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A "New Trade" Theory of GATT/WTO Negotiations

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I suggest a novel theory of GATT/WTO negotiations based on Krugman's "new trade" model. It emphasizes international production relocations and is easy to calibrate to bilateral trade data. Focusing on the major players in recent GATT/WTO negotiations, I find that it implies reasonable noncooperative tariffs as well as moderate gains from GATT/WTO negotiations.

I. Introduction

International trade has been liberalized dramatically since the end of World War II as a result of multilateral trade negotiations governed by the General Agreement on Tariffs and Trade (GATT) and its successor the World Trade Organization (WTO). According to WTO statistics, industrialized countries have cut their tariffs on industrial products by an average 36 percent during the first five GATT rounds (1942–62), an

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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).[1]

While the case for free trade provides good reasons for applauding this impressive success of GATT/WTO negotiations, it also makes the nature of these negotiations difficult to understand. Why do countries need to negotiate over tariff reductions? And what is the role played by the GATT/WTO's institutional design?

These questions have motivated what can be called the standard neoclassical theory of GATT/WTO negotiations. This theory invokes the classic optimal tariff argument, which is that countries impose import tariffs in order to gain at the expense of other countries by manipulating their terms of trade. It originates in the work of Johnson (1953–54), who demonstrates that countries are trapped in a prisoner's dilemma if they set optimal tariffs noncooperatively. It culminates in the work of Bagwell and Staiger (1999), who show that the GATT/WTO principles of reciprocity and nondiscrimination can be interpreted as simple negotiation rules that help countries escape this prisoner's dilemma.[2] The principles of reciprocity and nondiscrimination are usually considered to be the essence of the GATT/WTO's institutional design. Generally speaking, the former advises that tariff changes keep changes in imports equal across trading partners and the latter requires that the same tariff must be applied against all trading partners for any given traded product.[3]

For all its merits, this standard theory has two important limitations. First, it predicts that GATT/WTO negotiations should revolve solely around the issue of terms-of-trade manipulation, which seems implausible to many observers of real-world trade negotiations. Krugman (1997, 113), for example, finds the optimal tariff argument so irrelevant to actual disputes over trade policy that he even concludes that one cannot make economic sense of GATT/WTO negotiations at all. Such concerns are somewhat alleviated by recent work of Broda, Limao, and Weinstein

[1] 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 nonmembers. However, Subramanian and Wei (2007) and Tomz, Goldstein, and Rivers (2007) argue that this finding is not robust.

[2] See Bagwell and Staiger (2002) for a detailed account of the standard neoclassical theory of GATT/WTO negotiations. 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 and from the new trade theory of GATT/WTO negotiations developed in this paper in that it does not view trade negotiations as a means to internalize an international trade policy externality.

[3] 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.

(2008) and Bagwell and Staiger (forthcoming), which suggests that terms-of-trade considerations could play a role in governments' tariff choices. Yet it is hard to escape the fact that the optimal tariff argument is all but absent from the rhetoric of trade policy makers, which is starkly at odds with the exclusive role it ought to play.

Second, it is based on conventional neoclassical trade models, which are difficult to calibrate convincingly, so that little is known about its quantitative implications. This is unfortunate since many important questions are of a quantitative type. For example, are the noncooperative tariffs broadly consistent with the noncooperative tariffs observed during the tariff war following the Smoot-Hawley Tariff Act of 1930? And how large are the welfare gains from GATT/WTO negotiations?

In this paper, I suggest a novel theory of GATT/WTO negotiations that is not subject to these limitations of the standard theory. My main idea is to depart from the conventional neoclassical trade model and instead build on a Krugman (1980) "new trade" model.[4]

I first show that in a Krugman (1980) environment, GATT/WTO negotiations governed by the principles of reciprocity and nondiscrimination can be interpreted as helping governments internalize a production relocation externality. In my model, a production relocation externality arises because countries can use import tariffs to gain at the expense of other countries by attracting a larger share of manufacturing production. While trade policy makers 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. In contrast to the terms-of-trade case for protection, these motivations seem immediately consistent with real-world trade policy debates.

I then demonstrate that my model can be calibrated using an extension of the technique developed by Dekle, Eaton, and Kortum (2007). An attractive feature of this technique is that it relies directly on bilateral trade data and requires estimates of only a few parameters. Focusing on the six major players in recent GATT/WTO negotiations, I find that the predicted noncooperative tariffs have the same order of magnitude as the tariffs observed during the tariff war following the Smoot-Hawley

[4] While the argument can be made most cleanly in the context of the simple Krugman (1980) model, it generalizes to more complicated environments. For example, all results can also be derived in a variant of the Arkolakis et al. (2008) version of Melitz (2003), as I discuss in detail in a separate appendix, which is available on request.

Tariff Act of 1930.[5] I also find that the predicted welfare losses from moving to noncooperative tariffs are moderate and never exceed 35 percent of the predicted welfare losses from moving to autarky for any country in any specification.

While I am, I believe, the first to study trade negotiations in a new trade model, I am by no means the first to study trade policy in such a model. It is well known that in Krugman (1980) type environments, import tariffs generally have production relocation and terms-of-trade effects. Venables (1987) was the first to develop a version of the Krugman model that isolates production relocation effects. Gros (1987) was the first to develop a version of the Krugman model that isolates terms-of-trade effects.[6] Essentially, the positive profits made by domestic manufacturers as a result of import tariffs can be competed away either through entry, leading to a production relocation effect, or through an increase in wages, leading to a terms-of-trade effect. The relative strength of these two effects is determined by the elasticity of the labor supply curve facing the manufacturing sector as a whole. Models with freely traded homogeneous nonmanufacturing goods generate a perfectly elastic labor supply curve and therefore isolate production relocation effects. Models without nonmanufacturing goods at all generate a perfectly inelastic labor supply curve and therefore isolate terms-of-trade effects. Intermediate cases can be constructed with freely or costly traded differentiated nonmanufacturing goods.

In order to emphasize the novel features of my new trade theory of GATT/WTO negotiations, I focus on the case with only a production relocation effect. In Section II, I lay out the basic model and explain how GATT/WTO negotiations governed by the principles of reciprocity and nondiscrimination can be interpreted as helping governments internalize a production relocation externality. I keep this analysis deliberately stark with the purpose of clearly conveying my qualitative point. In Section III, I then calibrate a more realistic version of the basic model and present my quantitative results.

[5] In particular, I focus on Brazil, China, the European Union, India, Japan, and the United States since these countries are typically considered to be the main players in GATT/WTO negotiations. I aggregate all other countries into a seventh trade bloc referred to as the rest of the world.

[6] Venables (1987) studies unilateral trade policy only. Gros (1987) studies unilateral trade policy and also characterizes the noncooperative trade policy equilibrium. Neither Venables nor Gros considers trade negotiations. My paper is also related to the analysis of Baldwin and Robert-Nicoud (2000), who study Venables-type trade policy effects in an economic geography model. 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).

II. Basic Model

In this section, I lay out the basic model and explain how GATT/WTO negotiations governed by the principles of reciprocity and nondiscrimination can be interpreted as helping governments internalize a production relocation externality. I first focus on a two-country case to highlight the role played by the principle of reciprocity. I then move to a three-country extension to shed light on the role played by the principle of nondiscrimination.

A. Two-Country Case: GATT/WTO and Reciprocity

1. Setup

There are two countries, 1 and 2. Consumers have access to a continuum of differentiated manufacturing goods and a single homogeneous nonmanufacturing good. Preferences over these goods are identical across countries. They are given by the following utility functions:

$$U_j = \left[\sum_{i=1}^{2} \int_0^{n_i} m_{ij}(v_i)^{(\sigma-1)/\sigma} dv_i\right]^{\mu\sigma/(\sigma-1)} Y_j^{1-\mu}, \tag{1}$$

where m_{ij} is the quantity of a manufacturing good from country i consumed in country j, Y_j is the quantity of the nonmanufacturing good consumed in country j, n_i is the "number" of manufacturing goods produced in country i, $\sigma > 1$ is the elasticity of substitution between manufacturing 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:

$$l_j^M = f + cq_j^M, \tag{2}$$

$$l_j^Y = q_j^Y, \tag{3}$$

where l_j^M is the labor requirement for producing q_j^M units of a manufacturing good in country j, l_j^Y is the labor requirement for producing q_j^Y units of the nonmanufacturing good in country j, f denotes the fixed labor requirement of manufacturing production, and c denotes the marginal labor requirement of manufacturing production. The manufacturing good market is monopolistically competitive whereas the nonmanufacturing good market is perfectly competitive.

Tariffs are introduced as a component of "iceberg" trade costs that apply only to international manufacturing trade.[7] For one unit of a manufacturing good from country i to arrive in country j, $\theta(1 + t_{ij})$ units must be shipped and the remainder "melts away" in transit, where $\theta > 1$ is a transport cost and $t_{ij} \geq 0$ is the tariff imposed by country j against imports from country i. To economize on notation, I denote $\tau_{ij} \equiv 1 + t_{ij}$. Notice that, modeled this way, tariffs do not generate any revenue. This assumption is essential for the model's tractability but naturally restricts tariffs to be nonnegative. The results presented in this section of the paper are therefore best compared to a version of the standard neoclassical model of GATT/WTO negotiations in which tariffs are also restricted to be nonnegative. I discuss the implications of allowing for revenue-generating tariffs in the context of the quantitative analysis in Section III.

