposition 2

Proof. Recall that $G = p\left[n + n^*\phi^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$ and $G^* = p\left[n\phi^{*1-\sigma} + n^*\right]^{\frac{1}{1-\sigma}}$ from equations (16) and (17). Since reciprocal tariff changes leave the number of firms unchanged in both countries, from lemma 3, reciprocal trade liberalization (trade protection) therefore monotonically decreases (increases) both countries' price indices. ∎

5.2.5   Proof of lemma 4

Proof. $\frac{\partial G}{\partial \tau_i} = -\frac{(\phi_i\phi_i^*)^{-\sigma}\phi_i^*}{\Omega}G$ so that G is monotonically decreasing in τ_i for all $\tau_i^* \in [0,\infty)$ and constant in τ_i for $\tau_i^* = \infty$. Hence, H maximizes V by choosing $\tau_i = \infty$ if $\tau_i^* \in [0,\infty)$ and any possible τ_i if $\tau_i^* = \infty$. Similarly, $\frac{\partial G_i^*}{\partial \tau_i^*} = -\frac{(\phi_i\phi_i^*)^{-\sigma}\phi_i}{\Omega}G_i^*$ so that G_i^* is monotonically decreasing in τ_i^* for all $\tau_i \in [0,\infty)$ and constant in τ_i^* for $\tau_i = \infty$. Hence, Foreign i maximizes V_i^* by choosing $\tau_i^* = \infty$ if $\tau_i \in [0,\infty)$ and any possible τ_i^* if $\tau_i = \infty$. Thus, the set of Nash equilibrium tariffs consists of all $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ such that either $(\tau_1, \tau_1^*) = (\infty,$ any possible $\tau_1^*)$ or $(\tau_1, \tau_1^*) = ($any possible $\tau_1, \infty)$ and either $(\tau_2, \tau_2^*) = (\infty,$ any possible $\tau_2^*)$ or $(\tau_2, \tau_2^*) = ($any possible $\tau_2, \infty)$. However, if the governments' strategies are subject to small perturbations, H's (Foreign i's) best response is always to choose $\tau_i = \infty$ ($\tau_i^* = \infty$). Therefore, $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (\infty, \infty, \infty, \infty)$ is the is the unique trembling-hand perfect Nash equilibrium. ∎

5.2.6   Proof of lemma 5

Proof. A tariff combination $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ cannot be Pareto efficient if there exist feasible Pareto improving tariff changes $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$ at $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$. This includes tariff changes $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$, $d\tau_j = d\tau_j^* = 0$, such that $dG_i^* < 0$ and $dG = dG_j^* = 0$. From total differentiation, $dG = \frac{\partial G}{\partial \tau_i}d\tau_i + \frac{\partial G}{\partial \tau_i^*}d\tau_i^*$, $dG_i^* = \frac{\partial G_i^*}{\partial \tau_i}d\tau_i +$

39

$\frac{\partial G_i^*}{\partial \tau_i^*} d\tau_i^*$, and $dG_j^* = \frac{\partial G_j^*}{\partial \tau_i} d\tau_i + \frac{\partial G_j^*}{\partial \tau_i^*} d\tau_i^*$. Therefore, $dG = 0$ if $d\tau_i = -\frac{\partial \tau_i}{\partial G} \frac{\partial G}{\partial \tau_i^*} d\tau_i^*$

and $dG_j^* = 0$ if $d\tau_i = -\frac{\partial \tau_i}{\partial G_j^*} \frac{\partial G_j^*}{\partial \tau_i^*} d\tau_i^*$. Notice that these two conditions are identical.

This is because $\frac{\partial G}{\partial \tau_i} = -\frac{(\phi_i \phi_i^*)^{-\sigma} \phi_i^*}{\Omega} G$, $\frac{\partial G}{\partial \tau_i^*} = \frac{\Phi_i \phi_i^{*-\sigma}}{\Omega \Phi} G$, $\frac{\partial G_i^*}{\partial \tau_j} = \frac{\Phi(\phi_j \phi_j^*)^{-\sigma} \phi_j^* \phi_i^{1-\sigma}}{\Omega \Phi_i} G_i^*$, and

$\frac{\partial G_i^*}{\partial \tau_j^*} = -\frac{\Phi_j \phi_j^{*-\sigma} \phi_i^{1-\sigma}}{\Omega \Phi_i} G_i^*$ so that $-\frac{\partial \tau_i}{\partial G} \frac{\partial G}{\partial \tau_i^*} = -\frac{\partial \tau_i}{\partial G_j^*} \frac{\partial G_j^*}{\partial \tau_i^*}$. Hence, along $dG = dG_j^* = 0$,

$dG_i^* = \left(\frac{\partial G_i^*}{\partial \tau_i^*} - \frac{\partial G_i^*}{\partial \tau_i} \frac{\partial \tau_i}{\partial G} \frac{\partial G}{\partial \tau_i^*} \right) d\tau_i^*$. Notice that $\frac{\partial G_i^*}{\partial \tau_i^*} - \frac{\partial G_i^*}{\partial \tau_i} \frac{\partial \tau_i}{\partial G} \frac{\partial G}{\partial \tau_i^*} > 0$ for all possible finite

$(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$. This is because $\frac{\partial G_i^*}{\partial \tau_i^*} = -\frac{(\phi_i \phi_i^*)^{-\sigma} \phi_i}{\Omega} G_i^*$ and $\frac{\partial G_i^*}{\partial \tau_i} = \frac{\Phi\left[1-\left(\phi_j \phi_j^*\right)^{1-\sigma}\right] \phi_i^{-\sigma} G_i^*}{\Omega \Phi_i}$,

which, together with the derivatives given above, implies that $\frac{\partial G_i^*}{\partial \tau_i^*} - \frac{\partial G_i^*}{\partial \tau_i} \frac{\partial \tau_i}{\partial G} \frac{\partial G}{\partial \tau_i^*} = \frac{G_i^*}{\phi_i^*}$.

