

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

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(PRELIMINARY AND INCOMPLETE)

Abstract

In this paper, I develop a novel theory of GATT/WTO negotiations. I first argue that tariffs are inefficiently high in the non-cooperative equilibrium because countries attempt to improve their relative market access at the expense of other countries in order to attract manufacturing firms from abroad. I then show how GATT/WTO negotiations can help countries overcome this inefficiency by providing new rationales for the fundamental GATT/WTO principles of reciprocity and nondiscrimination.

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1 Introduction

“Without cooperation, we will be lost. Without institutions there will be little cooperation. And without a knowledge of how institutions work – and what makes them work well – there are likely to be fewer, and worse, institutions than if such knowledge is widespread”. Robert O. Keohane (1988: 393)

International trade has been liberalized dramatically during the past half-century. Since the end of World War II, the average ad valorem tariff on manufacturing goods has been reduced from over 40 percent to below 4 percent, making this undoubtedly one of the most important ever acts of economic policy making.

It is widely appreciated that this 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 import volumes 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 offer a new explanation for why GATT/WTO negotiations have been so successful in achieving trade liberalization by providing new rationales for the fundamental GATT/WTO principles of reciprocity and nondiscrimination. I consider GATT/WTO negotiations in a standard Krugman (1980) model with transport costs. The main idea is that GATT/WTO negotiations governed by the principles of reciprocity and nondiscrimination help governments escape a

¹According 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).

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

firm relocation driven prisoner's dilemma: In a monopolistically competitive environment, countries have an incentive to impose import tariffs in order to attract manufacturing firms from abroad. In particular, a unilateral increase in the own tariff implies that firms in the own country are better protected from competition from the other country so that the own firms can sell more and the other firms can sell less as a consequence of the tariff. This makes the own country a more and the other country a less attractive business location thus leading firms to relocate from the other country to the own country. This then reduces the own price index and hence increases the own welfare since a smaller fraction of goods consumed in the own country is now subject to transport costs. However, if all countries impose import tariffs in an attempt to attract manufacturing firms from abroad, no country actually succeeds and inefficiently high tariffs prevail. The purpose of GATT/WTO negotiations is then to bargain over a reduction in these inefficiently high tariffs. The principles of reciprocity and nondiscrimination assist governments in these trade negotiations. This is because they neutralize all trade policy externalities by ensuring that tariff changes no longer entail firm relocations.

My benchmark is, of course, the standard neoclassical theory of GATT/WTO negotiations developed by Johnson (1953-54) and Bagwell and Staiger (1999). As is well known, this theory argues that GATT/WTO negotiations governed by the principles of reciprocity and nondiscrimination help governments overcome a terms-of-trade driven prisoner's dilemma.³ Relative to this standard theory, my theory makes three main contributions. First, it builds on a 'new trade' model rather than the neoclassical trade model and therefore places our understanding of GATT/WTO negotiations on a broader basis. While the standard theory's

³An alternative theory of multilateral trade agreements is provided by Maggi (1999). It emphasizes enforcement considerations, arguing that lower tariffs can be enforced if multilateral retaliation is possible. Another alternative theory of trade agreements (bilateral or multilateral) is offered by Maggi and Rodriguez-Clare (1998 and forthcoming). It stresses commitment considerations, pointing out that trade agreements may help governments commit vis-à-vis domestic special interest groups. However, neither of these theories focuses on the detailed principles of GATT/WTO negotiations which is the topic of the present paper.

focus on the neoclassical trade model is clearly useful as a starting point, it can still only yield an incomplete understanding of GATT/WTO negotiations since the neoclassical trade model is itself only an incomplete theory of trade. Second, my theory does not rely on the terms-of-trade effect and therefore avoids a mechanism whose real-world relevance many economists doubt. Krugman (1997), for example, writes that “this optimal tariff argument plays almost no role in real-world trade disputes”.⁴ Third, my theory is immediately consistent with the fact that GATT/WTO regulations do not constrain export taxes and therefore offers a solution to the puzzle identified by Ethier (2002):⁵ Since GATT/WTO regulations do not constrain export taxes, they actually do not prevent countries from influencing their terms-of-trade. This is because, by Lerner symmetry, all effects of import tariffs can be exactly replicated by export taxes in general equilibrium.⁶ Therefore, if countries’ trade policy choices were really driven by a desire to influence their terms-of-trade, the GATT/WTO’s failure to restrict export taxes should lead to a widespread use of them. This is, however, not observed in practice.⁷

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

⁴However, a recent study by Broda, Limao, and Weinstein (forthcoming) suggests that countries do actually set higher tariffs on goods that are supplied inelastically, thus casting some doubt on this general scepticism of the terms-of-trade argument.