Motivated by the fact that import tariffs have always been by far the most important trade policy instruments in practice, my analysis abstracts from export policy instruments. The tariff war following the Smoot-Hawley Tariff Act of 1930 is an important case in point. It occurred before the use of export policy instruments was constrained by GATT/WTO regulations, suggesting that there are reasons why governments typically refrain from using them. I do not explore these reasons in this paper but simply assume that import tariffs are the only available trade policy instruments.[8]

I also make the following three additional assumptions: first, I restrict t_{ij} to be finite so that $\bar{t} \geq t_{ij} \geq 0$ overall, where $\bar{t}$ is an arbitrarily large but finite upper bound. This upper bound is just a technical convenience. Removing it would complicate the exposition without changing the results in any interesting way (see the Appendix for a detailed discussion of the consequences of letting $\bar{t} \to \infty$). Second, I assume that

[7] As will become clear shortly, the production relocation effect is closely related to the home market effect. Davis (1998) 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. Essentially, all that is needed for the home market effect to survive is a margin through which aggregate manufacturing employment can adjust.

[8] Bagwell and Staiger (2009) have recently argued that this assumption is crucial to be able to interpret the production relocation externality as a fundamental problem trade agreements are designed to solve. Allowing for import and export policy instruments in a framework similar to the one developed here, they show that the noncooperative equilibrium is inefficient only because of export tax–induced terms-of-trade effects since all import tariff–induced production relocation effects are exactly undone by export subsidy–induced production relocation effects. Readers who are therefore uncomfortable with my assumption should best view my analysis as an examination of the specific properties of real-world trade negotiations. In particular, GATT article 16 prohibits export subsidies for manufacturing goods, and the U.S. Constitution prohibits export taxes so that countries have access only to an incomplete set of trade policy instruments in practice. Fundamental problem or not, it seems important to understand the implications of this institutional arrangement for the motivation of trade negotiators and the efficiency of trade negotiations.

the manufacturing sector is always active in both countries. This assumption requires transport costs to be sufficiently large (see the Appendix for the precise restriction on θ). It ensures that countries can never attract all manufacturing firms through trade policy and thereby eliminates uninteresting corner solutions. Finally, I assume that the nonmanufacturing good sector is always active in both countries. This assumption requires the demand for manufacturing goods to be sufficiently small (see the Appendix for the precise parameter restriction on μ in eq. [1]). It ensures, together with the assumptions made on market structure, nonmanufacturing 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. Solution for Given Trade Policy

I choose the price of the nonmanufacturing good as the numeraire, which implies that wages are equal to one in both countries. The reason is that the nonmanufacturing good sector is always active in both countries, the nonmanufacturing good market is perfectly competitive, and the nonmanufacturing good is produced with unit efficiency everywhere and is freely traded among countries. For given tariffs, the model's solution is then determined by the market-clearing conditions for manufacturing firms in country 1 and country 2:

$$q = p^{-\sigma}G_1^{\sigma-1}\mu L_1 + p^{-\sigma}(\theta\tau_{12})^{1-\sigma}G_2^{\sigma-1}\mu L_2, \tag{4}$$

$$q = p^{-\sigma}(\theta\tau_{21})^{1-\sigma}G_1^{\sigma-1}\mu L_1 + p^{-\sigma}G_2^{\sigma-1}\mu L_2, \tag{5}$$

where $q \equiv f(\sigma-1)/c$ are the break-even outputs determined by free entry; $p \equiv \sigma c/(\sigma-1)$ are the ex–factory prices determined by profit maximization;

$$G_1 \equiv [n_1 p^{1-\sigma} + n_2(p\theta\tau_{21})^{1-\sigma}]^{1/(1-\sigma)}$$

and

$$G_2 \equiv [n_1(p\theta\tau_{12})^{1-\sigma} + n_2 p^{1-\sigma}]^{1/(1-\sigma)}$$

are the ideal manufacturing price indices; and L_1 and L_2 are the numbers of consumers or workers. Equations (4) and (5) can be solved immediately for the equilibrium manufacturing price indices:

$$G_1 = \left[\frac{qp^{\sigma}}{\mu L_1}\frac{1-(\theta\tau_{12})^{1-\sigma}}{1-(\theta\tau_{21}\theta\tau_{12})^{1-\sigma}}\right]^{1/(\sigma-1)}, \tag{6}$$

$$G_2 = \left[\frac{qp^{\sigma}}{\mu L_2}\frac{1-(\theta\tau_{21})^{1-\sigma}}{1-(\theta\tau_{21}\theta\tau_{12})^{1-\sigma}}\right]^{1/(\sigma-1)}. \tag{7}$$

If the definitions of the manufacturing price indices are substituted, they can also be solved for the equilibrium numbers of manufacturing firms:

$$n_1 = \frac{\mu}{qp}\left[\frac{L_1}{1-(\theta\tau_{12})^{1-\sigma}} - \frac{L_2(\theta\tau_{21})^{1-\sigma}}{1-(\theta\tau_{21})^{1-\sigma}}\right], \tag{8}$$

$$n_2 = \frac{\mu}{qp}\left[\frac{L_2}{1-(\theta\tau_{21})^{1-\sigma}} - \frac{L_1(\theta\tau_{12})^{1-\sigma}}{1-(\theta\tau_{12})^{1-\sigma}}\right]. \tag{9}$$

Notice that this equilibrium has three special features. First, the world number of manufacturing firms is constant since $n_1 + n_2 = \mu(L_1 + L_2)/qp$. Second, tariffs affect welfare only through the manufacturing price indices since indirect utilities are given by $V_j = \mu^{\mu}(1-\mu)^{1-\mu}L_jG_j^{-\mu}$. Finally, there can be no role for terms-of-trade effects since ex–factory prices are independent of trade policy.[9] These features all help to clarify the argument but are not crucial for the main results.

3. Production Relocation Effect and Import Price Effect

Equations (6) and (7) reveal that each country's price index is monotonically decreasing in its own tariff regardless of the other country's tariff but monotonically increasing in the other country's tariff regardless of the own tariff so that each country can always use trade policy to gain at the other country's expense. This trade policy externality is brought about by a production relocation effect. In particular, a unilateral increase in import tariffs makes foreign manufacturing goods more expensive in the domestic market so that domestic consumers shift expenditure toward domestic manufacturing goods. As a consequence, domestic manufacturing firms sell more, thus making profits, and foreign manufacturing firms sell less, thus making losses, which triggers entry into the domestic manufacturing sector and exit out of the foreign manufacturing sector, as is also reflected in equations (8) and (9). This production relocation effect reduces the domestic price index but increases the foreign price index since it reduces the share of manufacturing goods consumed by domestic consumers, which is subject to trade costs, but increases the share of manufacturing goods

[9] I follow the literature in defining the terms of trade as the ratio of ex–factory prices, which is equal to one in this model. One may object that this is too narrow a 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 still cannot be interpreted as terms-of-trade effects.

consumed by foreign consumers, which is subject to trade costs.[10] While this production relocation effect is the only channel through which domestic tariffs affect foreign welfare, domestic welfare is also affected by a counteracting but dominated import price effect. In particular, domestic import tariffs also directly increase the domestic price index by making still-imported manufacturing goods more expensive. The reason why the production relocation effect always dominates the import price effect can be best understood with the help of equations (4) and (5). With foreign import tariffs held fixed, a unilateral increase in domestic import tariffs initially increases the domestic price index because of the import price effect, which increases sales and profits of domestic firms. To restore equilibrium, there has to be entry into the domestic manufacturing sector and exit out of the foreign manufacturing sector, which reduces the domestic price index and increases the foreign price index. This effect makes it harder for domestic firms to sell goods in the domestic market but easier for domestic firms to sell goods in the foreign market so that the domestic posttariff equilibrium price index must be below its pretariff level. If it merely returned to its pretariff level, domestic firms could still export more than before and would therefore make positive profits.

4. Noncooperative Trade Policy

I now consider what happens if governments choose trade policy noncooperatively in an attempt to maximize their citizens' welfare. While welfare maximization is first and foremost a simplifying assumption, it is actually more realistic than one might think. Maggi and Goldberg (1999), for example, find that the weight of welfare in the government's objective function is many times larger than the weight of trade policy–influencing campaign contributions.

Notice first that the noncooperative equilibrium is maximum protection. This result follows immediately from the fact that each country's

[10] 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 environments. Notice that the production relocation gain still could not be interpreted as a terms-of-trade gain even if a price index–based definition of the terms of trade was adopted. The reason is that country j's terms of trade would then have to be defined as $G_j^{\exp}/G_j^{\text{imp}} = (n_j/n_i)^{1/(1-\sigma)}$ since $G_j^{\exp} = (n_j p^{1-\sigma})^{1/(1-\sigma)}$ is the world price index of country j's manufacturing exports and $G_j^{\text{imp}} = (n_i p^{1-\sigma})^{1/(1-\sigma)}$ is the world price index of country j's manufacturing imports and would therefore deteriorate and not improve in country j's tariff.

price index is monotonically decreasing in its own tariff regardless of the other country's tariff and is stated more formally in lemma 1.[11]

LEMMA 1. Suppose that governments choose tariffs simultaneously in an attempt to maximize their citizens' welfare. Then the unique Nash equilibrium is $(t_{21}, t_{12}) = (\bar{t}, \bar{t})$.

