

# A ‘New Trade’ Theory of GATT/WTO Negotiations\*

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## 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.

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# 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).<sup>1</sup> 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.<sup>2</sup>

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:<sup>3</sup> 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

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<sup>1</sup>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.

<sup>2</sup>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.

<sup>3</sup>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.<sup>4</sup> 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.<sup>5</sup>

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. This allows me to make two main contributions. First, my ‘new trade’ theory 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 monop-

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<sup>4</sup>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.

<sup>5</sup>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).

olistic competition and is the leading explanation of trade in similar goods between similar countries.<sup>6</sup> 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".<sup>7</sup> Be that as it may, I do not aim to disprove the importance of terms-of-trade effects.<sup>8</sup> 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

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<sup>6</sup>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.

<sup>7</sup>See Ethier (2002) and Regan (2006) for more examples.

<sup>8</sup>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.

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 all trade policy externalities. This is because, under these principles, tariff-induced changes in domestic consumer expenditure towards or away from domestic manufacturing goods are exactly offset by changes in foreign consumer expenditure away from or towards these goods so that tariff changes then leave the number of manufacturing firms constant in all countries. By neutralizing all trade policy externalities, 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).<sup>9</sup> 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 Helpman and Krugman (1989) in developing a version of the Krugman (1980) model which does not feature terms-of-trade effects.<sup>10</sup>

I develop my ‘new trade’ theory in the remainder of this paper. In the next section, I introduce the basic two-country model and use this model to establish that the noncooperative equilibrium is inefficient. I also demonstrate how trade negotiations governed by the principle of reciprocity help countries overcome this inefficiency in a way which monotonically increases welfare in both countries. In the third section, I then develop a three-country extension of this basic model and use this extended model to show that the principle of reciprocity alone is now no longer sufficient to help countries overcome the inefficient equilibrium in a way which monotonically improves welfare in all countries. I also demonstrate that, if the principle of reciprocity is augmented

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<sup>9</sup>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).

<sup>10</sup>Venables (1987) considers a version of the Krugman (1980) model which does not feature terms-of-trade effects. He studies unilateral trade policy only. Gros (1987) considers a version of the Krugman (1980) model which features only terms-of-trade effects. Besides studying unilateral trade policy he also characterizes the noncooperative trade policy equilibrium. Neither Venables (1987) nor Gros (1987) consider trade negotiations.

with the principle of nondiscrimination, they then together serve this purpose. In the fourth section, I explore whether preferential trade agreements which are allowed under GATT/WTO regulations as an exception to the principle of nondiscrimination undermine the functioning of multilateral GATT/WTO negotiations. In the final section, I then conclude.

## 2 Basic model

### 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’. Preferences over these goods are identical in both countries. They are given by the following utility functions

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

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

where  $m(i)$  denotes consumption of a differentiated manufacturing good,  $Y$  denotes consumption of the homogeneous outside good,  $n$  is the ‘number’ of manufacturing goods produced,  $\sigma$  is the elasticity of substitution between manufacturing goods, and  $\mu$  is the share of income spent on manufacturing goods. Technologies are also identical in both countries. They are summarized by the following (inverse) production functions

$$l^M = f + cq^M \quad (3)$$

$$l^{*M} = f + cq^{*M} \quad (4)$$

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

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

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 fixed labor requirement of manufacturing production, and  $c$  denotes the marginal labor requirement of manufacturing production. 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.<sup>11</sup> In particular, for one unit of a manufacturing good to arrive in the other country,  $\phi$  units must be shipped and the remainder ‘melts away’ in transit. These iceberg trade costs  $\phi$  are further decomposed into transport costs  $\theta$ , which are identical across countries, and trade barriers  $\tau$ , which may be different across countries. These trade barriers are policy instruments and the key variables of the analysis. For concreteness, I refer to them as tariffs in the following but they can really reflect any policy-induced impediment to trade.<sup>12</sup> I also restrict  $\tau < \bar{\tau}$ , where  $\bar{\tau}$  is some arbitrarily large but finite upper bound. This finite upper bound is purely introduced for technical convenience. Removing it would somewhat complicate the exposition without changing the results in any interesting way (see appendix A1 for a detailed discussion of this). Hence,

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

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<sup>11</sup>As will become clear shortly, the price index effect on which I build my ‘new trade’ theory of GATT/WTO negotiations 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. 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.

<sup>12</sup>One particularity of tariffs relative to other trade barriers is that they generate tariff revenue. I abstract from tariff revenue by considering ‘iceberg’ trade barriers which is essential for the model’s tractability.

$$\phi^* = \theta + \tau^*, \quad \theta > 1, \bar{\tau} \geq \tau^* \geq 0 \quad (8)$$

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 (see appendix A2 for the precise parameter restriction on  $\theta$ ). 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 (see again appendix A2 for the precise parameter restriction on  $\mu$ ). The former assumption ensures that countries can never attract all manufacturing firms through trade policy and thereby eliminates uninteresting corner solutions. The latter assumption 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  $w$  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

$$Y = (1 - \mu) L \quad (9)$$

$$Y^* = (1 - \mu) L^* \quad (10)$$

and the following demands for each manufacturing good

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

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

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

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

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

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

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

which implies that the price indices simplify to

$$G = p [n + n^* \phi^{1-\sigma}]^{\frac{1}{1-\sigma}} \quad (16)$$

$$G^* = p [n \phi^{*1-\sigma} + n^*]^{\frac{1}{1-\sigma}} \quad (17)$$

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

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

and hence the following break-even labor demands

$$l = l^* = f\sigma \quad (19)$$

Manufacturing market clearing thus requires

$$q = \mu L \frac{p^{-\sigma}}{G^{1-\sigma}} + \mu L^* \frac{\phi^{*1-\sigma} p^{-\sigma}}{G^{*1-\sigma}} \quad (20)$$

$$q = \mu L \frac{\phi^{1-\sigma} p^{-\sigma}}{G^{1-\sigma}} + \mu L^* \frac{p^{-\sigma}}{G^{*1-\sigma}} \quad (21)$$

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

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

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

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

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

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

Notice that this implies that the world number of manufacturing firms is always constant and given by<sup>13</sup>

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

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

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

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<sup>13</sup>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 analysis but serves to cleanly illustrate the tariff-induced production relocation effect which underlies this ‘new trade’ theory of GATT/WTO negotiations.