⁵In my model, an own export tax would reduce the sales of the own firms thereby making the own country a less attractive business location and thus make firms leave the country.

⁶Intuitively, the price of exports relative to imports can be increased either by imposing an import tariff which reduces world demand for the import product thereby making it cheaper, or by imposing an export tax which reduces the world supply of the export product thereby making it more expensive.

⁷One obvious objection to this criticism seems that countries are anyway constrained from using export taxes for political economy reasons. However, Bagwell and Staiger’s (1999) analysis suggests that this objection is in fact misguided. In particular, they represent government preferences by a general function of local and world prices. The only structure they impose on this function is that, for given local prices, governments prefer better terms-of-trade. They explain that this formulation of government preferences is so general that it can also capture distributional motives emphasized in leading political economy models. According to the Lerner symmetry theorem, import tariffs and export taxes have exactly the same effect on world and local prices. Hence, with respect to the government preferences used by Bagwell and Staiger (1999) both trade policy instruments are indeed perfect substitutes. Therefore, if the GATT/WTO forces governments to reduce import tariffs they should be expected to respond by increasing export taxes even if they are motivated by political economy considerations.

that the non-cooperative 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 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 The 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, σ is the elasticity of substitution between manufactur-

ing goods, and μ 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

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

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

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

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

where l^M (l^Y) is the labor requirement for producing q^M (q^Y) units of a manufacturing good (the outside good), and f (c) denotes the fixed (marginal) labor requirement of manufacturing production. The manufacturing goods market is monopolistically competitive whereas the outside good market is perfectly competitive. Trade costs only apply to manufacturing goods and take the familiar ‘iceberg’ form.⁸ These ‘iceberg’ trade costs are denoted by ϕ . They are further decomposed into ‘iceberg’ transport costs θ , which are identical across countries, and ‘iceberg’ tariffs τ , which may be different across countries. These tariffs can take any value in the interval $[0, \bar{\tau}]$, where $\bar{\tau}$ is some arbitrarily large but finite upper bound.⁹ Hence,

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

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

⁸The assumption that trade costs do not apply to the outside good sector is made for two reasons: First, as standard, to pin down the economies’ wage rate which greatly improves the model’s tractability. But second, also to ensure that prices are kept constant thereby eliminating any role for terms-of-trade effects.

⁹This upper bound is introduced for technical convenience. Dropping it would only complicate the model without changing its results in any interesting way.

The assumption of ‘iceberg’ tariffs helps preserve the model’s tractability because like that no tariff revenue is generated. For simplicity, I also make the following two additional assumptions: First, I assume that the outside good sector is always active in both countries. This is ensured for all possible (τ, τ^*) if and only if demand for manufacturing goods is sufficiently small: $\mu < \frac{\min(L, L^*)}{L+L^*}$ (see appendix A1 for details). Second, I assume that the manufacturing sector is always active in both countries. This is ensured for all possible (τ, τ^*) if and only if transport costs are sufficiently large: $\theta > \left[\frac{\min(L, L^*)}{L+L^*} \right]^{\frac{1}{1-\sigma}}$ (see again appendix A1 for details).

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

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

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

and the following demands for each manufacturing good

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

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

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 σ , profit-maximization implies that manufacturing firms charge a constant mark-up over marginal costs so that

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

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 by¹⁰

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

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

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

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

so that each country's welfare is decreasing in its manufacturing price index. This completes the derivation of the basic model.

¹⁰This 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.