Hence, there exist Pareto improving tariff changes $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$, $d\tau_j = d\tau_j^* = 0$,

such that $dG_i^* < 0$ and $dG = dG_j^* = 0$ for all possible finite $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$. These

$(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$ are such that $d\tau_i < 0$ and $d\tau_i^* < 0$ and are thus feasible if and

only if $\tau_i > 0$ and $\tau_i^* > 0$. This also includes tariff changes $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$,

$d\tau_j = d\tau_i^* = 0$, such that $dG_i^* < 0$ and $dG = dG_j^* = 0$. From total differentia-

tion, $dG = \frac{\partial G}{\partial \tau_i} d\tau_i + \frac{\partial G}{\partial \tau_j^*} d\tau_j^*$, $dG_i^* = \frac{\partial G_i^*}{\partial \tau_i} d\tau_i + \frac{\partial G_i^*}{\partial \tau_j^*} d\tau_j^*$, and $dG_j^* = \frac{\partial G_j^*}{\partial \tau_i} d\tau_i + \frac{\partial G_j^*}{\partial \tau_j^*} d\tau_j^*$.

Therefore, $dG = 0$ if $d\tau_j^* = -\frac{\partial \tau_j^*}{\partial G} \frac{\partial G}{\partial \tau_i} d\tau_i$ and $dG_j^* = 0$ if $d\tau_j^* = -\frac{\partial \tau_j^*}{\partial G_j^*} \frac{\partial G_j^*}{\partial \tau_i} d\tau_i$. Notice

from the derivatives given above that these two conditions are identical. Hence, along

$dG = dG_j^* = 0$, $dG_i^* = \left(\frac{\partial G_i^*}{\partial \tau_i} - \frac{\partial G_i^*}{\partial \tau_j^*} \frac{\partial \tau_j^*}{\partial G} \frac{\partial G}{\partial \tau_i} \right) d\tau_i$. Notice that $\frac{\partial G_i^*}{\partial \tau_i} - \frac{\partial G_i^*}{\partial \tau_j^*} \frac{\partial \tau_j^*}{\partial G} \frac{\partial G}{\partial \tau_i} > 0$

for all possible finite $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$. This is because $\frac{\partial G_i^*}{\partial \tau_i} - \frac{\partial G_i^*}{\partial \tau_j^*} \frac{\partial \tau_j^*}{\partial G} \frac{\partial G}{\partial \tau_i} = \frac{\Phi \phi_i^{-\sigma}}{\Phi_i} G_i^*$,

from the derivatives given above. Hence, there exist Pareto improving tariff changes

$(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$, $d\tau_j = d\tau_i^* = 0$, such that $dG_i^* < 0$ and $dG = dG_j^* = 0$ for all possible

finite $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$. These $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$ are such that $d\tau_i < 0$ and $d\tau_j^* < 0$ and

are thus feasible if and only if $\tau_i > 0$ and $\tau_j^* > 0$. Therefore, only $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ such that

$(\tau_1, \tau_2, \tau_1^*, \tau_2^*) =$ (any possible finite τ_1, any possible finite $\tau_2, 0, 0$) or $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) =$

$(0, 0,$ any possible finite τ_1^*, any possible finite τ_2^*) can be Pareto efficient among all

possible finite $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$. It is easy to verify that this conclusion extends beyond

all possible finite $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ so that only $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ such that $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) =$

(any possible τ_1, any possible $\tau_2, 0, 0$) or $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, 0,$ any possible τ_1^*, any possible τ_2^*)

can be Pareto efficient. It is also easy to verify that for none of these $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$

there exists another $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$, which makes one country better off without making at least one other country worse off. Therefore, they are also indeed Pareto efficient. ∎

5.2.7 Proof of lemma 6

Proof. By definition, $TB_{Mi}^* = \mu L p^{1-\sigma}\left(n_i^* \phi_i^{1-\sigma} G^{\sigma-1} - n\phi_i^{*1-\sigma} G_i^{*\sigma-1}\right)$ so that $\frac{TB_{Mi}^*}{\mu L} = \frac{n_i^* \phi_i^{1-\sigma}}{n+n_1^*\phi_1^{1-\sigma}+n_2^*\phi_2^{1-\sigma}} - \frac{n\phi_i^{*1-\sigma}}{n\phi_i^{*1-\sigma}+n_i^*}$. Also, $\frac{n_i^* qp}{\mu L} = \frac{n_i^* \phi_i^{1-\sigma}}{n+n_1^*\phi_1^{1-\sigma}+n_2^*\phi_2^{1-\sigma}} + \frac{n_i^*}{n\phi_i^{*1-\sigma}+n_i^*}$ from Foreign i' manufacturing market clearing condition. Hence, $n_i^* = \frac{\mu L}{qp} + \frac{TB_{Mi}^*}{qp}$, which implies that $dn_i^* = 0$ if and only if $dTB_{Mi}^* = 0$. Also, since $n + n_1^* + n_2^* = \frac{3\mu L}{qp}$, $dn = 0$ if $dn_1^* = dn_2^* = 0$.