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

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.<sup>14</sup> This completes the derivation of the basic model.

### 2.3 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. In the following, I characterize the noncooperative equilibrium in two steps: first, I show that the noncooperative equilibrium involves maximum protection. Second, I demonstrate that the noncooperative equilibrium is inefficient.

Thus, notice first that the noncooperative equilibrium involves maximum protection since each government always has an incentive to increase its tariff. This is because each country's price index is always decreasing in its own tariff, as can be seen from equations (22) and (23). Underlying this are two opposing effects of the own tariff on the own price index. In the following, I refer to these effects as import price effect and production relocation effect, respectively. On the one hand, an own tariff simply makes imported goods more expensive thereby increasing the own price index. On the other hand, an own tariff leads to a relocation of manufacturing production from the foreign manufacturing sector towards the domestic manufacturing sector thereby reducing the domestic price index since a smaller number of products consumed domestically are now subject to trade costs. This relocation occurs because an increase in the own tariff makes the own country a more and the other country a less attractive business location

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<sup>14</sup>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.

for manufacturing firms. In particular, a unilateral increase in the own tariff implies that manufacturing goods imported from the other country become more expensive relative to domestic manufacturing goods 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 the foreign manufacturing sector so that more of the world's manufacturing goods are produced by domestic firms.<sup>15</sup> In equilibrium, the production relocation effect dominates the import price effect because firms have to make zero profits due to free entry. Essentially, a country's increased attractiveness as a business location for manufacturing firms eventually needs to be counterbalanced by increased domestic competition, i.e. a lower domestic price index. To see this more clearly, 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 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 which makes it harder for Home firms to sell goods at Home but easier for Home firms to sell goods at Foreign. Notice that therefore Home's post-tariff equilibrium price index must be below its pre-tariff level. If it merely returned to its pre-tariff level, Home firms could still export more than before and would therefore make positive profits. This

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<sup>15</sup>Without the 'outside good', manufacturing labor supply would be inelastic so that there could be no entry into the domestic manufacturing sector and exit out of the foreign manufacturing sector to restore equilibrium. Instead, the domestic wage would increase relative to the foreign wage which would imply an improvement in the domestic country's terms-of-trade, just as in the neoclassical trade model. See Gros (1987) for more on this.

finding is summarized in proposition 1.<sup>16 17</sup>

**Proposition 1** *Suppose governments choose tariffs simultaneously, Home maximizing  $V$  and Foreign maximizing  $V^*$ . Then the unique Nash equilibrium tariff combination is  $(\tau, \tau^*) = (\bar{\tau}, \bar{\tau})$ .*

**Proof.** See appendix A3. ■

Observe second that this noncooperative equilibrium is inefficient since both governments try to gain at the expense of one another. Essentially, if both governments impose import tariffs in an attempt to host more of the world's manufacturing firms, no government actually succeeds and tariffs only push up import prices in both countries. This is established more formally in the second proposition. This proposition also describes more generally which tariff combinations are efficient which will be useful later in the analysis:

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

**Proof.** See appendix A3. ■

**Corollary 1** *The trade war equilibrium tariffs  $(\tau, \tau^*) = (\bar{\tau}, \bar{\tau})$  are inefficient.*

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<sup>16</sup>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. While it can be illustrated most cleanly in the simple setup developed here, it also arises in more complicated environments. Melitz and Ottaviano (2008), for example, identify it in a model with endogenous markups and heterogeneous firms.

<sup>17</sup>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  $G_{\text{exp}}$  as a world price index of Home's manufacturing exports and  $G_{\text{imp}}$  as a world price index of Home's manufacturing imports, where  $G_{\text{exp}}^{1-\sigma} = p^{1-\sigma}n$  and  $G_{\text{imp}}^{1-\sigma} = p^{1-\sigma}n^*$ . In terms of these world price indices, Home's terms-of-trade are then given by  $\frac{G_{\text{exp}}}{G_{\text{imp}}} = \left(\frac{n}{n^*}\right)^{\frac{1}{1-\sigma}}$ . 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.

Intuitively, Pareto improvements can only be achieved through bilateral tariff reductions. This is because a unilateral tariff cut reduces the welfare of the liberalizing country due to 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.

## **2.4 Trade policy under the GATT/WTO: the principle of reciprocity**

Consider now trade policy, if tariffs are set cooperatively 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.<sup>18</sup>

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. I develop the argument in three

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<sup>18</sup>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 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).

steps: first, I show that reciprocity prevents production relocations between countries and thereby neutralizes the production relocation effect. Second, I demonstrate that, as one consequence, reciprocity ensures that negotiated tariff concessions increase both countries' welfare monotonically. Third, I prove that, as another consequence, reciprocity secures all negotiated tariff concessions by guaranteeing that no country has an incentive to reverse them. Following the above discussion, I adopt the following formal definition of reciprocity:

**Definition 1** *Define a tariff change  $(d\tau, d\tau^*)$  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).*

Thus, 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:<sup>19</sup>

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

The numerator is just the total expenditure on Home manufacturing goods by Home and Foreign consumers, since this can be decomposed into the total expenditure on Home and Foreign manufacturing goods by Home consumers ( $\mu L$ ), plus the total expenditure on Home manufacturing goods by Foreign consumers ( $EXP_M$ ), minus the total expenditure on Foreign manufacturing goods by Home consumers ( $IMP_M$ ). The denominator is just the (constant) sales of Home 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 consumer expenditure towards or away from Home manufacturing goods are then exactly offset by tariff-

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<sup>19</sup>For details see the proof of proposition 3.

induced changes in Foreign consumer expenditure away from or towards these goods.<sup>20</sup>

This finding is summarized in proposition 3:

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

**Proof.** See appendix A3. ■

Observe second that reciprocal tariff concessions therefore increase both countries' welfare monotonically. 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 normally dominates the import price effect so that a country's price index is actually 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 becomes increasing in its own tariff. This result is summarized in proposition 4:

**Proposition 4** *Reciprocal trade liberalization monotonically increases welfare in both countries.*

**Proof.** See appendix A3. ■

Notice third that, by the same token, the principle of reciprocity also secures all negotiated tariff concessions by guaranteeing that no country has an incentive to reverse them. If a country responds reciprocally to any tariff increase of the other country, then

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<sup>20</sup>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).

the other country no longer has an incentive to increase its tariff since such an increase would only inflate its price index due to the import price effect. This is further illustrated in proposition 5:

**Proposition 5** *Suppose tariffs are set in the following two-stage game: in the first stage, governments choose tariffs cooperatively according to some bargaining protocol. In the second stage, Home gets the opportunity to deviate from the cooperative outcome by increasing its tariff unilaterally. However, Foreign responds reciprocally to any unilateral tariff increase by Home. Then, Home never deviates from the cooperative agreement in the second stage.*

**Proof.** See appendix A3. ■

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 both 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 proposition 2.

### 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. Everything else is just as in the basic model. The notation is a straightforward generalization of the one used before. For example,  $\tau_1$  is now the tariff imposed by Home against imports from Foreign 1,  $\tau_2^*$  is now the tariff imposed by Foreign 2 against imports from Home, and  $G_1^*$  is the manufacturing price index of Foreign 1.

### 3.2 No trade policy

The derivation of the equilibrium proceeds exactly as before and is thus not repeated here in detail. Instead, I focus only on its key steps and present only the model's key relationships. As before, all firms charge  $\frac{\sigma c}{\sigma-1} \equiv p$  in equilibrium and the price indices can be written as

$$G = p [n + n_1^* \phi_1^{1-\sigma} + n_2^* \phi_2^{1-\sigma}]^{\frac{1}{1-\sigma}} \quad (30)$$

$$G_1^* = p [n \phi_1^{*1-\sigma} + n_1^*]^{\frac{1}{1-\sigma}} \quad (31)$$

$$G_2^* = p [n \phi_2^{*1-\sigma} + n_2^*]^{\frac{1}{1-\sigma}} \quad (32)$$

Manufacturing market clearing requires

$$q = \mu L \frac{p^{-\sigma}}{G^{1-\sigma}} + \mu L_1^* \phi_1^{*1-\sigma} \frac{p^{-\sigma}}{G_1^{*1-\sigma}} + \mu L_2^* \phi_2^{*1-\sigma} \frac{p^{-\sigma}}{G_2^{*1-\sigma}} \quad (33)$$

$$q = \mu L \phi_1^{1-\sigma} \frac{p^{-\sigma}}{G^{1-\sigma}} + \mu L_1^* \frac{p^{-\sigma}}{G_1^{*1-\sigma}} \quad (34)$$

$$q = \mu L \phi_2^{1-\sigma} \frac{p^{-\sigma}}{G^{1-\sigma}} + \mu L_2^* \frac{p^{-\sigma}}{G_2^{*1-\sigma}} \quad (35)$$

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

$$G = \left[ \frac{qp^\sigma \Phi}{\mu L \Omega} \right]^{\frac{1}{\sigma-1}} \quad (36)$$

$$G_1^* = \left[ \frac{qp^\sigma \Phi_1}{\mu L_1^* \Omega} \right]^{\frac{1}{\sigma-1}} \quad (37)$$

$$G_2^* = \left[ \frac{qp^\sigma \Phi_2}{\mu L_2^* \Omega} \right]^{\frac{1}{\sigma-1}} \quad (38)$$

where

$$\Phi \equiv 1 - \phi_1^{*1-\sigma} - \phi_2^{*1-\sigma} \quad (39)$$

$$\Phi_1 \equiv 1 - \phi_1^{1-\sigma} - \phi_2^{*1-\sigma} (\phi_2^{1-\sigma} - \phi_1^{1-\sigma}) \quad (40)$$

$$\Phi_2 \equiv 1 - \phi_2^{1-\sigma} - \phi_1^{*1-\sigma} (\phi_1^{1-\sigma} - \phi_2^{1-\sigma}) \quad (41)$$

$$\Omega \equiv 1 - (\phi_1 \phi_1^*)^{1-\sigma} - (\phi_2 \phi_2^*)^{1-\sigma} \quad (42)$$

It is easy to verify that  $\Phi, \Phi_1, \Phi_2, \Omega > 0$ .<sup>21</sup> These price indices can then be solved for the equilibrium numbers of manufacturing firms

$$n = \frac{\mu}{qp} \left[ \frac{L}{\Phi} - \frac{L_1^* \phi_1^{1-\sigma}}{\Phi_1} - \frac{L_2^* \phi_2^{1-\sigma}}{\Phi_2} \right] \quad (43)$$

$$n_1^* = \frac{\mu}{qp} \left[ \frac{L_1^* \left[ 1 - (\phi_2 \phi_2^*)^{1-\sigma} \right]}{\Phi_1} + \frac{L_2^* (\phi_1^* \phi_2)^{1-\sigma}}{\Phi_2} - \frac{L \phi_1^{*1-\sigma}}{\Phi} \right] \quad (44)$$

$$n_2^* = \frac{\mu}{qp} \left[ \frac{L_2^* \left[ 1 - (\phi_1 \phi_1^*)^{1-\sigma} \right]}{\Phi_2} + \frac{L_1^* (\phi_1 \phi_2^*)^{1-\sigma}}{\Phi_1} - \frac{L \phi_2^{*1-\sigma}}{\Phi} \right] \quad (45)$$

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<sup>21</sup>This follows from the parameter restriction on  $\theta$  needed to ensure that the manufacturing sector is always active in all countries. See appendix A2 for this parameter restriction.