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).¹¹ 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 firm 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 firms towards the own country thereby reducing the own price index since a smaller number of products 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. In particular, a unilateral increase in the own tariff implies that firms in the own country are now better protected from competition from the other country so that the own firms can sell more and hence make profits and the other firms can sell less and hence make losses. In short, a tariff hence increases the market access of firms in the own country at the expense of the market access of firms in the other country. In equilibrium, the firm relocation effect dominates the import price effect because firms have to make zero profits due to free entry. A country's increased attractiveness as a business location eventually needs to be counterbalanced by increased domestic competition, i.e. a lower domestic price index. This finding is summarized in

¹¹This effect was first discovered by Venables (1987) in a related model. It is therefore sometimes referred to as 'Venables Effect'.

proposition 1:¹²

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 A2 ■

Observe second that this noncooperative equilibrium is inefficient since each government is trying to benefit at the other government's expense. Essentially, if both countries impose import tariffs in an attempt to attract manufacturing firms from abroad, no country 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 (τ, τ^*) such that $(\tau, \tau^*) = (\text{any possible } \tau, 0)$ or $(\tau, \tau^*) = (0, \text{any possible } \tau^*)$*

Proof. See appendix A2 ■

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

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 firm 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.

¹²Of course, governments would never impose export taxes in this framework. This is because an export tax deteriorates a country's relative market access thereby making firms move abroad.

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:¹³ Generally speaking, reciprocity requires that trade policy changes keep changes in import volumes 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 therefore does not have a legal character. 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.

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 steps: First, I show that reciprocity prevents firm relocations between countries and thereby neutralizes the firm 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 throughout:

¹³For a discussion of how this interpretation is obtained, see chapter 3 of Bagwell and Staiger (2002).

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).¹⁴

Thus, notice first that the principle of reciprocity neutralizes the firm relocation effect. This is because the number of firms operating at Home can be decomposed as follows:¹⁵

$$n = \frac{\mu L}{qp} + \frac{TB_M}{qp} \quad (29)$$

This decomposition shows that the number of manufacturing firms at Home consists of the number of manufacturing firms Home would have under autarky plus the additional number of firms required to satisfy the net demand from Foreign. This is because μL is Home's expenditure on manufacturing goods, TB_M is Foreign's net expenditure on Home's manufacturing goods, and qp is the (constant) level of firm sales. Hence, if Foreign's net expenditure on Home's manufacturing goods is fixed by reciprocity, Home's (and hence also Foreign's) number of manufacturing firms is fixed as well. 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 A2 ■

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 firm relocation effect which tends to make a country's price index decreasing in its own tariff. As was

¹⁴ Notice that $TB_M^* = -TB_M$ so that also $\Delta TB_M^* = 0$ if tariff changes are reciprocal.

¹⁵ See the proof of proposition 3 to see how this decomposition is derived.

discussed above, the firm 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 firm 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 A2 ■

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 one country commits to respond reciprocally to any tariff increase above the negotiated tariff levels, then 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 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 commits to respond reciprocally to any unilateral tariff increase by Home. Then, Home never deviates from the cooperative agreement in the second stage*

Proof. See appendix A2 ■

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 extension

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.¹⁶ 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.

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 the same price in equilibrium

¹⁶One further difference is as follows: For simplicity, I again assume that the outside good sector is active in all countries and that the manufacturing sector is always active in all countries. However, this now requires tighter parameter restrictions: $\mu < \frac{\min(L, L_1^*, L_2^*)}{L + L_1^* + L_2^*}$ and $\theta > \left(\frac{\min(L, L_1^*, L_2^*)}{L + L_1^* + L_2^*} \right)^{\frac{1}{1-\sigma}}$, respectively. Details can again be found in appendix A1.