Proof. Follows immediately from equations (6) and (7). QED

Observe second that a tariff combination is efficient if and only if the tariff is zero in at least one of the countries. Intuitively, there always exists a bilateral tariff reduction that reduces one country's price index without affecting the other country's price index by appropriately balancing the import price effect and the production relocation effect. However, bilateral tariff reductions are possible only 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.[12]

LEMMA 2. The set of Pareto-efficient tariff combinations consists of all (t_{21}, t_{12}) such that either $t_{21} = 0$ or $t_{12} = 0$ or both.

Proof. See the Appendix for a formal proof.

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

PROPOSITION 1. The noncooperative equilibrium is inefficient.

Proof. Follows immediately from lemmas 1 and 2. QED

5. Trade Policy under the GATT/WTO: The Principle of Reciprocity

I now contrast this noncooperative equilibrium with the outcome achieved under the GATT/WTO principle of reciprocity as interpreted by Bagwell and Staiger (1999). Generally speaking, the principle of reciprocity advises that tariff 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 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 an

[11] This stark result emerges because production relocations are the only motivation for protection in this environment. In the presence of tariff revenue, the noncooperative equilibrium involves less than maximum protection, as I discuss in detail in the quantitative application in Sec. III. Nevertheless, the noncooperative equilibrium remains inefficient in this case since tariffs continue to entail a production relocation externality.

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

important negotiation norm 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. In light of this discussion, I adopt the following formal definition of reciprocity, where TB_j^M denotes the difference between the value of country j's manufacturing exports and imports.[13]

Definition 1. Define a tariff change to be reciprocal if it is such that $dTB_1^M = dTB_2^M = 0$.

Notice first that the principle of reciprocity completely eliminates all trade policy externalities. Given aggregate manufacturing market clearing, the number of manufacturing firms operating in country j can be decomposed as follows:

$$n_j = \frac{\mu L_j + TB_j^M}{qp}. \tag{10}$$

The numerator is just the total expenditure on country j's manufacturing goods since this can be decomposed into the total expenditure on country i's and country j's manufacturing goods by country j's consumers (μL_j), plus the total expenditure on country j's manufacturing goods by country i's consumers (manufacturing exports of country j), minus the total expenditure on country i's manufacturing goods by country j's consumers (manufacturing imports of country j). The denominator is just the (constant) sales of country j's manufacturing firms. Hence, if TB_j^M is fixed by reciprocity, country j's number of manufacturing firms is fixed as well. Intuitively, tariff-induced changes in country j's consumer expenditure toward or away from country j's manufacturing goods are then exactly offset by tariff-induced changes in country i's consumer expenditure away from or toward these goods. This result is summarized as lemma 3.[14]

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

[13] While I follow Bagwell and Staiger's (1999) interpretation of the principle of reciprocity, I adapt their formal definition to my specific setting by applying it only to manufacturing trade. This adaptation makes it distinct from the definition used by Bagwell and Staiger (2001*b*) in the comparable "outside good" setting since they continue to include nonmanufacturing trade.

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

Proof. Follows immediately from equation (10) and the definition of reciprocity. QED

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

PROPOSITION 2. Reciprocal trade liberalization monotonically increases welfare in both countries.

Proof. Follows immediately from lemma 3 and the definitions of manufacturing price indices. QED

Notice finally that the principle of reciprocity therefore not only guides countries away from the inefficient noncooperative equilibrium in a way that monotonically increases welfare in all countries but also secures negotiated tariff concessions by eliminating all incentives to reverse them. Suppose that, starting at the noncooperative equilibrium, country j assumes the leadership in trade negotiations. Then, since country i is to respond reciprocally to any tariff reduction by country j, that is, since country i is to seek a "balance of concessions," country j immediately has an incentive to initiate reciprocal trade liberalization, which monotonically increases welfare in both countries. Also, since country i is entitled to respond reciprocally to any tariff increase by country j, that is, since country i is entitled to "withdraw substantially equivalent concessions," country j never has an incentive to increase its tariff so that negotiated tariff concessions can be secured.[15] In summary,

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

the principle of reciprocity can thus be seen as helping governments escape the inefficient noncooperative equilibrium in a way that monotonically increases welfare in all countries.[16]

B. Three-Country Case: GATT/WTO and Nondiscrimination

While the basic two-country model is useful to illustrate the role played by the GATT/WTO principle of reciprocity, it is too simple to shed light on the role played by the GATT/WTO principle of nondiscrimination. For this reason, I now consider an extension of this model. In particular, I focus on the simplest possible setup that allows for discriminatory tariff setting. There are now three countries. Country 1 trades with both 2 and 3, but country 2 and country 3 trade with 1 only. Hence, only country 1 can set discriminatory tariffs.

All results regarding noncooperative trade policy naturally generalize to the three-country case. Most important, the noncooperative equilibrium is still inefficient because tariffs entail a production relocation externality that governments fail to internalize when setting tariffs noncooperatively. Readers interested in the details of the noncooperative equilibrium can find the solution of the three-country model together with the three-country versions of lemma 1, lemma 2, and proposition 1 in the Appendix.

However, this similarity conceals that tariffs now have more complicated international implications. Besides the import price effect, there is now both a bilateral and a multilateral production relocation effect. The bilateral production relocation effect acts between the two countries directly affected by the tariff and is just the production relocation effect familiar from the two-country model. The multilateral production relocation effect is an additional effect on the third country, which works through changes in country 1's manufacturing price index.

The presence of this multilateral production relocation effect implies that the key properties of the principle of reciprocity generalize to the three-country case only if countries engage in multilateral trade negotiations. To establish this, I adapt the earlier definition of reciprocity to the three-country case. Tariff changes must now be bilaterally reciprocal in bilateral trade negotiations and multilaterally reciprocal in multilateral trade negotiations, where bilaterally reciprocal and multilaterally reciprocal tariff changes are formally defined as follows.

Definition 2. Define a tariff change to be bilaterally reciprocal between country 1 and country 2 if it is such that $dTB_2^M = 0$ and bilaterally

[16] In fact, the principle of reciprocity not only helps governments escape the inefficient equilibrium but also directly guides them to efficient tariffs. The reason is that countries can liberalize their trade reciprocally unless one country has completely eliminated all its tariffs, which is sufficient for efficiency from lemma 2.

reciprocal between country 1 and country 3 if it is such that $dTB_3^M = 0$. Define a tariff change to be multilaterally reciprocal if it is such that $dTB_1^M = dTB_2^M = dTB_3^M = 0$.

Now, the principle of reciprocity eliminates all trade policy externalities only if it is applied in multilateral trade negotiations. Given aggregate manufacturing market clearing, the number of manufacturing firms operating in country j can again be decomposed as follows:

$$n_j = \frac{\mu L_j + TB_j^M}{qp}. \tag{11}$$

Hence, if country 1 and country 2 change tariffs in a bilaterally reciprocal way, the number of firms in country 2 remains unchanged. Therefore, the principle of reciprocity eliminates the bilateral production relocation effect if it is applied in bilateral trade negotiations. Also, if all countries change tariffs in a multilaterally reciprocal way, the number of firms remains unchanged in all countries. Therefore, the principle of reciprocity eliminates both the bilateral and the multilateral production relocation effect if it is applied in multilateral trade negotiations. Although not obvious from equation (11), the principle of reciprocity is not sufficient to also eliminate the multilateral production relocation effect if it is applied in bilateral trade negotiations. The reason is that bilaterally reciprocal tariff changes between country 1 and country 2 change country 1's price index, thereby affecting the profitability of firms in country 3. For example, a bilaterally reciprocal trade liberalization between country 1 and country 2 reduces the price index in country 1. This makes it harder for firms in country 3 to sell their products to country 1 so that production relocations from country 3 to country 1 have to occur in equilibrium. This result is summarized in lemma 4.

LEMMA 4. Tariff changes leave the number of firms unchanged in all countries if and only if they are multilaterally reciprocal. Moreover, bilaterally reciprocal trade liberalization between country 1 and country 2 leaves the number of firms unchanged in country 2 but monotonically increases the number of firms in country 1 at the expense of country 3. Similarly, bilaterally reciprocal trade liberalization between country 1 and country 3 leaves the number of firms unchanged in country 3 but monotonically increases the number of firms in country 1 at the expense of country 2.

Proof. See the Appendix for a formal proof.

Moreover, the principle of reciprocity now ensures that negotiated tariff concessions increase welfare monotonically in all countries only if it is applied in multilateral trade negotiations. If country 1 and country 2 liberalize in a bilaterally reciprocal way, country 2 gains because of the import price effect, country 1 gains because of the import price effect and the multilateral production relocation effect, but country 3 loses because of the multilateral production relocation effect. If, instead, country 1, country 2, and country 3 liberalize in a multilaterally reciprocal way, all countries gain because of the import price effect. This result is summarized in proposition 3.

Proposition 3. Multilaterally reciprocal trade liberalization monotonically increases welfare in all countries. Moreover, bilaterally reciprocal trade liberalization between country 1 and country 2 monotonically increases welfare in country 1 and country 2 but monotonically decreases welfare in country 3. Similarly, bilaterally reciprocal trade liberalization between country 1 and country 3 monotonically increases welfare in country 1 and country 3 but monotonically decreases welfare in country 2.