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

$$n + n_1^* + n_2^* = \frac{\mu(L + L_1^* + L_2^*)}{qp} \quad (46)$$

### 3.3 Noncooperative trade policy

Consider now again trade policy if tariffs are set noncooperatively. Propositions 1 and 2 naturally generalize to the three-country model. As in proposition 1, all governments choose maximum protection in the noncooperative equilibrium:

**Proposition 6** *Suppose governments choose tariffs simultaneously, Home maximizing  $V$ , Foreign 1 maximizing  $V_1^*$ , and Foreign 2 maximizing  $V_2^*$ . Then the unique Nash equilibrium tariff combination is  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (\bar{\tau}, \bar{\tau}, \bar{\tau}, \bar{\tau})$ .*

**Proof.** See appendix A3. ■

As in proposition 2, this noncooperative equilibrium is inefficient:

**Proposition 7** *The set of Pareto-efficient tariff combinations consists of all  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$  such that  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (\text{any possible } \tau_1, \text{any possible } \tau_2, 0, 0)$  or  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, 0, \text{any possible } \tau_1^*, \text{any possible } \tau_2^*)$ .*

**Proof.** See appendix A3. ■

**Corollary 2** *The trade war equilibrium tariffs  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (\bar{\tau}, \bar{\tau}, \bar{\tau}, \bar{\tau})$  are inefficient.*

However, the fact that propositions 1 and 2 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 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 falls. This implies that Home's market becomes more competitive which makes it harder for firms in Foreign  $j$  to sell their products to Home. As a consequence, the number of firms operating in Foreign  $j$  has to fall in equilibrium so that a tariff imposed by Home against Foreign  $i$  does not only lead to production relocations from Foreign  $i$  to Home but also from Foreign  $j$  to Home.

### **3.4 Trade policy under the GATT/WTO: the principle of nondiscrimination**

Consider now again trade policy, if tariffs are set cooperatively in GATT/WTO negotiations. 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 improves welfare in all countries. However, if the principle of reciprocity is augmented with the principle of nondiscrimination they then together serve this purpose. I develop this argument in four steps: first, I show that the principle of reciprocity neutralizes the bilateral production relocation effect but not the multilateral production relocation effect if it is applied in bilateral trade negotiations but that it neutralizes both effects if it is applied in multilateral trade negotiations. Second, I

demonstrate that, as a consequence, the principle of reciprocity only ensures that negotiated tariff concessions increase all countries' welfare monotonically if it is applied in multilateral trade negotiations. Third, I show that the principle of nondiscrimination is a simple way to 'multilateralize' trade negotiations. And finally, I demonstrate that under reciprocity and nondiscrimination negotiated tariff concessions are secured. 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  $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$  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  $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$  to be multilaterally reciprocal if it is such that  $dTB_{M1}^* = dTB_{M2}^* = 0$ .*

Thus, notice first that reciprocity neutralizes the bilateral production relocation effect but not the multilateral production relocation effect if it is applied in bilateral trade negotiations but that it 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:<sup>22</sup>

$$n_i^* = \frac{\mu L_i^*}{qp} + \frac{TB_{Mi}^*}{qp} \quad (47)$$

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 serves to eliminate the bilateral production relocation effect if it is applied in bilateral

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<sup>22</sup>For details see the proof of proposition 8.

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 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 (47), the principle of reciprocity is not sufficient to also eliminate the multilateral production relocation effect if it is applied in bilateral trade negotiations. This is because a bilaterally reciprocal tariff change between Home and Foreign  $i$  changes Home's price index thereby 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 makes it harder for firms in Foreign  $j$  to export their goods to Home. As a consequence, firms in Foreign  $j$  make losses unless some production relocates to Home. This is summarized in proposition 8:

**Proposition 8** *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 increases (decreases) the number of firms at Home at the expense of (to the benefit of) Foreign  $j$ .*

**Proof.** See appendix A3. ■

Observe second that, as a consequence, the principle of reciprocity only ensures that negotiated tariff concessions increase all countries' welfare monotonically if it is applied in multilateral trade negotiations. If Home and Foreign  $i$  liberalize in a bilaterally reciprocal way 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 neutralized so that all countries gain because of the import price effect. This is summarized in proposition 9:

**Proposition 9** *Multilaterally reciprocal trade liberalization monotonically increases welfare in all countries. Bilaterally reciprocal trade liberalization between Home and Foreign  $i$  monotonically increases welfare in Home and Foreign  $i$  but monotonically decreases welfare in Foreign  $j$ .*

**Proof.** See appendix A3. ■

Notice third that the principle of nondiscrimination is a simple way to ‘multilateralize’ trade negotiations.<sup>23</sup> The reasoning for this is straightforward: if Home is forced to impose the same tariff against Foreign 1 and Foreign 2, and both Foreign 1 and Foreign 2 respond to tariff changes by Home in a bilaterally reciprocal way, both trade balances are kept constant so that multilateral reciprocity prevails. This is summarized in proposition 10:

**Definition 3** *Define tariffs to be nondiscriminatory if  $\tau_1 = \tau_2 \equiv \tau$ .*<sup>24</sup>

**Proposition 10** *If tariffs are restricted to be nondiscriminatory, all bilaterally reciprocal tariff changes are also multilaterally reciprocal.*

**Proof.** See appendix A3. ■

Observe finally that under reciprocity and nondiscrimination all negotiated tariff concessions are secured by guaranteeing that no country has an incentive to reverse

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<sup>23</sup>Notice that Home needs to be forced to multilateralize trade negotiations. In particular, Home would prefer liberalizing in a bilaterally reciprocal way first vis-a-vis Foreign 1 and second vis-a-vis Foreign 2 to liberalizing in a multilaterally reciprocal way simultaneously vis-a-vis Foreign 1 and Foreign 2. This is because, in the former case, Home would attract manufacturing production from first Foreign 2 and second Foreign 1, due to the multilateral production relocation effect.