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. Defining

$$\Phi \equiv 1 - \phi_1^{*1-\sigma} - \phi_2^{*1-\sigma} \quad (36)$$

$$\Phi_1 \equiv 1 - \phi_1^{1-\sigma} - \phi_2^{*1-\sigma} (\phi_2^{1-\sigma} - \phi_1^{1-\sigma}) \quad (37)$$

$$\Phi_2 \equiv 1 - \phi_2^{1-\sigma} - \phi_1^{*1-\sigma} (\phi_1^{1-\sigma} - \phi_2^{1-\sigma}) \quad (38)$$

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

they can be written as

$$G = \left[\frac{qp^\sigma \Phi}{\mu L \Omega} \right]^{\frac{1}{\sigma-1}} \quad (40)$$

$$G_1^* = \left[\frac{qp^\sigma \Phi_1}{\mu L_1^* \Omega} \right]^{\frac{1}{\sigma-1}} \quad (41)$$

$$G_2^* = \left[\frac{qp^\sigma \Phi_2}{\mu L_2^* \Omega} \right]^{\frac{1}{\sigma-1}} \quad (42)$$

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

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

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

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

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. Notice that propositions 1 and 2 naturally generalize to the three-country model, the intuitions being as before. 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 A2 ■

As in proposition 2, this noncooperative equilibrium is inefficient since tariff combinations are efficient if and only if at least one of the tariffs is equal to zero in each bilateral trading relationship:

Proposition 7 *The set of Pareto-efficient tariff combinations consists of all $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$*

such that (i) $(\tau_1, \tau_1^*) = (\text{any possible } \tau_1, 0)$ or $(\tau_1, \tau_1^*) = (0, \text{any possible } \tau_1^*)$ and
(ii) $(\tau_2, \tau_2^*) = (\text{any possible } \tau_2, 0)$ or $(\tau_2, \tau_2^*) = (0, \text{any possible } \tau_2^*)$

Proof. See appendix A2 ■

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 firm relocation effect. The bilateral firm relocation effect is an effect between the two countries directly affected by the tariff and is just the relocation effect familiar from the basic model: For example, a tariff imposed by Home against Foreign i leads to firm relocations from Foreign i to Home since this improves the market access of firms at Home and reduces the market access of firms at Foreign i thereby making Home a more attractive business location. The multilateral firm relocation effect is an additional effect on the third country which is not directly affected by the tariff. This multilateral firm relocation effect works through changes in Home's price index: For example, since a tariff imposed by Home against Foreign i leads to firm relocations from Foreign i towards Home, Home's price index falls. This implies that the Home 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 firm 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 firm relocation effect but not the multilateral firm relocation effect if it is applied bilaterally but that it neutralizes both effects if it is applied multilaterally. 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 multilaterally. Third, I show that the principle of nondiscrimination is a simple way to 'multilateralize' the principle of reciprocity. 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 bilateral and multilateral tariff changes are formally defined as follows:

Definition 2 *Define a tariff change $(d\tau_i, d\tau_i^*)$ 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 country 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 $dTB_{M1}^* = dTB_{M2}^* = 0$.¹⁷*

¹⁷Notice that $TB_M = -(TB_{M1}^* + TB_{M2}^*)$ so that also $\Delta TB_M = 0$ if tariff changes are multilaterally reciprocal.

Thus, notice first that reciprocity neutralizes the bilateral firm relocation effect but not the multilateral firm relocation effect if it is applied bilaterally but that it neutralizes both effects if it is applied multilaterally. To see this, observe that the number of manufacturing firms operating in Foreign i can be decomposed into the number of manufacturing firms Foreign i would have under autarky plus the additional number of manufacturing firms required to satisfy net foreign demand from Home, just as in the basic model:

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

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 firm relocation effect if it is applied bilaterally. However, it is not sufficient to also eliminate the multilateral firm relocation effect in this case. 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 relocate 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 A2 ■

Observe second that, as a consequence, the principle of reciprocity only ensures that negotiated tariff concessions increase all countries' welfare monotonically if

trade negotiations are multilateral. If Home and Foreign i liberalize in a bilaterally reciprocal way only the bilateral firm 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 firm relocation effect, but Foreign j loses because of the multilateral firm relocation effect. If, instead, Home, Foreign i , and Foreign j liberalize in a multilaterally reciprocal way, the multilateral firm relocation effect is also neutralized so that all countries gains because of the import price effect. This is summarized in proposition 9:

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

Proof. See appendix A2 ■

Notice third that the principle of nondiscrimination is a simple way to ‘multilateralize’ the principle of reciprocity.¹⁸ 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 $\tau_1 = \tau_2 \equiv \tau$*

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

¹⁸Notice that Home needs to be forced to multilateralize the principle of reciprocity. 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 firms from first Foreign 2 and second Foreign 1, due to the multilateral firm relocation effect.