Proof. See the Appendix for a formal proof.

Hence, the principle of reciprocity now helps countries overcome the inefficient noncooperative equilibrium in a way that monotonically increases welfare in all countries only if it is applied in multilateral trade negotiations. This observation suggests that an important role played by the principle of nondiscrimination is to multilateralize trade negotiations. Under the principle of nondiscrimination, country 1 has to impose the same tariff against country 2 and country 3 so that country 1 cannot change its tariff against country 2 or country 3 only. As a consequence, country 2 and country 3 are then both authorized to respond to any tariff change by country 1 in a way that keeps their manufacturing trade balances unchanged so that multilateral reciprocity prevails.[17]

It is important to emphasize that, according to this interpretation, the principle of reciprocity alone continues to reverse all incentives for protection so that the principle of nondiscrimination plays no efficiency-enhancing role. Instead, it ensures only that all trade policy externalities are eliminated so that governments cannot gain at the expense of one

[17] This simple interpretation actually squares well with the justification given by U.S. Secretary of State Cordell Hull for making the principle of nondiscrimination a cornerstone of the U.S. Reciprocal Trade Agreements Act of 1934 on which the GATT/WTO is largely based. As summarized by Bagwell and Staiger (2002, 72), Hull regarded the principle of nondiscrimination as beneficial "since it offered a way to multilateralize the reciprocal tariff reductions that governments might negotiate bilaterally." Notice that countries do not necessarily have an incentive to engage in multilateral trade negotiations. For example, it is easy to show that country 1 would always prefer sequential bilateral trade negotiations to simultaneous multilateral trade negotiations in the special case of symmetric countries. The reason is that country 1 gains only because of the import price effect in simultaneous multilateral trade negotiations but also because of the multilateral production relocation effect in sequential bilateral trade negotiations. GATT/WTO articles allow countries to sign preferential trade agreements as an important exception to the principle of nondiscrimination. This exception has generated a debate on whether preferential trade agreements are "building blocks" or "stumbling blocks" on the way to multilateral free trade. See Panagariya (2000) for a survey of the literature.

another and welfare increases monotonically in all countries during all stages of the liberalization process.[18]

III. Quantitative Application

In this section, I calibrate a more realistic version of the basic model and present my quantitative results. This version is more realistic in four ways. First, there are now J countries and trade can flow between all of them. Second, tariffs now generate revenue that is distributed in a lump-sum fashion to consumers. Third, production and trading technologies are now asymmetric in the sense that marginal costs c and fixed costs f are allowed to vary across countries and transport costs θ are allowed to vary across exporter-importer pairs. Finally, there are now aggregate trade imbalances captured by an exogenous trade surplus parameter TB_j. Everything else is just as in the basic model.

For given tariffs, the model's solution is now determined by the following equations, which represent manufacturing market-clearing conditions, manufacturing price index definitions, and consumer expenditure conditions, respectively:

$$q_i = \sum_{j=1}^{J} p_i^{-\sigma}\theta_{ij}^{1-\sigma}\tau_{ij}^{-\sigma}G_j^{\sigma-1}\mu X_j, \quad i = 1, \dots, J, \tag{12}$$

$$G_j = \left[\sum_{i=1}^{J} n_i(p_i\theta_{ij}\tau_{ij})^{1-\sigma}\right]^{1/(1-\sigma)}, \quad j = 1, \dots, J, \tag{13}$$

$$X_j = L_j - TB_j + \sum_{i=1}^{J} t_{ij}n_i(p_i\theta_{ij})^{1-\sigma}\tau_{ij}^{-\sigma}G_j^{\sigma-1}\mu X_j, \quad j = 1, \dots, J. \tag{14}$$

[18] Notice that the principle of nondiscrimination plays a different role in Bagwell and Staiger (1999). There, it does not neutralize the multilateral terms-of-trade effect by multilateralizing trade negotiations but instead by equalizing all bilateral terms of trade. In fact, multilateralizing trade negotiations would not be sufficient to neutralize the multilateral terms-of-trade effect because the multilateral terms of trade are a trade-weighted average of the bilateral terms of trade and thus depend on trade shares unless the bilateral terms of trade are equalized. One implication of this difference is that the principles of reciprocity and nondiscrimination neutralize all third-party externalities without requiring any third-party response in Bagwell and Staiger (1999). Notice that reciprocal trade liberalization no longer necessarily leads to efficient tariffs if the principle of nondiscrimination is imposed. The reason is that reciprocity and nondiscrimination can be satisfied only if all tariffs are lowered simultaneously, as can be easily established by differentiating the three-country versions of the manufacturing market-clearing conditions. But this is impossible if at least one of the tariffs is equal to zero, which is not sufficient for efficiency, as can be seen from the three-country version of lemma 2. 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.

The key difference compared to the basic model is that consumer expenditure now consists of labor income minus the aggregate trade surplus plus tariff revenue necessitating the introduction of the consumer expenditure variable X_j and the consumer expenditure condition (14).[19] Denoting the counterfactual value of t_{ij} by t'_{ij} and counterfactual changes in τ_{ij} by $\hat{\tau}_{ij} \equiv (1 + t'_{ij})/(1 + t_{ij})$ and so forth, one can easily verify using the technique of Dekle et al. (2007) that equations (12)–(14) can be rewritten in changes as

$$1 = \sum_{j=1}^{J} \alpha_{ij}(\hat{\tau}_{ij})^{-\sigma}(\hat{G}_j)^{\sigma-1}\hat{X}_j, \quad i = 1, \ldots, J, \tag{15}$$

$$\hat{G}_j = \left[\sum_{i=1}^{J} \beta_{ij}\hat{n}_i(\hat{\tau}_{ij})^{1-\sigma}\right]^{1/(1-\sigma)}, \quad j = 1, \ldots, J, \tag{16}$$

$$\hat{X}_j = \gamma_j + \sum_{i=1}^{J} \delta_{ij}t'_{ij}\hat{n}_i(\hat{\tau}_{ij})^{-\sigma}(\hat{G}_j)^{\sigma-1}\hat{X}_j, \quad j = 1, \ldots, J, \tag{17}$$

where α_{ij}, β_{ij}, γ_j, and δ_{ij} are simple functions of μ, tariffs, and trade flows only.[20] In particular, $\alpha_{ij} \equiv T_{ij}/S_i$, $\beta_{ij} \equiv \tau_{ij}T_{ij}/\mu X_j$, $\gamma_j \equiv (X_j - R_j)/X_j$, and $\delta_{ij} \equiv T_{ij}/X_j$, where T_{ij} denotes the total value of trade flowing from country i to country j evaluated at world prices; $S_i \equiv \sum_{j=1}^{J} T_{ij}$ denotes the total value of manufacturing sales of firms from country i evaluated at world prices; $X_j \equiv (1/\mu)\sum_{i=1}^{J} \tau_{ij}T_{ij}$ denotes the total expenditure of consumers in country j; and $R_j \equiv \sum_{i=1}^{J} t_{ij}T_{ij}$ denotes the tariff revenue of country j. Given estimates of μ and σ as well as data on tariffs and trade flows only, equations (15)–(17) can be used to compute the counterfactual changes in manufacturing price indices $\hat{G}_j$, numbers of manufacturing firms $\hat{n}_i$, and consumer expenditures $\hat{X}_j$ induced by counterfactual tariffs t'_{ij}. Counterfactual changes in welfare can then be calculated from $\hat{V}_j = \hat{X}_j(\hat{G}_j)^{-\mu}$ since indirect utility is now given by $V_j = \mu^{\mu}(1-\mu)^{1-\mu}X_jG_j^{-\mu}$.

I use trade and tariff data for the year 2004. I focus on the main players in recent GATT/WTO negotiations—Brazil, China, the European Union, India, Japan, and the United States—and aggregate all other countries into a seventh trade bloc, which I refer to as the rest

[19] Also, q_j and p_j are now country specific since marginal costs and fixed costs are allowed to vary across countries, θ_{ij} is exporter-importer pair specific, and τ_{ij} enters only with a coefficient of $-\sigma$ into the manufacturing market-clearing condition since it is no longer part of the iceberg trade barriers and therefore does not generate any indirect demand.

[20] Caliendo and Parro (2010) were the first to apply the technique of Dekle et al. (2007) to an analysis of tariff changes.

TABLE 1
AGGREGATED TRADE MATRIX FROM DEKLE ET AL. (2007)

	ROW	European Union	Brazil	China	India	Japan	United States
ROW	3,907.4	551.6	15.1	434.4	20.4	91.2	550.8
European Union	656.9	6,372.9	14.3	83.6	16.9	48.3	235.9
Brazil	24.1	9.3	314.6	2.1	.3	1.0	16.4
China	349.7	161.6	3.9	801.7	7.0	82.4	212.2
India	18.6	17.3	.4	6.2	387.0	1.4	14.6
Japan	191.8	96.1	2.9	123.1	2.9	3,074.1	128.4
United States	390.4	177.4	10.7	45.6	5.5	44.0	5,201.3

NOTE.—Entry (i, j) is factual exports from i to j in US$ billions in 2004.