Moreover, if $d\tau_j = d\tau_j^* = dn_i^* = 0$, $\frac{dn_j^*}{d\tau_i} = \dfrac{(\sigma-1)\phi_i^{-\sigma}\phi_j^{1-\sigma}n_i^*}{G^{2(1-\sigma)}\left[\frac{1-\phi_j^{*1-\sigma}}{G_j^{*2(1-\sigma)}} - \frac{\phi_j^{1-\sigma}\left(1-\phi_j^{1-\sigma}\right)}{G^{2(1-\sigma)}}\right]}$ from Foreign j's manufacturing market clearing condition. Also, $\frac{1-\phi_j^{*1-\sigma}}{G_j^{*2(1-\sigma)}} > \frac{\phi_j^{1-\sigma}\left(1-\phi_j^{1-\sigma}\right)}{G^{2(1-\sigma)}}$ for all possible $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ if and only if $\theta > \left(\frac{1}{2}\right)^{\frac{1}{1-\sigma}}$, which is true because $\theta > \left(\frac{1}{3}\right)^{\frac{1}{1-\sigma}}$ by assumption (c.f. the parameter restrictions imposed on the three-country model in appendix A1). ∎

5.2.8 Proof of proposition 4

Proof. Recall that $G = p\left[n + n_1^*\phi_1^{1-\sigma} + n_2^*\phi_2^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$, $G_1^* = p\left[n\phi_1^{*1-\sigma} + n_1^*\right]^{\frac{1}{1-\sigma}}$, and $G_2^* = p\left[n\phi_2^{*1-\sigma} + n_2^*\right]^{\frac{1}{1-\sigma}}$ from equations (31 - 33). Since multilaterally reciprocal tariff changes leave the number of firms unchanged in all countries, from lemma 6, multilaterally reciprocal trade liberalization (trade protection) therefore monotonically reduces (increases) all countries' price indices. Since bilaterally reciprocal trade liberalization between Home and Foreign i leaves the number of firms unchanged in Foreign i but increases the number of firms in Home at the expense of Foreign j, if $\tau_j < \infty$, from lemma 6, bilaterally reciprocal trade liberalization (trade protection) between Home and Foreign i therefore monotonically decreases (increases) the price indices of Home and Foreign i but monotonically increases (decreases) the price index of Foreign j, if

$\tau_j < \infty$. ∎

5.2.9 Bilateral versus multilateral trade liberalization

Consider first simultaneous multilaterally reciprocal trade negotiations between Home, Foreign 1, and Foreign 2. Home chooses (τ_1, τ_2) subject to $n = n_1^* = n_2^* = \frac{\mu L}{qp}$, $\tau_1, \tau_2, \tau_1^*, \tau_2^* \geq 0$, and manufacturing market clearing. Since $\tau_1 = \tau_2 = 0$, $n = n_1^* = n_2^* = \frac{\mu L}{qp}$, and manufacturing market clearing imply $\tau_1^* = \tau_2^* = \left(\frac{\theta^{1-\sigma}}{1+\theta^{1-\sigma}} \right)^{\frac{1}{1-\sigma}} - \theta > 0$, Home can choose $\tau_1 = \tau_2 = 0$. Since $G = p \left[n + n_1^* \phi_1^{1-\sigma} + n_2^* \phi_2^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$, Home also maximizes welfare by choosing $\tau_1 = \tau_2 = 0$. The outcome is then $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, 0, \text{some } \tau_1^* : \ 0 < \tau_1^* < \infty, \ \text{some } \tau_2^* : \ 0 < \tau_2^* < \infty)$, and $n = n_1^* = n_2^* = \frac{\mu L}{qp}$, as claimed in the main text. Consider second sequential bilaterally reciprocal trade negotiations first between Home and Foreign 1, and second between Home and Foreign 2. In its negotiations with Foreign 1, Home chooses τ_1 subject to $n_1^* = \frac{\mu L}{qp}$, $\tau_1, \tau_1^* \geq 0$, $\tau_2 = \tau_2^* = \infty$, and manufacturing market clearing. Since $\tau_1 = 0$, $n_1^* = \frac{\mu L}{qp}$, $\tau_2 = \tau_2^* = \infty$, and manufacturing market clearing imply $\tau_1^* = 0$, Home can choose $\tau_1 = 0$. The outcome is then $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, \infty, 0, \infty)$, and $n = n_1^* = n_2^* = \frac{\mu L}{qp}$, as claimed in the main text. In its subsequent negotiations with Foreign 2, Home chooses τ_2 subject to $n_2^* = \frac{\mu L}{qp}$, $\tau_1 = \tau_1^* = 0$, $\tau_2, \tau_2^* \geq 0$, and manufacturing market clearing. Since $\tau_2 = 0$, $n_2^* = \frac{\mu L}{qp}$, $\tau_1 = \tau_1^* = 0$, and manufacturing market clearing imply $\frac{\mu L}{qp} = n \left[1 + (\theta + \tau_2^*)^{1-\sigma} - \theta^{1-\sigma} \right]$, and $n > \frac{\mu L}{qp}$ from lemma 6, it must be that $\tau_2^* \geq 0$ so that Home can choose $\tau_2 = 0$. The outcome is then $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, 0, 0, \text{some } \tau_2^* : \ 0 < \tau_2^* < \infty)$, and $(n, n_1^*, n_2^*) = \left(\text{some } n : \frac{\mu L}{qp} < n, \ \text{some } n_1^* : 0 < n_1^* < \frac{\mu L}{qp}, \frac{\mu L}{qp} \right)$, as claimed in the main text.