Proof. See appendix A2 ■

Observe finally that under reciprocity and nondiscrimination all negotiated tariff concessions are secured by guaranteeing that no country has an incentive to reverse them. If Foreign 1 and Foreign 2 commit to respond reciprocally to any tariff increase by Home above the negotiated tariff levels, then Home no longer has an incentive to increase its tariffs. 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 11:¹⁹

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 commit to respond in a bilaterally reciprocal way to any unilateral tariff increase by Home. Then Home never deviates from the cooperative agreement in the second stage*

Proof. See appendix A2 ■

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 increase 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. But this is impossible if at least one of the tariffs is equal to zero which is not

¹⁹Notice 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 firm relocation effect.

sufficient for efficiency, from proposition 7. Recall, however, that the requirement to liberalize reciprocally is not binding legally so that this feature of the principle of nondiscrimination should not be overemphasized.

3.5 Preferential trade agreements

To be added.

4 Conclusion

In this paper, I developed a ‘new trade’ theory of GATT/WTO negotiations. I first argued that tariffs are inefficiently high in the non-cooperative equilibrium because countries attempt to improve their relative market access at the expense of other countries in order to attract manufacturing firms from abroad. I then showed how GATT/WTO negotiations can help countries overcome this inefficiency by providing new rationales for the fundamental GATT/WTO principles of reciprocity and nondiscrimination.

Relative to the standard terms-of-trade theory, this ‘new trade’ theory makes three main contributions. First, it builds on a ‘new trade’ model rather than the neoclassical trade model and therefore places our understanding of GATT/WTO negotiations on a broader basis. Second, it does not rely on the terms-of-trade effect and therefore avoids a mechanism whose real-world relevance many economists doubt. Third, it is immediately consistent with the fact that GATT/WTO regulations do not constrain export taxes and therefore offers a solution to the puzzle identified by Ethier (2002).

Still, much further work is needed. To fully develop this ‘new trade’ theory of trade negotiations, two questions seem to be particularly important: First, what is the role of political economy considerations in multilateral trade negotiations? And second, how does the GATT/WTO enforce the rules of reciprocity

and nondiscrimination?²⁰

²⁰See Bagwell and Staiger (2002) for a discussion of how these questions are addressed in the context of the standard terms-of-trade theory.

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5 Appendix

5.1 A1: Parameter restrictions

5.1.1 Two-country model

1. The outside good sector is always active in both countries if and only if both countries are large enough to host the total number of world manufacturing firms. This implies that $(n + n^*)l < \min(L, L^*) \iff \frac{\mu l}{qp} < \frac{\min(L, L^*)}{L + L^*} \iff \mu < \frac{\min(L, L^*)}{L + L^*}$.
2. Suppose there are no manufacturing firms in country i and consider the incentives to enter. It is straightforward to show that, at price p , at least $\frac{\mu L}{p\theta^{1-\sigma}(n+n^*)}$ units could be sold at Home given any (τ, τ^*) , and at least $\frac{\mu L^*}{p\theta^{1-\sigma}(n+n^*)}$ units could be sold at Foreign given any (τ, τ^*) . Hence, entry is always profitable at Home if and only if $\frac{\mu L}{p\theta^{1-\sigma}(n+n^*)} > q \iff \theta > \left[\frac{L}{L+L^*}\right]^{\frac{1}{1-\sigma}}$ and entry is always profitable at Foreign if and only if $\frac{\mu L^*}{p\theta^{1-\sigma}(n+n^*)} > q \iff \theta > \left[\frac{L^*}{L+L^*}\right]^{\frac{1}{1-\sigma}}$. Therefore, entry is always profitable at both Home and Foreign if and only if $\theta > \left[\frac{\min(L, L^*)}{L+L^*}\right]^{\frac{1}{1-\sigma}}$. In this proof I assume $\bar{\tau} \rightarrow \infty$ to include all possible $\bar{\tau}$. For a more restrictive $\bar{\tau}$, weaker parameter conditions can be derived.