<sup>24</sup>This definition refers to the trade policy aspect of the principle of nondiscrimination - the most favored nation (MFN) principle - as opposed to the domestic policy aspect of the principle of nondiscrimination - the national treatment principle. See Horn (2006) for more on the national treatment principle.

them. If Foreign 1 and Foreign 2 respond reciprocally to any tariff increase by Home above the negotiated tariff levels, then Home no longer has an incentive to increase its tariff. This is again because such an increase in tariffs would only inflate Home's price index because of the import price effect. This is summarized in proposition 11.<sup>25</sup>

**Proposition 11** *Suppose tariffs are set in the following two-stage game. Throughout all stages, Home is restricted to set nondiscriminatory tariffs. In the first stage, governments choose tariffs cooperatively according to some bargaining protocol. In the second stage, Home gets the opportunity to deviate from the cooperative outcome by increasing its tariffs unilaterally. However, Foreign 1 and Foreign 2 respond reciprocally to any unilateral tariff increase by Home. Then Home never deviates from the cooperative agreement in the second stage.*

**Proof.** See appendix A3. ■

Overall, the principles of reciprocity and nondiscrimination can therefore be interpreted as jointly helping governments to escape the inefficient noncooperative equilibrium in a way which monotonically increases welfare in all countries. Notice, however, that reciprocal trade liberalization no longer necessarily leads to efficient tariffs if the principle of nondiscrimination is imposed. This is because reciprocity and nondiscrimination can only be satisfied if all tariffs are lowered simultaneously.<sup>26</sup> But this is impossible if at least one of the tariffs is equal to zero which is not sufficient for efficiency, from proposition 7. Recall, however, that the requirement to liberalize reciprocally is not binding in a legal sense so that this feature of the principle of nondiscrimination should not be overemphasized.

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<sup>25</sup>Notice that the principle of nondiscrimination is actually not essential for this result. Even if only the principle of reciprocity was imposed, Home would have no incentive to reverse negotiated tariff concessions against either country since this would inflate its price index due to the import price effect and the multilateral production relocation effect.

<sup>26</sup>This can be easily established by differentiating the manufacturing market clearing conditions and imposing nondiscrimination.

## 4 Free trade agreements

GATT/WTO articles allow countries to sign free trade agreements as an important exception to the principle of nondiscrimination. Given that this principle is one of the two fundamental pillars of the GATT/WTO system, this has raised concerns that free trade agreements could undermine multilateral trade negotiations.<sup>27</sup> Bagwell and Staiger's (1999) analysis strengthens these concerns. In their model, free trade agreements pose a major threat to the functioning of GATT/WTO negotiations in the sense that they eliminate the possibility to implement efficient trade agreements. In this section, I revisit these concerns in the context of my 'new trade' theory.

Suppose thus that Home and Foreign 1 sign a free trade agreement so that  $\tau_1 = \tau_1^* = 0$ . Will reciprocal trade negotiations between Home and Foreign 2 guide countries to the efficiency frontier? It should be clear from the discussion in the previous sections that this is indeed the case. Basically, Home and Foreign 2 can both improve their welfare monotonically if they liberalize in a bilaterally reciprocal way. This is because bilateral reciprocity eliminates the bilateral production relocation effect and Home gains at the expense of Foreign 1 due to the multilateral production relocation effect. Such bilaterally reciprocal liberalization can continue until  $\tau_2 = 0$  and/or  $\tau_2^* = 0$  which, together with the fact that  $\tau_1 = \tau_1^* = 0$ , implies that efficient tariffs will be reached. For the same reasons, neither Home nor Foreign 2 has an incentive to deviate from such efficient tariffs so that the principle of reciprocity also secures efficient tariffs.

Of course, welfare no longer improves monotonically in all countries during the liberalization process. If Home and Foreign 1 both gain from a free trade agreement, Foreign 2 loses due to the multilateral production relocation effect. And if Home and Foreign 2 then liberalize in a bilaterally reciprocal way, Foreign 1 loses due to the multilateral production relocation effect. This again highlights the role of nondiscrimination

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<sup>27</sup>More generally, the debate is whether preferential trade agreements are 'building blocs' or 'stumbling blocs' on the way to multilateral free trade. See Panagariya (2000) for a comprehensive survey of the literature. See also Antras et al. (2007) for an interesting recent contribution to this literature.

in this environment: to multilateralize trade negotiations in order to ensure that no government gains at another government's expense during the liberalization process.

## 5 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.

While I thus hope to provide a plausible alternative to the standard neoclassical theory of GATT/WTO negotiations, an empirical assessment of its relative importance is left for future work. To guide such work it would be necessary to first integrate the neoclassical theory of GATT/WTO negotiations and the 'new trade' theory of GATT/WTO negotiations into a unified framework. Helpman and Krugman's (1985) synthesis of neoclassical and 'new trade' theory would be a natural starting point for such research.

Besides, 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.

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## 6 Appendix

### 6.1 Appendix A1: Effects of allowing $\bar{\tau} \rightarrow \infty$

If  $\bar{\tau} \rightarrow \infty$ , propositions 1, 6, 8, and 9 would have to be modified as follows:

Effect on proposition 1: If  $\bar{\tau} \rightarrow \infty$ ,  $(\bar{\tau}, \bar{\tau})$  would no longer be the unique Nash equilibrium tariff combination but instead the unique trembling-hand perfect Nash equilibrium tariff combination. In particular,  $\frac{\partial G}{\partial \tau} \rightarrow 0$  if  $\tau^* \rightarrow \infty$  and  $\frac{\partial G^*}{\partial \tau^*} \rightarrow 0$  if  $\tau \rightarrow \infty$  as can be seen from equations (22) and (23). Therefore, all  $(\tau, \tau^*)$  such that  $(\tau, \tau^*) = (\text{any } \tau, \bar{\tau})$  or  $(\tau, \tau^*) = (\bar{\tau}, \text{any } \tau^*)$  would be Nash equilibrium tariff combinations if  $\bar{\tau} \rightarrow \infty$ . However, only  $(\bar{\tau}, \bar{\tau})$  would be robust to small perturbations in the governments' strategies because  $\frac{\partial G}{\partial \tau} < 0$  as soon as  $\tau^* < \infty$  and  $\frac{\partial G^*}{\partial \tau^*} < 0$  as soon as  $\tau < \infty$ .