5.3 Appendix A3: Robustness checks

5.3.1 Terms-of-trade effects/wage effects/outside good sector transport costs

A tariff generally has both a production relocation and a terms-of-trade effect in Krugman (1980) type environments. Venables (1987) considers a version of the Krugman

(1980) model, which isolates the production relocation effect. Gros (1987) considers a version of the Krugman (1987) model, which isolates the terms-of-trade effect. To see this, consider the labor market for Home's manufacturing workers. Labor demand is given by $L_D^M = nl$. Following the steps from section 2 without immediately imposing $w = w^* = 1$, it is easy to show that $n = \frac{\mu}{l} \left[\frac{L}{1 - \phi^{*1-\sigma} \left(\frac{w}{w^*} \right)^{-\sigma}} - \frac{\left(\frac{w}{w^*} \right)^{\sigma-1} L^*}{\phi^{\sigma-1} - \left(\frac{w}{w^*} \right)^{\sigma}} \right]$ so that $L_D^M = \frac{\mu L}{1 - \phi^{*1-\sigma} \left(\frac{w}{w^*} \right)^{-\sigma}} - \frac{\left(\frac{w}{w^*} \right)^{\sigma-1} \mu L^*}{\phi^{\sigma-1} - \left(\frac{w}{w^*} \right)^{\sigma}}$. Notice that this labor demand curve is decreasing in $\frac{w}{w^*}$. Labor supply depends on the nature of the outside good sector. If the outside goods produced by Home and Foreign are freely traded and homogeneous as in Venables (1987), the labor supply curve is horizontal since then $\frac{w}{w^*} = 1$. If there is no outside good at all as in Gros (1987), the labor supply curve is vertical since then $L_S^M = L$.[43] An intermediate case arises, for example, if the outside goods produced by Home and Foreign are freely traded but imperfect substitutes with a constant elasticity of substitution $\varepsilon > 1$. The demand for Home's outside good is then given by $Y + Y^* = \frac{(1-\mu)wL \left(p^Y \right)^{-\varepsilon}}{(p^Y)^{1-\varepsilon} + (p^{Y*})^{1-\varepsilon}} + \frac{(1-\mu)w^*L^* \left(p^Y \right)^{-\varepsilon}}{(p^Y)^{1-\varepsilon} + (p^{Y*})^{1-\varepsilon}}$, which can be rewritten as $Y + Y^* = \frac{(1-\mu)}{1 + \left(\frac{w}{w^*} \right)^{\varepsilon-1}} \left[L + \left(\frac{w}{w^*} \right)^{-1} L^* \right]$. The labor supply curve is then increasing in $\frac{w}{w^*}$ since $L_S^M = L - \frac{(1-\mu)}{1 + \left(\frac{w}{w^*} \right)^{\varepsilon-1}} \left[L + \left(\frac{w}{w^*} \right)^{-1} L^* \right]$. Consider now an increase in ϕ. Notice that this shifts the labor demand curve to the right while leaving all three labor supply curves unchanged. If the labor supply curve is horizontal, an increase in ϕ only leads to an increase in L^M while leaving $\frac{w}{w^*}$ unchanged. If the labor supply curve is vertical, an increase in ϕ only leads to an increase in $\frac{w}{w^*}$ while leaving L^M unchanged. If the labor supply curve is upward sloping, an increase in ϕ leads to an increase in $\frac{w}{w^*}$ and L^M. Since $\frac{w}{w^*} = \frac{p}{p^*}$ and $L^M = nl$, a change in $\frac{w}{w^*}$ reflects a terms-of-trade effect while a change in L^M reflects a production relocation effect. This is illustrated in figure 1.[44] Notice that the intermediate case also arises if there are equally large

---

[43] Of course, also $\mu = 1$ in this case.

[44] While this analysis illustrates that a tariff generally has production relocation and a terms-of-trade effect, it is too simple to shed light on optimal trade policy. This is because it abstracts from tariff revenue which is essential for the terms-of-trade case for protection. However, given that Home's government has an incentive to impose an import tariff if there is only a production relocation effect and

outside good sector 'iceberg' transport costs. The demand for Home's outside good is then given by $Y + \theta Y^* = \frac{(1-\mu)wL(p^Y)^{-\varepsilon}}{(p^Y)^{1-\varepsilon}+(\theta p^{Y*})^{1-\varepsilon}} + \frac{(1-\mu)w^*L^*\theta^{1-\varepsilon}(p^Y)^{-\varepsilon}}{(\theta p^Y)^{1-\varepsilon}+(p^{Y*})^{1-\varepsilon}}$, which can be rewritten as $Y + \theta Y^* = \frac{(1-\mu)L}{1+\theta^{1-\varepsilon}\left(\frac{w}{w^*}\right)^{\varepsilon-1}} + \frac{(1-\mu)L^*\theta^{1-\varepsilon}\left(\frac{w}{w^*}\right)^{-1}}{\theta^{1-\varepsilon}+\left(\frac{w}{w^*}\right)^{\varepsilon-1}}$. The labor supply curve is then increasing in $\frac{w}{w^*}$ since $L_S^M = L - \frac{(1-\mu)L}{1+\theta^{1-\varepsilon}\left(\frac{w}{w^*}\right)^{\varepsilon-1}} - \frac{(1-\mu)L^*\theta^{1-\varepsilon}\left(\frac{w}{w^*}\right)^{-1}}{\theta^{1-\varepsilon}+\left(\frac{w}{w^*}\right)^{\varepsilon-1}}$. Hence, allowing for differentiated outside good production is one way of generating a production relocation effect even in the presence of equally large outside good sector 'iceberg' transport costs. Other ways are discussed in detail in Krugman and Venables (1999).