TABLE 2
AGGREGATED TARIFF MATRIX FROM BOUMELLASSA ET AL. (2009)

	ROW	European Union	Brazil	China	India	Japan	United States
ROW	.0	2.5	12.7	4.2	14.8	1.3	2.2
European Union	7.0	.0	12.7	4.2	14.8	1.3	2.2
Brazil	7.0	2.5	.0	4.2	14.8	1.3	2.2
China	7.0	2.5	12.7	.0	14.8	1.3	2.2
India	7.0	2.5	12.7	4.2	.0	1.3	2.2
Japan	7.0	2.5	12.7	4.2	14.8	.0	2.2
United States	7.0	2.5	12.7	4.2	14.8	1.3	.0

NOTE.—Entry (i, j) is the factual tariff imposed by j against imports from i in percent in 2004.

of the world (ROW).[21] I construct the matrix of trade flows exactly as in Dekle et al. (2007) and also work with their parameter estimates $\mu = 0.188$ and $\sigma = 9.28$ or, alternatively, $\sigma = 4.60$.[22] I construct the matrix of tariffs by taking simple averages over the applied manufacturing protection rates reported by Boumellassa, Laborde, and Mitaritonna (2009).[23] I present my trade and tariff data in tables 1 and 2.

Before I implement the full seven–trade bloc case, it is instructive to turn to a simple two–trade bloc example to illustrate the implications of tariff revenue and to motivate the algorithm used for computing

[21] I aggregate Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom into the European Union since these were the member states at the beginning of 2004. The European Union is a customs union and therefore sets a common external tariff. I include Hong Kong in my definition of China.

[22] In particular, I downloaded their GDP data, trade balance data, and international trade data from the Web site of Sam Kortum and followed their exact procedure to compute internal trade flows. Notice that μ compares to α in their paper and σ compares to $1 + \theta$ in their paper.

[23] Consistent with the principle of nondiscrimination, these manufacturing protection rates vary by importer only.

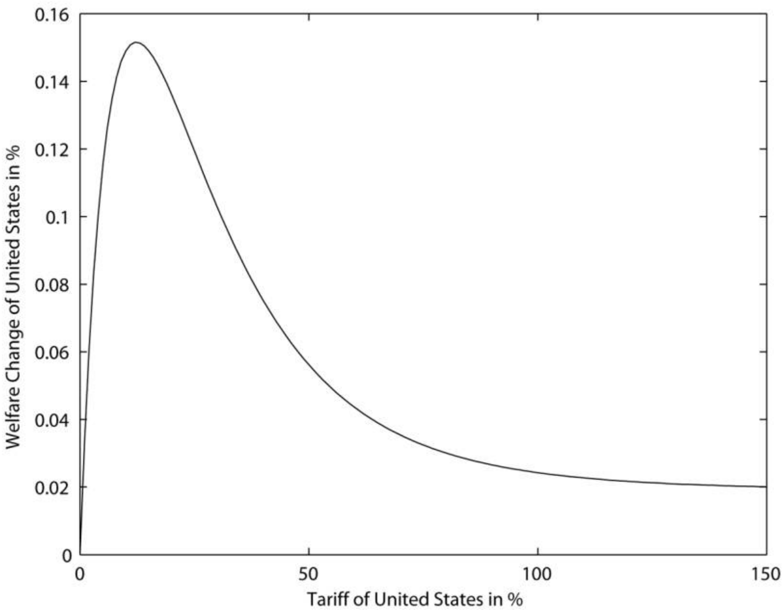

FIG. 1.—Optimal tariff with tariff revenue

Nash tariffs. I generate such an example by keeping the United States only and aggregating all other countries into the rest of the world. Figure 1 shows how U.S. welfare varies in the U.S. tariff and reveals that there is now an interior optimal tariff. The reason is that tariff revenue is hump shaped in the tariff and the welfare loss due to a reduction in tariff revenue dominates the welfare gain due to additional production relocations at some point. Figure 2 plots the U.S. optimal tariff against the tariff of the rest of the world and vice versa, suggesting that Nash tariffs can be computed using a simple iterative algorithm. In particular, the Nash equilibrium can be found by first computing the U.S. optimal tariff given a guess of the rest of the world's optimal tariff, then computing the rest of the world's optimal tariff given the U.S. optimal tariff, and so on, as this procedure quickly converges to the point at which both reaction functions cross. Both figures take all factual tariffs to be zero for simplicity and focus on the case $\sigma = 9.28$ only but look similar under alternative assumptions.

Tables 3 and 4 report the Nash tariffs for the full seven–trade bloc case computed using this simple algorithm under the assumption of $\sigma = 9.28$ and $\sigma = 4.60$, respectively. Nash tariffs are predicted to be relatively similar across trade bloc pairs. They range between 10.3 percent and 13.0 percent in the case of $\sigma = 9.28$ and between 25.6 percent

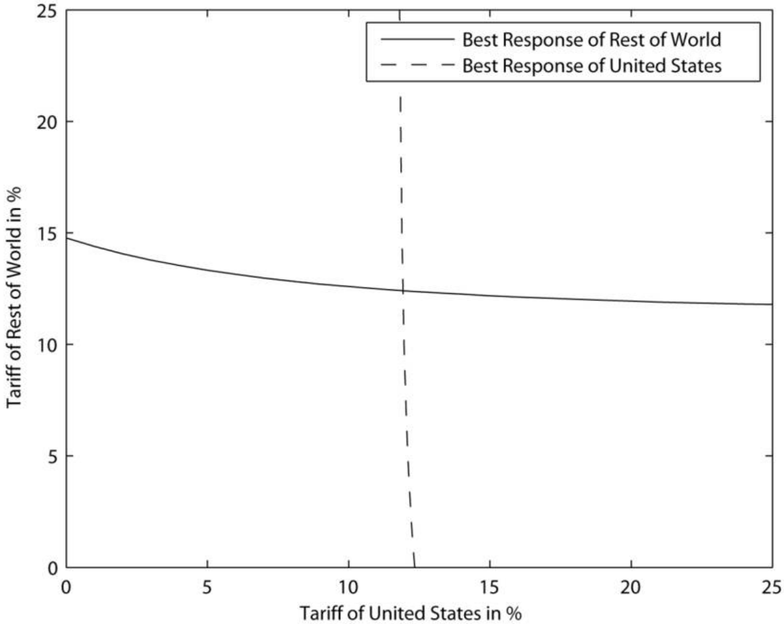

FIG. 2.—Reaction functions and Nash equilibrium

and 28.9 percent in the case of $\sigma = 4.60$. The tariffs observed during the trade war following the Smoot-Hawley Tariff Act of 1930 are typically reported to be around 50 percent (see, e.g., Bagwell and Staiger 2002, 43). While a direct comparison is difficult given the differences in the set of players and the timing of the experiment, it is still noteworthy that my stylized production relocation model generates Nash tariffs that have the same order of magnitude as these actual noncooperative tariffs. In contrast, the stylized terms-of-trade model calibrated by Perroni and Whalley (2000) predicts Nash tariffs of up to 1,000 percent.[24]

Table 5 presents the counterfactual welfare changes from moving to the predicted Nash tariffs. They range between 0.01 percent and −0.36 percent in the case of $\sigma = 9.28$ and between −0.05 percent and −1.20 percent in the case of $\sigma = 4.60$. With the exception of the United States, all countries are always predicted to be strictly worse off in the case of a tariff war. It is well known from Kennan and Riezman (1988) that big countries can win a tariff war since their tariffs inflict large externalities

[24] To the best of my knowledge, Perroni and Whalley (2000) is the only quantitative study of noncooperative trade policy that has a scope similar to that of the analysis provided here. Earlier studies such as Whalley (1985, 231–49) were forced to restrict attention to simple two-country cases because of computational constraints faced at the time.

TABLE 3
Nash Tariffs with $\sigma = 9.28$

	ROW	European Union	Brazil	China	India	Japan	United States
ROW	.0	13.0	12.1	11.6	12.0	12.4	12.4
European Union	11.0	.0	12.1	11.9	12.0	12.1	12.0
Brazil	11.6	12.5	.0	12.0	12.1	12.2	12.3
China	10.3	11.5	12.0	.0	12.0	12.5	10.9
India	12.2	12.5	12.1	12.0	.0	12.1	12.1
Japan	11.3	12.0	12.1	11.6	12.1	.0	11.9
Unitd States	11.4	12.1	12.1	12.0	12.1	12.1	.0

Note.—Entry (i, j) is the counterfactual Nash tariff imposed by j against imports from i in percent.

TABLE 4
Nash Tariffs with $\sigma = 4.60$

	ROW	European Union	Brazil	China	India	Japan	United States
ROW	.0	28.7	27.8	26.2	27.7	28.3	27.8
European Union	26.3	.0	27.7	27.6	27.8	27.8	27.7
Brazil	26.7	28.2	.0	27.6	27.8	27.9	27.8
China	28.4	26.9	27.7	.0	27.7	28.9	25.6
India	27.5	28.0	27.8	27.5	.0	27.8	27.6
Japan	26.6	27.5	27.8	26.9	27.8	.0	27.5
United States	27.0	27.8	27.8	27.8	27.8	27.9	.0

Note.—Entry (i, j) is the counterfactual Nash tariff imposed by j against imports from i in percent.