Effect on proposition 6: This is analogous to the effect on proposition 1. If  $\bar{\tau} \rightarrow \infty$ ,  $(\bar{\tau}, \bar{\tau}, \bar{\tau}, \bar{\tau})$  would no longer be the unique Nash equilibrium tariff combination but instead the unique trembling-hand perfect Nash equilibrium tariff combination since all other Nash equilibrium tariff combinations would not be robust to small perturbations in the governments' strategies.

Effect on proposition 8: If  $\bar{\tau} \rightarrow \infty$ , the statement on bilaterally reciprocal trade liberalization (trade protection) would have to be qualified. In particular, bilaterally reciprocal trade liberalization (trade protection) between Home and Foreign i would then leave the number of firms unchanged in Foreign i but increase (decrease) the number of firms at Home at the expense of (to the benefit of) Foreign j if  $\tau_j < \infty$  and leave the number of firms unchanged in all countries if  $\tau_j \rightarrow \infty$ . The latter case arises because  $\frac{\partial G_j^*}{\partial \tau_i} = \frac{\partial G_j^*}{\partial \tau_i^*} = 0$  if  $\tau_j \rightarrow \infty$ , as can be seen from equations (37) and (38).

Effect on proposition 9: This follows directly from the effect on proposition 8. If  $\bar{\tau} \rightarrow \infty$ , the statement on bilaterally reciprocal trade liberalization would have to be qualified. In particular, bilaterally reciprocal trade liberalization between Home

and Foreign i would then monotonically increase welfare in Home and Foreign i but monotonically decrease welfare in Foreign j if  $\tau_j < \infty$  and monotonically increase welfare in Home and Foreign i but leave welfare unchanged in Foreign j if  $\tau_j \rightarrow \infty$ . This would imply that, starting at the noncooperative equilibrium, reciprocal trade liberalization between Home and Foreign i would leave welfare unaffected in Foreign j. However, any subsequent bilaterally reciprocal trade liberalization between Home and Foreign j would then still monotonically decrease welfare in Foreign i so that the multilateral production relocation effect would still have to be neutralized in order to eliminate all trade policy externalities.

## 6.2 A2: Parameter restrictions

### 6.2.1 Two-country model

The equilibrium number of manufacturing firms operating at Home is given by  $n = \frac{\mu}{qp} \left[ \frac{L}{1-\phi^{1-\sigma}} - \frac{L^*\phi^{1-\sigma}}{1-\phi^{1-\sigma}} \right]$  from equation (24). Hence, the maximum value  $n$  can take for all  $(\tau, \tau^*, \bar{\tau})$  is  $n_{\max} = \frac{\mu}{qp} \left[ \frac{L}{1-\theta^{1-\sigma}} \right]$  and the minimum value  $n$  can take for all  $(\tau, \tau^*, \bar{\tau})$  is  $n_{\min} = \frac{\mu}{qp} \left[ L - \frac{L^*\theta^{1-\sigma}}{1-\theta^{1-\sigma}} \right]$ . By symmetry,  $n_{\max}^* = \frac{\mu}{qp} \left[ \frac{L^*}{1-\theta^{1-\sigma}} \right]$  and  $n_{\min}^* = \frac{\mu}{qp} \left[ L^* - \frac{L\theta^{1-\sigma}}{1-\theta^{1-\sigma}} \right]$ . Therefore, the manufacturing sector is always active in both countries for all  $(\tau, \tau^*, \bar{\tau})$  if and only if  $n_{\min} > 0$  and  $n_{\min}^* > 0 \iff \theta > \left[ \frac{\min(L, L^*)}{L+L^*} \right]^{\frac{1}{1-\sigma}}$ . Also, the outside good sector is always active in both countries for all  $(\tau, \tau^*, \bar{\tau})$  if and only if Home is large enough to fit  $n_{\max}$  and Foreign is large enough to fit  $n_{\max}^*$ . This is the case if  $n_{\max}l < L$  and  $n_{\max}^*l < L^* \iff \mu < 1 - \theta^{1-\sigma}$ .

### 6.2.2 Three-country model

The equilibrium number of manufacturing firms operating at Home is given by  $n = \frac{\mu}{qp} \left[ \frac{L}{\Phi} - \frac{L_1^*\phi_1^{1-\sigma}}{\Phi_1} - \frac{L_2^*\phi_2^{1-\sigma}}{\Phi_2} \right]$  from equation (43). Hence, the maximum value  $n$  can take for all  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*, \bar{\tau})$  is  $n_{\max} = \frac{\mu}{qp} \left[ \frac{L}{1-2\theta^{1-\sigma}} \right]$  and the minimum value  $n$  can take for all  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*, \bar{\tau})$  is  $n_{\min} = \frac{\mu}{qp} \left[ L - \frac{L_1^*\theta^{1-\sigma}}{1-\theta^{1-\sigma}} - \frac{L_2^*\theta^{1-\sigma}}{1-\theta^{1-\sigma}} \right]$ . The equilibrium number of manu-

facturing firms operating at Foreign  $i$  is given by  $n_i^* = \frac{\mu}{qp} \left[ \frac{L_i^* [1 - (\phi_j \phi_j^*)^{1-\sigma}]}{\Phi_i} + \frac{L_j^* (\phi_i^* \phi_j)^{1-\sigma}}{\Phi_j} - \frac{L \phi_i^{*1-\sigma}}{\Phi} \right]$  from equations (44 and 45). Hence, the maximum value  $n_i^*$  can take for all  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*, \bar{\tau})$  is  $n_{i \max}^* = \frac{\mu}{qp} \left[ \frac{L_i^*}{1 - \theta^{1-\sigma}} \right]$  and the minimum value  $n$  can take for all  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*, \bar{\tau})$  is  $n_{i \min}^* = \frac{\mu}{qp} \left[ L_i^* - \frac{L \theta^{1-\sigma}}{1 - 2\theta^{1-\sigma}} \right]$ . Therefore, the manufacturing sector is always active in all countries for all  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*, \bar{\tau})$  if and only if  $n_{\min} > 0$  and  $n_{1 \min}^* > 0$  and  $n_{2 \min}^* > 0 \iff \theta > \left( \frac{L}{L + L_1^* + L_2^*} \right)^{\frac{1}{1-\sigma}}$  and  $\theta > \left( \frac{L_1^*}{L + 2L_1^*} \right)^{\frac{1}{1-\sigma}}$  and  $\theta > \left( \frac{L_2^*}{L + 2L_2^*} \right)^{\frac{1}{1-\sigma}}$ . Also, the outside good sector is always active in all countries for all  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*, \bar{\tau})$  if and only if Home is large enough to fit  $n_{\max}$  and Foreign  $i$  is large enough to fit  $n_{i \max}^*$ . This is the case if  $n_{\max} l < L$  and  $n_{1 \max}^* l < L_1^*$  and  $n_{2 \max}^* l < L_2^* \iff \mu < 1 - 2\theta^{1-\sigma}$ .