5.3.2   Endogenous mark-ups and heterogeneous firms

While the argument can be made most cleanly in the context of the simple Krugman (1980) model, it generalizes to far more complicated environments. For example, the main results can also be derived in the Melitz and Ottaviano (2008) model, featuring variable instead of constant mark-ups, variable instead of constant expenditure shares, and heterogeneous instead of homogeneous firms. To see this, consider the open economy version of the Melitz and Ottaviano (2008) model in its original notation. Just like before, decompose iceberg trade costs τ^l into transport costs θ and tariffs t^l so that $\tau^l = \theta + t^l$, where $\theta > 1$ and $t^l > 0$. All results from the basic model except lemma 3 then apply verbatim with obvious notational changes:[45]

Proof of lemma 1 in Melitz and Ottaviano (2008).   Given the form of U^H, U^H is maximized when c_D^H is minimized. Also, $\frac{\partial c_D^H}{\partial t^H} = -\frac{k}{k+2}\frac{(\tau^H)^{-k-1}(\tau^F)^{-k}}{1-(\tau^H\tau^F)^{-k}}c_D^H$ so that c_D^H is monotonically decreasing in t^H for all $t^F \in [0,\infty)$ and constant in t^H for $t^F = \infty$. Hence, Home maximizes U^H by choosing $t^H = \infty$ if $t^F \in [0,\infty)$ and any possible t^H if $t^F = \infty$. Similarly, Foreign maximizes U^F by choosing $t^F = \infty$ if $t^H \in [0,\infty)$ and any possible

---

if there is only a terms-of-trade effect, one should expect that Home's government also has an incentive to impose an import tariff if there is both a production relocation and a terms-of-trade effect. I have numerically analyzed a version of the above model featuring tariff revenue and the results suggest that this is indeed the case.

[45]For simplicity, I focus on the results of the basic model only. However, the results of the three-country model should generalize accordingly.

t^F if $\tau = \infty$. Thus, the set of Nash equilibrium tariffs consists of all $\left(t^H, t^F\right)$ such that either $\left(t^H, t^F\right) = \left(\infty, \text{ any possible } t^F\right)$ or $\left(t^H, t^F\right) = \left(\text{any possible } t^H, \ \infty\right)$. However, if the governments' strategies are subject to small perturbations, Home's (Foreign's) best response is always to choose $t^H = \infty$ ($t^F = \infty$). Therefore, $\left(t^H, t^F\right) = (\infty, \infty)$ is the unique trembling-hand perfect Nash equilibrium. ∎

Proof of lemma 2 in Melitz and Ottaviano (2008). A tariff combination $\left(t^H, t^F\right)$ cannot be Pareto efficient if there exist feasible Pareto improving tariff changes $\left(dt^H, dt^F\right)$ at $\left(t^H, t^F\right)$. This includes tariff changes $\left(dt^H, dt^F\right)$ such that $dc_D^F < 0$ and $dc_D^H = 0$. From total differentiation, $dc_D^H = \frac{\partial c_D^H}{\partial t^H} dt^H + \frac{\partial c_D^H}{\partial t^F} dt^F$ and $dc_D^F = \frac{\partial c_D^F}{\partial t^H} dt^H + \frac{\partial c_D^F}{\partial t^F} dt^F$. Therefore, $dc_D^H = 0$ if $dt^H = -\frac{\partial t^H}{\partial c_D^H} \frac{\partial c_D^H}{\partial t^F} dt^F$ so that $dc_D^F = \left(\frac{\partial c_D^F}{\partial t^F} - \frac{\partial c_D^F}{\partial t^H} \frac{\partial t^H}{\partial c_D^H} \frac{\partial c_D^H}{\partial t^F} \right) dt^F$ along $dc_D^H = 0$. Notice that $\frac{\partial c_D^F}{\partial t^F} - \frac{\partial c_D^F}{\partial t^H} \frac{\partial t^H}{\partial c_D^H} \frac{\partial c_D^H}{\partial t^F} > 0$ for all possible finite $\left(t^H, t^F\right)$. This is because $\frac{\partial c_D^H}{\partial t^H} = -\frac{k}{k+2} \frac{\left(\tau^H\right)^{-k-1}\left(\tau^F\right)^{-k}}{1-\left(\tau^H \tau^F\right)^{-k}} c_D^H$, $\frac{\partial c_D^H}{\partial t^F} = \frac{k}{k+2} \frac{\left(\tau^F\right)^{-k-1}}{1-\left(\tau^H \tau^F\right)^{-k}} \frac{1-\left(\tau^H\right)^{-k}}{1-\left(\tau^F\right)^{-k}} c_D^H$, $\frac{\partial c_D^F}{\partial t^H} = \frac{k}{k+2} \frac{\left(\tau^H\right)^{-k-1}}{1-\left(\tau^H \tau^F\right)^{-k}} \frac{1-\left(\tau^F\right)^{-k}}{1-\left(\tau^H\right)^{-k}} c_D^F$, and $\frac{\partial c_D^F}{\partial t^F} = -\frac{k}{k+2} \frac{\left(\tau^F\right)^{-k-1}\left(\tau^H\right)^{-k}}{1-\left(\tau^H \tau^F\right)^{-k}} c_D^F$ so that $\frac{\partial c_D^F}{\partial t^F} - \frac{\partial c_D^F}{\partial t^H} \frac{\partial t^H}{\partial c_D^H} \frac{\partial c_D^H}{\partial t^F} = \frac{k}{k+2} \frac{c_D^F}{\tau^F}$. Hence, there exist Pareto improving tariff changes $\left(dt^H, dt^F\right)$ for all possible finite $\left(t^H, t^F\right)$. These $\left(dt^H, dt^F\right)$ are such that $dt^H < 0$ and $dt^F < 0$ and are thus feasible if and only if $t^H > 0$ and $t^F > 0$. Therefore, only $\left(t^H, t^F\right)$ such that $\left(t^H, t^F\right) = \left(\text{any possible finite } t^H, 0\right)$ or $\left(t^H, t^F\right) = \left(0, \text{ any possible finite } t^F\right)$ can be Pareto efficient among all possible finite $\left(t^H, t^F\right)$. It is easy to verify that this conclusion extends beyond all finite $\left(t^H, t^F\right)$ so that only $\left(t^H, t^F\right)$ such that $\left(t^H, t^F\right) = \left(\text{any possible } t^H, 0\right)$ or $\left(t^H, t^F\right) = \left(0, \text{ any possible } t^F\right)$ can be Pareto efficient. It is also easy to verify that for none of these $\left(t^H, t^F\right)$ there exists another $\left(t^H, t^F\right)$, which makes one country better off without making the other country worse off. Therefore, they are also indeed Pareto efficient. ∎