TABLE 5
Welfare Losses from Moving to Nash Tariffs

	$\sigma = 9.28$			$\sigma = 4.60$		
	Nash	Autarky	Relative	Nash	Autarky	Relative
ROW	−.28	−1.19	23.31	−.65	−2.23	29.22
European Union	−.03	−.41	6.42	−.18	−.86	21.20
Brazil	−.12	−.67	18.68	−.34	−1.13	30.18
China	−.36	−1.94	18.77	−1.20	−3.97	30.36
India	−.12	−.66	19.07	−.34	−1.08	31.60
Japan	−.08	−.39	20.87	−.30	−.87	34.86
United States	.01	−.35	−3.06	−.05	−.71	6.49

Note.—Entries under Nash are counterfactual welfare changes from moving to Nash tariffs, in percent; entries under Autarky are counterfactual welfare changes from moving to autarky, in percent; and entries under Relative are entries under Nash relative to entries under Autarky, in percent (computed from nonrounded values).

on other countries. Countries are typically said to win a tariff war if they are better off under noncooperative tariffs than under free trade. Table 5, instead, states that the United States may be better off under noncooperative tariffs than under factual tariffs. Notice that factual tariffs are relatively low for the United States so that the United States also simply has a lot of room to increase tariffs in case of a tariff war.

Table 5 also reports the counterfactual welfare changes from moving to autarky and puts the counterfactual welfare changes from moving to the predicted Nash tariffs in relation to them. These ratios range between -3.06 percent and 23.31 percent in the case of $\sigma = 9.28$ and between 6.49 percent and 34.86 percent in the case of $\sigma = 4.60$. On average, the losses from moving to Nash tariffs amount to a sizable fraction of the losses from moving to autarky. Notice that these ratios are robust to misspecifications of the model if these misspecifications affect the losses from moving to Nash tariffs and the losses from moving to autarky proportionately. One apparent misspecification is the absence of intermediate goods. Intermediate goods are difficult to include in the specific setup developed here since they turn the model into a version of the Krugman and Venables (1995) “new economic geography” model featuring multiple equilibria if a reasonable value for manufacturing value added is chosen.[25]

While tariffs have already been cut substantially as a result of GATT/WTO negotiations, the model suggests that there is still room for further Pareto-improving tariff changes. Suppose, for example, that countries implement tariff changes that maximize the mean welfare change subject to the constraints that no welfare change is negative and no tariff is negative. In the case of $\sigma = 9.28$, the resulting mean welfare increase is predicted to be 0.11 percent. In the case of $\sigma = 4.60$, it is predicted to be 0.09 percent.

IV. Conclusion

In this paper, I developed a novel theory of GATT/WTO negotiations based on the Krugman (1980) new trade model. Unlike the standard terms-of-trade theory, it emphasizes international production relocations and is easy to calibrate to bilateral trade data. Focusing on the major players in recent GATT/WTO negotiations, I found that it implies

[25] In particular, entry leads to a reduction in the price index due to an increase in the number of goods. Without intermediate goods, this decreases profits only by increasing competition and thereby discourages further entry. With intermediate goods, however, it also increases profits by reducing costs and thereby encourages further entry. If intermediate goods are sufficiently important, the latter effect dominates, which gives rise to a process of cumulative causation. Notice that the absence of wage effects makes this scenario particularly likely in the specific setup developed here.

reasonable noncooperative tariffs and moderate gains from GATT/WTO negotiations.

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*a*) 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 (2006) to evaluate the GATT/WTO rules on production subsidies.

Appendix

A. *Basic Model: Two-Country Case*

1. Parameter Restrictions

The manufacturing sector is active in both countries for all possible (t_{21}, t_{12}) if and only if $\theta \geq [L_1/(L_1 + L_2)]^{1/(1-\sigma)}$ and $\theta \geq [L_2/(L_1 + L_2)]^{1/(1-\sigma)}$. The nonmanufacturing good sector is active in both countries for all possible (t_{21}, t_{12}) if and only if $\mu \leq 1 - \theta^{1-\sigma}$.

2. Proof of Lemma 2

A tariff combination (t_{21}, t_{12}) cannot be Pareto efficient if there exist possible Pareto-improving tariff changes (dt_{21}, dt_{12}) at (t_{21}, t_{12}). This includes tariff changes (dt_{21}, dt_{12}) such that $dG_2 < 0$ and $dG_1 = 0$. From total differentiation,

$$dG_1 = \frac{\partial G_1}{\partial t_{21}} dt_{21} + \frac{\partial G_1}{\partial t_{12}} dt_{12}$$

and

$$dG_2 = \frac{\partial G_2}{\partial t_{21}} dt_{21} + \frac{\partial G_2}{\partial t_{12}} dt_{12}.$$

Therefore, $dG_1 = 0$ if

$$dt_{21} = -\frac{\partial t_{21}}{\partial G_1} \frac{\partial G_1}{\partial t_{12}} dt_{12}$$

so that

$$dG_2 = \left(\frac{\partial G_2}{\partial t_{12}} - \frac{\partial G_2}{\partial t_{21}} \frac{\partial t_{21}}{\partial G_1} \frac{\partial G_1}{\partial t_{12}}\right) dt_{12}$$

along $dG_1 = 0$. Notice that

$$\frac{\partial G_2}{\partial t_{12}} - \frac{\partial G_2}{\partial t_{21}} \frac{\partial t_{21}}{\partial G_1} \frac{\partial G_1}{\partial t_{12}} > 0$$

for all (t_{21}, t_{12}). The reason is that

$$\frac{\partial G_1}{\partial t_{21}} = -\frac{(\theta\tau_{21}\theta\tau_{12})^{-\sigma}\theta\tau_{12}}{1-(\theta\tau_{21}\theta\tau_{12})^{1-\sigma}}\theta G_1,$$

$$\frac{\partial G_1}{\partial t_{12}} = \frac{[1-(\theta\tau_{21})^{1-\sigma}](\theta\tau_{12})^{-\sigma}}{[1-(\theta\tau_{12})^{1-\sigma}][1-(\theta\tau_{21}\theta\tau_{12})^{1-\sigma}]}\theta G_1,$$

$$\frac{\partial G_2}{\partial t_{21}} = \frac{[1-(\theta\tau_{12})^{1-\sigma}](\theta\tau_{21})^{-\sigma}}{[1-(\theta\tau_{21})^{1-\sigma}][1-(\theta\tau_{21}\theta\tau_{12})^{1-\sigma}]}\theta G_2,$$

$$\frac{\partial G_2}{\partial t_{12}} = -\frac{(\theta\tau_{21}\theta\tau_{12})^{-\sigma}\theta\tau_{21}}{1-(\theta\tau_{21}\theta\tau_{12})^{1-\sigma}}\theta G_2$$

so that

$$\frac{\partial G_2}{\partial t_{12}} - \frac{\partial G_2}{\partial t_{21}}\frac{\partial t_{21}}{\partial G_1}\frac{\partial G_1}{\partial t_{12}} = \frac{G_2}{\tau_{12}}.$$

Hence, there exist Pareto-improving tariff changes (dt_{21}, dt_{12}) for all (t_{21}, t_{12}). These (dt_{21}, dt_{12}) are such that $dt_{21} < 0$ and $dt_{12} < 0$ and are thus possible if and only if $t_{21} > 0$ and $t_{12} > 0$. Therefore, only (t_{21}, t_{12}) such that either $t_{21} = 0$ or $t_{12} = 0$ or both can be Pareto efficient. It is easy to verify that for none of these (t_{21}, t_{12}) does there exist another (t_{21}, t_{12}) that makes one country better off without making the other country worse off. Therefore, they are also indeed Pareto efficient. QED

B. Basic Model: Three-Country Case

1. Parameter Restrictions

The manufacturing sector is active in all countries for all possible (t_{21}, t_{31}, t_{12}, t_{13}) if and only if $\theta \geq [L_1/(L_1 + L_2 + L_3)]^{1/(1-\sigma)}$, $\theta \geq [L_2/(L_1 + 2L_2)]^{1/(1-\sigma)}$, and $\theta \geq [L_3/(L + 2L_3)]^{1/(1-\sigma)}$.[26] The nonmanufacturing good sector is active in all countries for all possible (t_{21}, t_{31}, t_{12}, t_{13}) if and only if $\mu \leq 1 - 2\theta^{1-\sigma}$.