### 6.3 A3: Proofs

#### 6.3.1 Proof of proposition 1

**Proof.** Given the form of  $V$ ,  $V$  is maximized when  $G$  is minimized. Also,  $\frac{\partial G}{\partial \tau} = -\frac{\phi^* (\phi \phi^*)^{-\sigma}}{[1 - (\phi \phi^*)^{1-\sigma}]} G$  so that  $\frac{\partial G}{\partial \tau} < 0$  for all possible  $(\tau, \tau^*)$ . Hence, choosing  $\tau = \bar{\tau}$  is a dominant strategy for Home. Similarly, choosing  $\tau^* = \bar{\tau}$  is a dominant strategy for Foreign. Thus,  $(\tau, \tau^*) = (\bar{\tau}, \bar{\tau})$  is the unique Nash equilibrium tariff combination. ■

#### 6.3.2 Proof of proposition 2

**Proof.** A tariff combination  $(\tau, \tau^*)$  cannot be Pareto efficient if there exist possible Pareto improving tariff changes  $(d\tau, d\tau^*)$  at  $(\tau, \tau^*)$ . 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  $(\tau, \tau^*)$ . This is because  $\frac{\partial G}{\partial \tau} = -\frac{(\phi \phi^*)^{-\sigma} \phi^*}{1 - (\phi \phi^*)^{1-\sigma}} G$ ,  $\frac{\partial G}{\partial \tau^*} = \frac{(1 - \phi^{1-\sigma}) \phi^{*-\sigma}}{(1 - \phi^{*1-\sigma}) [1 - (\phi \phi^*)^{1-\sigma}]} G$ ,  $\frac{\partial G^*}{\partial \tau} = \frac{(1 - \phi^{*1-\sigma}) \phi^{-\sigma}}{(1 - \phi^{1-\sigma}) [1 - (\phi \phi^*)^{1-\sigma}]} G^*$ , 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  $(\tau, \tau^*)$ . These

$(d\tau, d\tau^*)$  are such that  $d\tau < 0$  and  $d\tau^* < 0$  and are thus possible if and only if  $\tau > 0$  and  $\tau^* > 0$ . Therefore, only  $(\tau, \tau^*)$  such that  $(\tau, \tau^*) = (\text{any possible } \tau, 0)$  or  $(\tau, \tau^*) = (0, \text{any possible } \tau^*)$  can be Pareto efficient. It is easy to verify that for none of these  $(\tau, \tau^*)$  there exists another  $(\tau, \tau^*)$  which makes one country better off without making the other country worse off. Therefore, they are also indeed Pareto efficient. ■

### 6.3.3 Proof of proposition 3

**Proof.** By definition,  $TB_M = \mu p^{1-\sigma} (n\phi^{*1-\sigma} L^* G^{*\sigma-1} - n^* \phi^{1-\sigma} L G^{\sigma-1})$  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 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  $dn = 0$ . ■

### 6.3.4 Proof of proposition 4

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

### 6.3.5 Proof of proposition 5

**Proof.** Recall that  $G = p [n + n^* \phi^{1-\sigma}]$  from equation (16). Since reciprocal tariff changes leave the number of firms unchanged in both countries, from proposition 3, Home's price index is therefore increasing in its own tariff in the second stage. ■

### 6.3.6 Proof of proposition 6

**Proof.**  $\frac{\partial G}{\partial \tau_i} = -\frac{(\phi_i \phi_i^*)^{-\sigma} \phi_i^*}{\Omega} G$  so that  $\frac{\partial G}{\partial \tau_i} < 0$  for all possible  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ . Hence, choosing  $(\tau_1, \tau_2) = (\bar{\tau}, \bar{\tau})$  is a dominant strategy for Home. Similarly,  $\frac{\partial G_i^*}{\partial \tau_i^*} = -\frac{(\phi_i \phi_i^*)^{-\sigma} \phi_i}{\Omega} G_i^*$  so that  $\frac{\partial G_i^*}{\partial \tau_i^*} < 0$  for all possible  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ . Hence, choosing  $\tau_i = \bar{\tau}$  is also a dominant

strategy for Foreign i. Thus,  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (\bar{\tau}, \bar{\tau}, \bar{\tau}, \bar{\tau})$  is the unique Nash equilibrium tariff combination. ■