Proof of proposition 1 in Melitz and Ottaviano (2008). Follows immediately from lemmas 1 and 2. ∎

Proof of proposition 2 in Melitz and Ottaviano (2008). Home's manufacturing exports are given by $EXP_M = \int_0^{c_x^H} p_x^H \left(c\right) q_x^H \left(c\right) dG \left(c\right)$ and Home's manufacturing

imports are given by $IMP_M = \int_0^{c_x^F} p_x^F(c) q_x^F(c) dG(c)$. Therefore, Home's manufacturing trade balance is given by $TB_M^H = \int_0^{c_x^H} p_x^H(c) q_x^H(c) dG(c) - \int_0^{c_x^F} p_x^F(c) q_x^F(c) dG(c) = (k+1) f_E \left[\frac{(\tau^F)^{-k} - (\tau^H)^{-k}}{1-(\tau^H \tau^F)^{-k}} \right]$. Thus, $dt^F = \frac{(\tau^H)^{-k-1} \left[1-(\tau^F)^{-2k} \right]}{(\tau^F)^{-k-1} \left[1-(\tau^H)^{-2k} \right]} dt^H > 0$ along $dTB_M = 0$ so that $dc_D^H = \frac{k(\tau^H)^{-k-1}}{k+2} \frac{\left[1-(\tau^H)^{-k} - (\tau^F)^{-k} + (\tau^H \tau^F)^{-k} \right]}{\left[1-(\tau^H)^{-2k} \right]\left[1-(\tau^F)^{-k} \right]} c_D^H dt^H > 0$ along $dTB_M = 0$. Similarly, $dc_D^F = \frac{k(\tau^F)^{-k-1}}{k+2} \left[\frac{1-(\tau^H)^{-k} - (\tau^F)^{-k} + (\tau^H \tau^F)^{-k}}{\left[1-(\tau^H)^{-k} \right]\left[1-(\tau^F)^{-2k} \right]} \right] c_D^F dt^F > 0$ along $dTB_M = 0$. ∎

Lemma 3 does not apply verbatim since the world number of manufacturing firms is not independent of trade policy in Melitz and Ottaviano (2008) (c.f. footnote 32 above). However, the principle of reciprocity still prevents production relocations by ruling out changes in the manufacturing trade balance, which shift expenditure away from one country's manufacturing sector towards the other country's manufacturing sector.

5.3.3   Tariff revenue

Besides restricting tariffs to be nonnegative, abstracting from tariff revenue does not appear to affect the analysis in any major way. In particular, numerical analysis suggests that even in the presence of tariff revenue governments have an incentive to impose import tariffs, the non-cooperative equilibrium is inefficient, and reciprocity ensures that governments gain monotonically during trade liberalization. This should also be expected since tariff revenue merely adds an additional motivation for protection. Even with tariff revenue, tariffs continue to entail an international production relocation externality which can be internalized in reciprocal trade negotiations. To see this, consider a version of the basic model in which tariffs are not part of the iceberg trade costs but instead generate revenue, which is distributed lump-sum to consumers.[46] For simplicity, also replace (1) and (2) with $U = \frac{A\varepsilon}{\varepsilon-1} \left[\int_0^{n+n^*} m(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{(\varepsilon-1)\sigma}{(\sigma-1)\varepsilon}} + Y$ and $U^* = \frac{A\varepsilon}{\varepsilon-1} \left[\int_0^{n+n^*} m^*(j)^{\frac{\sigma-1}{\sigma}} dj \right]^{\frac{(\varepsilon-1)\sigma}{(\sigma-1)\varepsilon}} + Y^*$, $\sigma > \varepsilon > 1$. This modification does not restore the model's tractability but permits to solve for tariff revenue explicitly since

---

[46]For simplicity, I focus on the results of the basic model only. However, the results of the three-country model should generalize accordingly.