2. Solution for Given Trade Policy

For given tariffs, the model's solution is determined by the manufacturing market-clearing conditions

$$q = p^{-\sigma}G_1^{\sigma-1}\mu L_1 + p^{-\sigma}(\theta\tau_{12})^{1-\sigma}G_2^{\sigma-1}\mu L_2 + p^{-\sigma}(\theta\tau_{13})^{1-\sigma}G_3^{\sigma-1}\mu L_3, \tag{A1}$$

$$q = p^{-\sigma}(\theta\tau_{21})^{1-\sigma}G_1^{\sigma-1}\mu L_1 + p^{-\sigma}G_2^{\sigma-1}\mu L_2, \tag{A2}$$

[26] Notice that this restriction gets stronger the more countries are featured in the analysis. It should, however, not be taken literally empirically since wage adjustments are ruled out in order to cleanly isolate production relocation effects. If positive profits could also be competed away by wage adjustments instead of entry, a milder parameter restriction would be sufficient to guarantee diversified manufacturing production.

$$q = p^{-\sigma}(\theta\tau_{31})^{1-\sigma}G_1^{\sigma-1}\mu L_1 + p^{-\sigma}G_3^{\sigma-1}\mu L_3, \tag{A3}$$

where $q \equiv f(\sigma - 1)/c$ and $p \equiv \sigma c/(\sigma - 1)$ as in the two-country case, but the ideal manufacturing price indices are now given by

$$G_1 \equiv [n_1 p^{1-\sigma} + n_2(p\theta\tau_{21})^{1-\sigma} + n_3(p\theta\tau_{31})^{1-\sigma}]^{1/(1-\sigma)},$$

$$G_2 \equiv [n_1(p\theta\tau_{12})^{1-\sigma} + n_2 p^{1-\sigma}]^{1/(1-\sigma)},$$

$$G_3 \equiv [n_1(p\theta\tau_{13})^{1-\sigma} + n_3 p^{1-\sigma}]^{1/(1-\sigma)}.$$

Equations (A1)–(A3) can be solved immediately for the equilibrium manufacturing price indices

$$G_1 = \left(\frac{qp^\sigma}{\mu L_1}\frac{\Phi_1}{\Omega}\right)^{1/(\sigma-1)}, \tag{A4}$$

$$G_2 = \left(\frac{qp^\sigma}{\mu L_2}\frac{\Phi_2}{\Omega}\right)^{1/(\sigma-1)}, \tag{A5}$$

$$G_3 = \left(\frac{qp^\sigma}{\mu L_3}\frac{\Phi_3}{\Omega}\right)^{1/(\sigma-1)}, \tag{A6}$$

where

$$\Phi_1 \equiv 1 - (\theta\tau_{12})^{1-\sigma} - (\theta\tau_{13})^{1-\sigma}, \tag{A7}$$

$$\Phi_2 \equiv 1 - (\theta\tau_{21})^{1-\sigma} - (\theta\tau_{13})^{1-\sigma}[(\theta\tau_{31})^{1-\sigma} - (\theta\tau_{21})^{1-\sigma}], \tag{A8}$$

$$\Phi_3 \equiv 1 - (\theta\tau_{31})^{1-\sigma} - (\theta\tau_{12})^{1-\sigma}[(\theta\tau_{21})^{1-\sigma} - (\theta\tau_{31})^{1-\sigma}], \tag{A9}$$

$$\Omega \equiv 1 - (\theta\tau_{21}\theta\tau_{12})^{1-\sigma} - (\theta\tau_{31}\theta\tau_{13})^{1-\sigma}. \tag{A10}$$

It is easy to verify that Φ_1, Φ_2, Φ_3, and $\Omega > 0$ given the assumed parameter restrictions. If the definitions of manufacturing price indices are substituted, they can also be solved for the equilibrium numbers of manufacturing firms:

$$n_1 = \frac{\mu}{qp}\left[\frac{L_1}{\Phi_1} - \frac{L_2(\theta\tau_{21})^{1-\sigma}}{\Phi_2} - \frac{L_3(\theta\tau_{31})^{1-\sigma}}{\Phi_3}\right], \tag{A11}$$

$$n_2 = \frac{\mu}{qp}\left\{\frac{L_2[1 - (\theta\tau_{31}\theta\tau_{13})^{1-\sigma}]}{\Phi_2} + \frac{L_3(\theta\tau_{12}\theta\tau_{31})^{1-\sigma}}{\Phi_3} - \frac{L_1(\theta\tau_{12})^{1-\sigma}}{\Phi_1}\right\}, \tag{A12}$$

$$n_3 = \frac{\mu}{qp}\left\{\frac{L_3[1 - (\theta\tau_{21}\theta\tau_{12})^{1-\sigma}]}{\Phi_3} + \frac{L_2(\theta\tau_{21}\theta\tau_{13})^{1-\sigma}}{\Phi_2} - \frac{L_1(\theta\tau_{13})^{1-\sigma}}{\Phi_1}\right\}. \tag{A13}$$

As in the two-country case, the world number of manufacturing firms is constant, tariffs affect welfare only through the manufacturing price indices, and there can be no role for terms-of-trade effects.

3. Three-Country Version of Lemma 1

Suppose that governments choose tariffs simultaneously in an attempt to maximize their citizens' welfare. Then the unique Nash equilibrium is $(t_{21}, t_{31}, t_{12}, t_{13}) = (\bar{t}, \bar{t}, \bar{t}, \bar{t})$.

Proof. Follows immediately from equations (A4)–(A6). QED

4. Three-Country Version of Lemma 2

The set of Pareto-efficient tariff combinations consists of all $(t_{21}, t_{31}, t_{12}, t_{13})$ such that either $t_{12} = t_{13} = 0$ or $t_{21} = t_{31} = 0$ or both.

Proof. A tariff combination $(t_{21}, t_{31}, t_{12}, t_{13})$ cannot be Pareto efficient if there exist possible Pareto-improving tariff changes $(dt_{21}, dt_{31}, dt_{12}, dt_{13})$ at $(t_{21}, t_{31}, t_{12}, t_{13})$. This includes tariff changes $(dt_{21}, dt_{31}, dt_{12}, dt_{13})$, $dt_{31} = dt_{13} = 0$, such that $dG_2 < 0$ and $dG_1 = dG_3 = 0$. From total differentiation,

$$dG_1 = \frac{\partial G_1}{\partial t_{21}} dt_{21} + \frac{\partial G_1}{\partial t_{12}} dt_{12},$$

$$dG_2 = \frac{\partial G_2}{\partial t_{21}} dt_{21} + \frac{\partial G_2}{\partial t_{12}} dt_{12},$$

$$dG_3 = \frac{\partial G_3}{\partial t_{21}} dt_{21} + \frac{\partial G_3}{\partial t_{12}} dt_{12}.$$

Therefore, $dG_1 = 0$ if

$$dt_{21} = -\frac{\partial t_{21}}{\partial G_1} \frac{\partial G_1}{\partial t_{12}} dt_{12}$$

and $dG_3 = 0$ if

$$dt_{21} = -\frac{\partial t_{21}}{\partial G_3} \frac{\partial G_3}{\partial t_{12}} dt_{12}.$$

Notice that these two conditions are identical. The reason is that

$$\frac{\partial G_1}{\partial t_{21}} = -\frac{(\theta\tau_{21}\theta\tau_{12})^{-\sigma}\theta\tau_{12}}{\Omega}\theta G_1,$$

$$\frac{\partial G_1}{\partial t_{12}} = \frac{\Phi_2(\theta\tau_{12})^{-\sigma}}{\Omega\Phi_1}\theta G_1,$$

$$\frac{\partial G_3}{\partial t_{21}} = \frac{\Phi_1(\theta\tau_{21}\theta\tau_{12})^{-\sigma}\theta\tau_{12}(\theta\tau_{31})^{1-\sigma}}{\Omega\Phi_3}\theta G_3,$$

$$\frac{\partial G_3}{\partial t_{12}} = -\frac{\Phi_2(\theta\tau_{12})^{-\sigma}(\theta\tau_{31})^{1-\sigma}}{\Omega\Phi_3}\theta G_3$$

so that

$$-\frac{\partial t_{21}}{\partial G_1} \frac{\partial G_1}{\partial t_{12}} = -\frac{\partial t_{21}}{\partial G_3} \frac{\partial G_3}{\partial t_{12}}.$$

Hence, along $dG_1 = dG_3 = 0$,

$$dG_2 = \left(\frac{\partial G_2}{\partial t_{12}} - \frac{\partial G_2}{\partial t_{21}}\frac{\partial t_{21}}{\partial G_1}\frac{\partial G_1}{\partial t_{12}}\right)dt_{12}.$$

Notice that

$$\frac{\partial G_2}{\partial t_{12}} - \frac{\partial G_2}{\partial t_{21}}\frac{\partial t_{21}}{\partial G_1}\frac{\partial G_1}{\partial t_{12}} > 0$$

for all $(t_{21}, t_{31}, t_{12}, t_{13})$. The reason is that

$$\frac{\partial G_2}{\partial t_{12}} = -\frac{(\theta\tau_{21}\theta\tau_{12})^{-\sigma}\theta\tau_{21}}{\Omega}\theta G_2$$

and

$$\frac{\partial G_2}{\partial t_{21}} = \frac{\Phi_1[1-(\theta\tau_{31}\theta\tau_{13})^{1-\sigma}](\theta\tau_{21})^{-\sigma}}{\Omega\Phi_2}\theta G_2,$$

which, together with the derivatives given above, implies that

$$\frac{\partial G_2}{\partial t_{12}} - \frac{\partial G_2}{\partial t_{21}}\frac{\partial t_{21}}{\partial G_1}\frac{\partial G_1}{\partial t_{12}} = \frac{G_2}{\tau_{12}}.$$