5.1.2 Three-country model

1. The outside good sector is always active in all countries if and only if all countries are large enough to host the total number of world manufacturing firms. This implies that $(n + n_1^* + n_2^*)l < L \iff \frac{\mu l}{qp} < \frac{\min(L, L_1^*, L_2^*)}{L + L_1^* + L_2^*} \iff \mu < \frac{\min(L, L_1^*, L_2^*)}{L + L_1^* + L_2^*}$.
2. Suppose there are no manufacturing firms in country i and consider the incentives to enter. It is straightforward to show that, at price p , at least $\frac{\mu L_i}{p\theta^{1-\sigma}(n+n_1^*+n_2^*)}$ units could be sold given any $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$, where $L_i = L$

if $i = H$ and so on. Hence, entry is always profitable in all countries if and only if $\frac{\mu \min(L, L_1^*, L_2^*)}{p\theta^{1-\sigma}(n+n_1^*+n_2^*)} > q \iff \theta > \left[\frac{\min(L, L_1^*, L_2^*)}{L+L_1^*+L_2^*} \right]^{\frac{1}{1-\sigma}}$.

5.2 A2: Proofs

5.2.1 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 (τ, τ^*) . 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

■

5.2.2 Proof of proposition 2

Proof. A tariff combination (τ, τ^*) cannot be Pareto efficient if there exist possible 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 (τ, τ^*) . This is because $\frac{\partial G}{\partial \tau} = -\frac{(\phi\phi^*)^{-\sigma}\phi^*}{1-(\phi\phi^*)^{1-\sigma}}G$, $\frac{\partial G}{\partial \tau^*} = \frac{(1-\phi^{1-\sigma})\phi^{*-\sigma}}{(1-\phi^{*1-\sigma})[1-(\phi\phi^*)^{1-\sigma}]}G$, $\frac{\partial G^*}{\partial \tau} = \frac{(1-\phi^{*1-\sigma})\phi^{-\sigma}}{(1-\phi^{1-\sigma})[1-(\phi\phi^*)^{1-\sigma}]}G^*$, 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 (τ, τ^*) . 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 (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 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 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 $dn = 0$ ■

5.2.4 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). Recall also that $dn = dn^* = 0$ if $(d\tau, d\tau^*)$ is reciprocal, from proposition 3. Therefore, $\frac{\partial G}{\partial \tau} > 0$ and $\frac{\partial G^*}{\partial \tau^*} > 0$ if $(d\tau, d\tau^*)$ is reciprocal. ■

5.2.5 Proof of proposition 5

Proof. Recall that $G = p [n + n^* \phi^{1-\sigma}]$, from equation (16). Recall also that $dn = dn^* = 0$ if $(d\tau, d\tau^*)$ is reciprocal, from proposition 3. Therefore, $\frac{\partial G}{\partial \tau} > 0$ if Foreign retaliates reciprocally so that Home does not have an incentive to deviate from the cooperative agreement in the second stage. ■