tariff revenue then affects outside good consumption only.[47] Defining $B \equiv A^\varepsilon$, the demands for each manufacturing good are then given by $m(i) + \theta m^*(i) = Bp^{-\sigma}G^{\sigma-\varepsilon} + B\theta^{1-\sigma}p^{-\sigma}(1+\tau^*)^{-\sigma}G^{*\sigma-\varepsilon}$ and $\theta m(j) + m^*(j) = B\theta^{1-\sigma}p^{-\sigma}(1+\tau)^{-\sigma}G^{\sigma-\varepsilon} + Bp^{-\sigma}G^{*\sigma-\varepsilon}$ so that manufacturing firms charge $p(j) = p^*(j) = \frac{\sigma c}{\sigma-1} \equiv p$. Free entry drives manufacturing firms' profits down to zero leading to break-even outputs $q = q^* = \frac{f(\sigma-1)}{c}$ and hence break-even labor demands $l = l^* = f\sigma$. Manufacturing market clearing thus requires $q = Bp^{-\sigma}G^{\sigma-\varepsilon} + B\theta^{1-\sigma}p^{-\sigma}(1+\tau^*)^{-\sigma}G^{*\sigma-\varepsilon}$ and $q = B\theta^{1-\sigma}p^{-\sigma}(1+\tau)^{-\sigma}G^{\sigma-\varepsilon} + Bp^{-\sigma}G^{*\sigma-\varepsilon}$. These conditions can be solved for the equilibrium price indices $G = \left[\frac{qp^\sigma\left[1-\theta^{1-\sigma}(1+\tau^*)^{-\sigma}\right]}{B\left[1-\theta^{2(1-\sigma)}(1+\tau)^{-\sigma}(1+\tau^*)^{-\sigma}\right]}\right]^{\frac{1}{\sigma-\varepsilon}}$ and $G^* = \left[\frac{qp^\sigma\left[1-\theta^{1-\sigma}(1+\tau)^{-\sigma}\right]}{B\left[1-\theta^{2(1-\sigma)}(1+\tau)^{-\sigma}(1+\tau^*)^{-\sigma}\right]}\right]^{\frac{1}{\sigma-\varepsilon}}$. These equilibrium price indices determine the equilibrium numbers of manufacturing firms $n = \frac{G^{1-\sigma}-\theta^{1-\sigma}(1+\tau)^{1-\sigma}G^{*1-\sigma}}{p^{1-\sigma}\left[1-\theta^{2(1-\sigma)}(1+\tau)^{1-\sigma}(1+\tau^*)^{1-\sigma}\right]}$ and $n^* = \frac{G^{*1-\sigma}-\theta^{1-\sigma}(1+\tau^*)^{1-\sigma}G^{1-\sigma}}{p^{1-\sigma}\left[1-\theta^{2(1-\sigma)}(1+\tau)^{1-\sigma}(1+\tau^*)^{1-\sigma}\right]}$. Tariff revenues and indirect utility functions are given by $TR = \tau B(p\theta)^{1-\sigma}(1+\tau)^{-\sigma}G^{\sigma-\varepsilon}n^*$, $TR^* = \tau^* B(p\theta)^{1-\sigma}(1+\tau^*)^{-\sigma}G^{*\sigma-\varepsilon}n$, $V = \frac{B}{\varepsilon-1}G^{1-\varepsilon}+L+TR$, and $V^* = \frac{B}{\varepsilon-1}G^{*1-\varepsilon}+L^*+TR^*$. Notice that the expressions for V and V^* become very complicated once n, n^*, G, and G^* are substituted so that it seems impossible to analytically characterize optimal trade policy, efficient tariffs, and reciprocal tariff changes. Figure 2 plots how V and $V - TR$ vary with τ for $\tau^* = 0$. This figure shows that Home's government still has an incentive to impose import tariffs. However, there is now an interior optimal tariff since Home's tariff revenue first grows and then falls with Home's tariff. Figure 3 depicts the noncooperative equilibrium by plotting Home's optimal tariff as a function of Foreign's tariff and vice versa. Figure 4 plots the welfare effects of tariff cuts, which, starting at the noncooperative equilibrium, leave the trade balance unchanged. Figures 3 and 4 together demonstrate that the noncooperative equilibrium is still inefficient and that governments still gain monotonically from a reciprocal reduction in import tariffs. All figures are drawn for $\theta = 2$, $c = f = 1$, $L = L^* = 50$, $\sigma = 3$, $\varepsilon = 2$, and $A = 1$ but look

---

[47]The main complication is to compute imports. With utility functions (1) and (2), Home's imports depend on Home's and Foreign's incomes, which depend on Home's and Foreign's tariff revenues and vice versa, all in a way ruling out closed-form solutions.
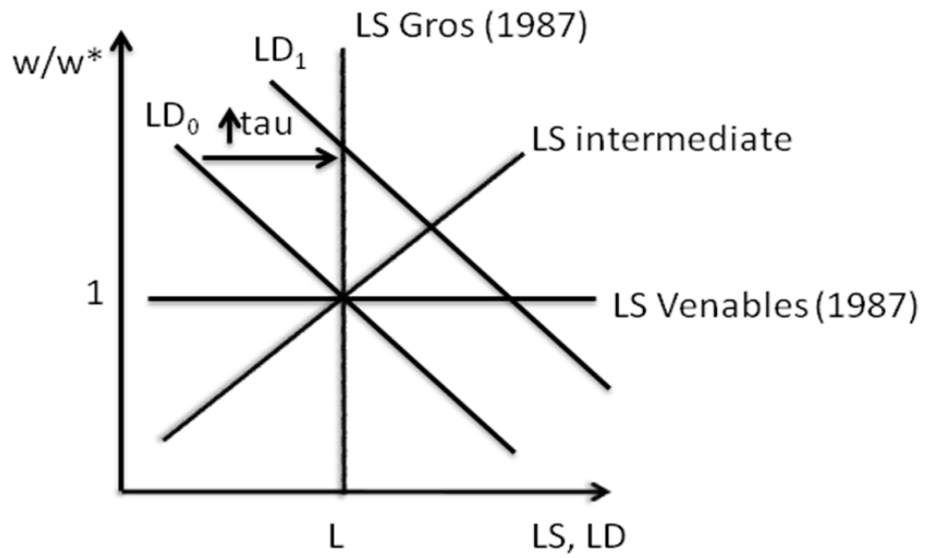
similar for other parameter values.