### 6.3.7 Proof of proposition 7

**Proof.** A tariff combination  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$  cannot be Pareto efficient if there exist possible 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,  $dG = \frac{\partial G}{\partial \tau_i} d\tau_i + \frac{\partial G}{\partial \tau_i^*} d\tau_i^*$ ,  $dG_i^* = \frac{\partial G_i^*}{\partial \tau_i} d\tau_i + \frac{\partial G_i^*}{\partial \tau_i^*} d\tau_i^*$ , 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  $\frac{\partial G_j^*}{\partial \tau_j^*} = -\frac{\Phi_j \phi_j^{*-\sigma} \phi_i^{1-\sigma}}{\Omega \Phi_j} G_j^*$  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  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ . This is because  $\frac{\partial G_i^*}{\partial \tau_i^*} = -\frac{(\phi_i \phi_i^*)^{-\sigma} \phi_i}{\Omega} G_i^*$  and  $\frac{\partial G_i^*}{\partial \tau_i} = \frac{\Phi[1 - (\phi_j \phi_j^*)^{1-\sigma}] \phi_i^{-\sigma} G_i^*}{\Omega \Phi_i}$  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  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ . 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 possible if and only if  $\tau_i > 0$  and  $\tau_i^* > 0$ . This also includes tariff changes  $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$ ,  $d\tau_j = d\tau_j^* = 0$ , such that  $dG_i^* < 0$  and  $dG = dG_j^* = 0$ . From total differentiation,  $dG = \frac{\partial G}{\partial \tau_i} d\tau_i + \frac{\partial G}{\partial \tau_j^*} d\tau_j^*$ ,  $dG_i^* = \frac{\partial G_i^*}{\partial \tau_i} d\tau_i + \frac{\partial G_i^*}{\partial \tau_j^*} d\tau_j^*$ , 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  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ . 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  $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$ ,  $d\tau_j = d\tau_j^* = 0$ , such that  $dG_i^* < 0$  and  $dG = dG_j^* = 0$  for all  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ . 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 possible if and only if  $\tau_i > 0$  and  $\tau_j^* > 0$ . Therefore, only  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$  such that  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (\text{any possible } \tau_1, \text{any possible } \tau_2, 0, 0)$  or  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*) = (0, 0, \text{any possible } \tau_1^*, \text{any possible } \tau_2^*)$  can be Pareto efficient. It is 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 of the other countries worse off. Therefore, they are also indeed Pareto efficient. ■

### 6.3.8 Proof of proposition 8

**Proof.** By definition,  $TB_{Mi}^* = \mu p^{1-\sigma} (n_i^* \phi_i^{1-\sigma} L G^{\sigma-1} - n \phi_i^{*1-\sigma} L_i^* G_i^{*\sigma-1})$  so that  $\frac{TB_{Mi}^*}{\mu} = \frac{n_i^* \phi_i^{1-\sigma} L}{n + n_1^* \phi_1^{1-\sigma} + n_2^* \phi_2^{1-\sigma}} - \frac{n \phi_i^{*1-\sigma} L_i^*}{n \phi_i^{*1-\sigma} + n_i^*}$ . Also,  $\frac{n_i^* q p}{\mu} = \frac{n_i^* \phi_i^{1-\sigma} L}{n + n_1^* \phi_1^{1-\sigma} + n_2^* \phi_2^{1-\sigma}} + \frac{n_i^* L_i^*}{n \phi_i^{*1-\sigma} + n_i^*}$  from Foreign i' manufacturing market clearing condition. Hence,  $n_i^* = \frac{\mu L_i^*}{q p} + \frac{TB_{Mi}^*}{q p}$  which implies that  $dn_i^* = 0$  if and only if  $dTB_{Mi}^* = 0$ . Also, since  $n + n_1^* + n_2^* = \frac{\mu(L + L_1^* + L_2^*)}{q p}$ ,  $dn = 0$  if  $dn_1^* = dn_2^* = 0$ .

Moreover, if  $d\tau_j = d\tau_j^* = dn_i^* = 0$ ,  $\frac{dn_j^*}{d\tau_i} = \frac{(\sigma-1)\phi_i^{-\sigma} L \phi_j^{1-\sigma} n_i^*}{G^{2(1-\sigma)} \left[ \frac{L_j^*(1-\phi_j^{*1-\sigma})}{G_j^{*2(1-\sigma)}} - \frac{L \phi_j^{1-\sigma} (1-\phi_j^{1-\sigma})}{G^{2(1-\sigma)}} \right]}$  from Foreign j's manufacturing market clearing condition. Also,  $\frac{L_j^*(1-\phi_j^{*1-\sigma})}{G_j^{*2(1-\sigma)}} > \frac{L \phi_j^{1-\sigma} (1-\phi_j^{1-\sigma})}{G^{2(1-\sigma)}}$  for all possible  $(\tau_1, \tau_2, \tau_1^*, \tau_2^*, \bar{\tau})$  if and only if  $\theta > \left( \frac{L}{L + L_j^*} \right)^{\frac{1}{1-\sigma}}$  which is true because  $\theta > \left( \frac{L}{L + 2L_j^*} \right)^{\frac{1}{1-\sigma}}$  by assumption (c.f. appendix A2). ■

### 6.3.9 Proof of proposition 9

**Proof.** Recall that  $G = p [n + n_1^* \phi_1^{1-\sigma} + n_2^* \phi_2^{1-\sigma}]^{\frac{1}{1-\sigma}}$ ,  $G_1^* = p [n \phi_1^{*1-\sigma} + n_1^*]^{\frac{1}{1-\sigma}}$ , and  $G_2^* = p [n \phi_2^{*1-\sigma} + n_2^*]^{\frac{1}{1-\sigma}}$  from equations (30 - 32). Since multilaterally reciprocal tariff changes leave the number of firms unchanged in all countries, from proposition 8, multilaterally reciprocal trade liberalization therefore monotonically reduces 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 at Home at the expense of Foreign j, from proposition 8, bilaterally reciprocal trade

liberalization between Home and Foreign  $i$  therefore monotonically decreases the price indices of Home and Foreign  $i$  but monotonically increases the price index of Foreign  $j$ .

■

### 6.3.10 Proof of proposition 10

**Proof.** If tariffs are restricted to be nondiscriminatory,  $d\tau_1 = d\tau_2$  so that purely bilateral tariff changes between Home and Foreign 1 or Home and Foreign 2 are not possible. Hence all bilaterally reciprocal tariff changes must then be bilaterally reciprocal between Home and Foreign 1 and Home and Foreign 2. Since tariff changes which are bilaterally reciprocal between Home and Foreign 1 and Home and Foreign 2 are also multilaterally reciprocal this implies that all bilaterally reciprocal tariff changes must then also be multilaterally reciprocal. ■

### 6.3.11 Proof of proposition 11

**Proof.** Recall that  $G = p [n + n_1^* \phi_1^{1-\sigma} + n_2^* \phi_2^{1-\sigma}]$  from equation (30). Since reciprocal tariff changes leave the number of firms unchanged in all countries if tariffs are restricted to be nondiscriminatory, from propositions 8 and 10, Home's price index is therefore increasing in its own tariffs in the second stage. ■