Hence, there exist Pareto-improving tariff changes $(dt_{21}, dt_{31}, dt_{12}, dt_{13})$, $dt_{31} = dt_{13} = 0$, such that $dG_2 < 0$ and $dG_1 = dG_3 = 0$ for all $(t_{21}, t_{31}, t_{12}, t_{13})$. These $(dt_{21}, dt_{31}, dt_{12}, dt_{13})$ are such that $dt_{21} < 0$ and $dt_{12} < 0$ and are thus possible if and only if $t_{21} > 0$ and $t_{12} > 0$. This also includes tariff changes $(dt_{21}, dt_{31}, dt_{12}, dt_{13})$, $dt_{31} = dt_{12} = 0$, such that $dG_2 < 0$ and $dG_1 = dG_3 = 0$. From total differentiation,

$$dG_1 = \frac{\partial G_1}{\partial t_{21}}dt_{21} + \frac{\partial G_1}{\partial t_{13}}dt_{13},$$

$$dG_2 = \frac{\partial G_2}{\partial t_{21}}dt_{21} + \frac{\partial G_2}{\partial t_{13}}dt_{13},$$

$$dG_3 = \frac{\partial G_3}{\partial t_{21}}dt_{21} + \frac{\partial G_3}{\partial t_{13}}dt_{13}.$$

Therefore, $dG_1 = 0$ if

$$dt_{13} = -\frac{\partial t_{13}}{\partial G_1}\frac{\partial G_1}{\partial t_{21}}dt_{21}$$

and $dG_3 = 0$ if

$$dt_{13} = -\frac{\partial t_{13}}{\partial G_3}\frac{\partial G_3}{\partial t_{21}}dt_{21}.$$

Notice that these two conditions are identical. The reason is that

$$\frac{\partial G_1}{\partial t_{13}} = \frac{\Phi_3(\theta\tau_{13})^{-\sigma}}{\Omega\Phi_1}\theta G_1$$

and

$$\frac{\partial G_3}{\partial t_{13}} = -\frac{(\theta\tau_{31}\theta\tau_{13})^{-\sigma}\theta\tau_{31}}{\Omega}\theta G_3,$$

which, together with the derivatives given above, implies that

$$-\frac{\partial t_{13}}{\partial G_1}\frac{\partial G_1}{\partial t_{21}} = -\frac{\partial t_{13}}{\partial G_3}\frac{\partial G_3}{\partial t_{21}}.$$

Hence, along $dG_1 = dG_3 = 0$,

$$dG_2 = \left(\frac{\partial G_2}{\partial t_{21}} - \frac{\partial G_2}{\partial t_{13}}\frac{\partial t_{13}}{\partial G_1}\frac{\partial G_1}{\partial t_{21}}\right) dt_{21}.$$

Notice that

$$\frac{\partial G_2}{\partial t_{21}} - \frac{\partial G_2}{\partial t_{13}}\frac{\partial t_{13}}{\partial G_1}\frac{\partial G_1}{\partial t_{21}} > 0$$

for all $(t_{21}, t_{31}, t_{12}, t_{13})$. The reason is that

$$\frac{\partial G_2}{\partial t_{13}} = -\frac{\Phi_3(\theta\tau_{13})^{-\sigma}(\theta\tau_{21})^{1-\sigma}}{\Omega\Phi_2}\theta G_2,$$

which, together with the derivatives given above, implies that

$$\frac{\partial G_2}{\partial t_{21}} - \frac{\partial G_2}{\partial t_{13}}\frac{\partial t_{13}}{\partial G_1}\frac{\partial G_1}{\partial t_{21}} = \frac{\Phi_1(\theta\tau_{21})^{-\sigma}}{\Phi_2}\theta G_2.$$

Hence, there exist Pareto-improving tariff changes $(dt_{21}, dt_{31}, dt_{12}, dt_{13})$, $dt_{31} = dt_{12} = 0$, such that $dG_2 < 0$ and $dG_1 = dG_3 = 0$ for all $(t_{21}, t_{31}, t_{12}, t_{13})$. These $(dt_{21}, dt_{31}, dt_{12}, dt_{13})$ are such that $dt_{21} < 0$ and $dt_{13} < 0$ and are thus possible if and only if $t_{21} > 0$ and $t_{13} > 0$. Symmetric arguments can be made for tariff changes $(dt_{21}, dt_{31}, dt_{12}, dt_{13})$, $dt_{21} = dt_{12} = 0$, such that $dG_3 < 0$ and $dG_1 = dG_2 = 0$ and tariff changes $(dt_{21}, dt_{31}, dt_{12}, dt_{13})$, $dt_{21} = dt_{13} = 0$, such that $dG_3 < 0$ and $dG_1 = dG_2 = 0$. Therefore, only $(t_{21}, t_{31}, t_{12}, t_{13})$ such that either $t_{12} = t_{13} = 0$ or $t_{21} = t_{31} = 0$ or both can be Pareto efficient. It is easy to verify that for none of these $(t_{21}, t_{31}, t_{12}, t_{13})$ does there exist another $(t_{21}, t_{31}, t_{12}, t_{13})$ that makes one country better off without making at least one of the other countries worse off. Therefore, they are also indeed Pareto efficient.

5. Three-Country Version of Proposition 1

The noncooperative equilibrium is inefficient.

Proof. Follows immediately from the three-country versions of lemmas 1 and 2. QED

6. Proof of Lemma 4

The statement that tariff changes leave the number of firms unchanged in all countries if and only if they are multilaterally reciprocal follows immediately from equation (11) and the definition of multilateral reciprocity. Similarly, the statement that bilaterally reciprocal trade liberalization between country 1 and country 2 (country 3) leaves the number of firms unchanged in country 2 (country 3) follows immediately from equation (11) and the definition of bilateral reciprocity. Finally, the statement that bilaterally reciprocal trade liberalization between country 1 and country 2 (country 3) monotonically increases the number of firms in country 1 at the expense of country 3 (country 2) follows from the fact that $dn_1 + dn_2 + dn_3 = 0$ together with the observation that

$dn_3/dt_{21} > 0$ if $dt_{31} = dt_{13} = dn_2 = 0$ ($dn_2/dt_{31} > 0$ if $dt_{21} = dt_{12} = dn_3 = 0$), which can be easily established from equation (A3) (eq. [A2]). QED

7. Proof of Proposition 3

Follows immediately from lemma 4 and the definitions of manufacturing price indices. QED

C. *Effects of* $\bar{t} \to \infty$

If $\bar{t} \to \infty$, the two-country version of lemma 1, the three-country version of lemma 1, lemma 4, and proposition 3 would have to be modified as follows.

Effect on the two-country version of lemma 1.—If $\bar{t} \to \infty$, $(\bar{t}, \bar{t})$ would no longer be the unique Nash equilibrium but instead the unique trembling-hand perfect Nash equilibrium. In particular, $\partial G_1/\partial t_{21} \to 0$ if $t_{12} \to \infty$ and $\partial G_2/\partial t_{12} \to 0$ if $t_{21} \to \infty$, as can be seen from equations (6) and (7). Therefore, all (t_{21}, t_{12}) such that $(t_{21}, t_{12}) = (\text{any } t_{21}, \bar{t})$ or $(t_{21}, t_{12}) = (\bar{t}, \text{any } t_{12})$ would then also be Nash equilibria. However, only $(\bar{t}, \bar{t})$ would be robust to small perturbations in the governments' strategies because $\partial G_1/\partial t_{21} < 0$ as soon as $t_{12} < \infty$ and $\partial G_2/\partial t_{12} < 0$ as soon as $t_{21} < \infty$.

Effect on the two-country version of lemma 1.—This is analogous to the effect on the two-country version of lemma 1. If $\bar{t} \to \infty$, $(\bar{t}, \bar{t}, \bar{t}, \bar{t})$ would no longer be the unique Nash equilibrium but instead the unique trembling-hand perfect Nash equilibrium since all other Nash equilibria would not be robust to small perturbations in the governments' strategies.

Effect on lemma 4.—If $\bar{t} \to \infty$, the statement on bilaterally reciprocal trade liberalization would have to be qualified. In particular, bilaterally reciprocal trade liberalization between country 1 and country 2 would then leave the number of firms unchanged in country 2 but increase the number of firms in country 1 at the expense of country 3 if $t_{31} < \infty$ and leave the number of firms unchanged in all countries if $t_{31} \to \infty$. The latter case arises because $\partial G_3/\partial t_{21} = \partial G_3/\partial t_{12} = 0$ if $t_{31} \to \infty$, as can be seen from equation (A6). Similarly, bilaterally reciprocal trade liberalization between country 1 and country 3 would then leave the number of firms unchanged in country 3 but increase the number of firms in country 1 at the expense of country 2 if $t_{21} < \infty$ and leave the number of firms unchanged in all countries if $t_{21} \to \infty$. The latter case arises because $\partial G_2/\partial t_{31} = \partial G_2/\partial t_{13} = 0$ if $t_{21} \to \infty$, as can be seen from equation (A5).

Effect on proposition 3.—This follows directly from the effect on lemma 4. If $\bar{t} \to \infty$, the statement on bilaterally reciprocal trade liberalization would have to be qualified. In particular, bilaterally reciprocal trade liberalization between country 1 and country 2 would then monotonically increase welfare in country 1 and country 2 but monotonically decrease welfare in country 3 if $t_{31} < \infty$ and monotonically increase welfare in country 1 and country 2 but leave welfare unchanged in country 3 if $t_{31} \to \infty$. Similarly, bilaterally reciprocal trade liberalization between country 1 and country 3 would then monotonically increase welfare in country 1 and country 3 but monotonically decrease welfare in country

2 if $t_{21} < \infty$ and monotonically increase welfare in country 1 and country 3 but leave welfare unchanged in country 2 if $t_{21} \rightarrow \infty$.

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