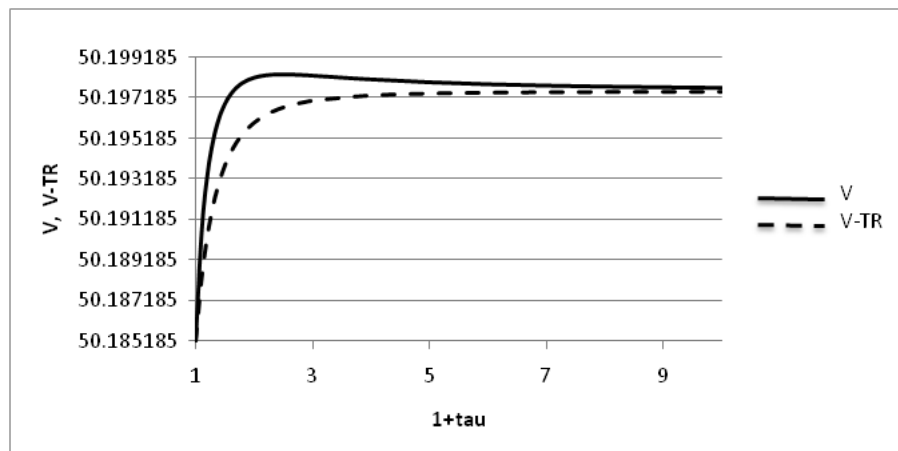Figure 1: Production relocation and terms-of-trade effects

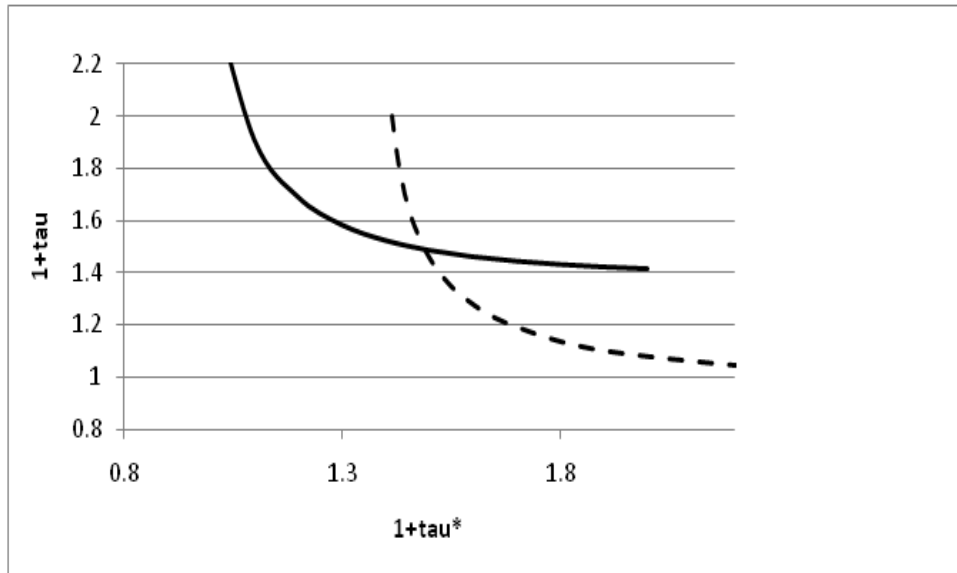Figure 2: Optimal tariff with tariff revenue
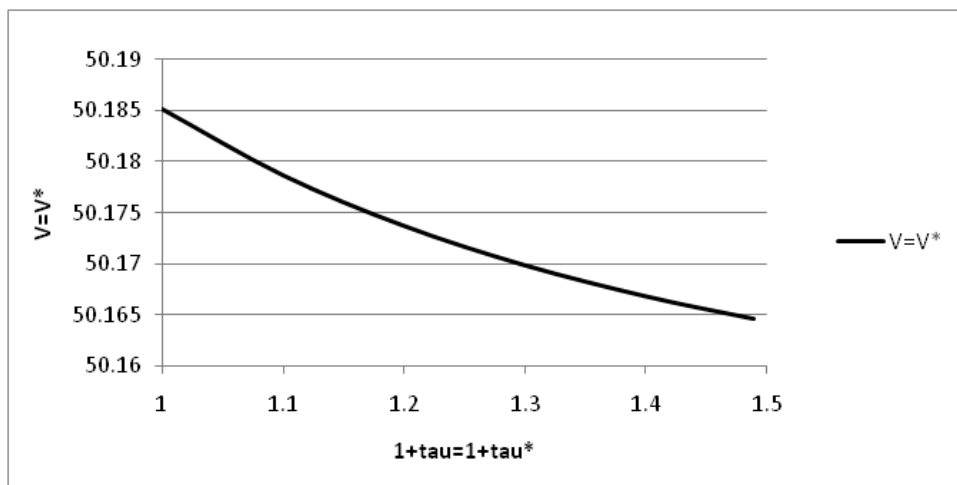
Figure 3: Non-cooperative equilibrium with tariff revenue

Figure 4: Reciprocal trade liberalization with tariff revenue