5.2.6 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 ■

5.2.7 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 $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$, $d\tau_2 = d\tau_2^* = 0$, such that $dG_1^* < 0$ and $dG = dG_2^* = 0$. From total differentiation, $dG = \frac{\partial G}{\partial \tau_1} d\tau_1 + \frac{\partial G}{\partial \tau_1^*} d\tau_1^*$, $dG_1^* = \frac{\partial G_1^*}{\partial \tau_1} d\tau_1 + \frac{\partial G_1^*}{\partial \tau_1^*} d\tau_1^*$, and $dG_2^* = \frac{\partial G_2^*}{\partial \tau_1} d\tau_1 + \frac{\partial G_2^*}{\partial \tau_1^*} d\tau_1^*$. Therefore, $dG = 0$ if $d\tau_1 = -\frac{\partial \tau_1}{\partial G} \frac{\partial G}{\partial \tau_1^*} d\tau_1^*$ and $dG_2^* = 0$ if $d\tau_1 = -\frac{\partial \tau_1}{\partial G_2^*} \frac{\partial G_2^*}{\partial \tau_1^*} d\tau_1^*$. Notice that these two conditions are identical. This is because $\frac{\partial G}{\partial \tau_1} = -\frac{(\phi_1 \phi_1^*)^{-\sigma} \phi_1^*}{\Omega} G$, $\frac{\partial G}{\partial \tau_1^*} = \frac{\Phi_1 \phi_1^{1-\sigma}}{\Omega \Phi} G$, $\frac{\partial G_2^*}{\partial \tau_1} = \frac{\Phi(\phi_1 \phi_1^*)^{-\sigma} \phi_1^* \phi_2^{1-\sigma}}{\Omega \Phi_2} G_2^*$, and $\frac{\partial G_2^*}{\partial \tau_1^*} = -\frac{\Phi_1 \phi_1^{1-\sigma} \phi_2^{1-\sigma}}{\Omega \Phi_2} G_2^*$ so that $-\frac{\partial \tau_1}{\partial G} \frac{\partial G}{\partial \tau_1^*} = -\frac{\partial \tau_1}{\partial G_2^*} \frac{\partial G_2^*}{\partial \tau_1^*}$. Hence, along $dG = dG_2^* = 0$, $dG_1^* = \left(\frac{\partial G_1^*}{\partial \tau_1} - \frac{\partial G_1^*}{\partial \tau_1} \frac{\partial \tau_1}{\partial G} \frac{\partial G}{\partial \tau_1^*} \right) d\tau_1^*$. Notice that $\frac{\partial G_1^*}{\partial \tau_1} - \frac{\partial G_1^*}{\partial \tau_1} \frac{\partial \tau_1}{\partial G} \frac{\partial G}{\partial \tau_1^*} > 0$ for all $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$. This is because $\frac{\partial G_1^*}{\partial \tau_1} = -\frac{(\phi_1 \phi_1^*)^{-\sigma} \phi_1}{\Omega} G_1^*$ which, together with the derivatives given above, implies that $\frac{\partial G_1^*}{\partial \tau_1} - \frac{\partial G_1^*}{\partial \tau_1} \frac{\partial \tau_1}{\partial G} \frac{\partial G}{\partial \tau_1^*} = \frac{G_1^*}{\phi_1^*}$. Hence, there exist Pareto improving tariff changes $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$, $d\tau_2 = d\tau_2^* = 0$, such that $dG_1^* < 0$ and $dG = dG_2^* = 0$ 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 $d\tau_1 < 0$ and $d\tau_1^* < 0$ and are thus possible if and only if $\tau_1 > 0$ and $\tau_1^* > 0$. By symmetry, there also exist Pareto improving tariff changes $(d\tau_1, d\tau_2, d\tau_1^*, d\tau_2^*)$, $d\tau_1 = d\tau_1^* = 0$, such that $dG_2^* < 0$ and $dG = dG_1^* = 0$ 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 $d\tau_2 < 0$ and $d\tau_2^* < 0$ and are thus possible if and only if $\tau_2 > 0$ and $\tau_2^* > 0$. Therefore, only $(\tau_1, \tau_2, \tau_1^*, \tau_2^*)$ such that (i) $(\tau_1, \tau_1^*) = (\text{any possible } \tau_1, 0)$ or $(\tau_1, \tau_1^*) = (0, \text{any possible } \tau_1^*)$ and (ii) $(\tau_2, \tau_2^*) = (\text{any possible } \tau_2, 0)$ or $(\tau_2, \tau_2^*) = (0, \text{any possible } \tau_2^*)$ 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 ■

5.2.8 Proof of proposition 8

Proof. To be added ■

5.2.9 Proof of proposition 9

Proof. To be added ■

5.2.10 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, if tariff changes are nondiscriminatory and bilaterally reciprocal they must 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 tariff changes which are nondiscriminatory and bilaterally reciprocal must also be multilaterally reciprocal ■

5.2.11 Proof of proposition 11

Proof. To be added ■

5.2.12 Proof of proposition 12

Proof. To be added ■