Tariffs and the Most Favored Nation Clause

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Abstract

In the standard oligopoly model of intraindustry trade, this paper explores the economics of the most-favored-nation (MFN) principle when tariffs are used to extract rents from foreign firms. Countries are assumed to differ with respect to their production technologies, generating a rationale for tariff discrimination. While each country's MFN adoption increases total world welfare, all countries choose to practice tariff discrimination. The country whose adoption of MFN contributes most to world welfare loses the most from doing so. Since inefficient exporters bear relatively higher tariffs under MFN relative to full tariff discrimination, countries with inefficient technologies not only refuse *reciprocal* MFN adoption with other countries but also lose if *others* engage in reciprocal MFN adoption amongst themselves. However, even reciprocal MFN adoption among a set of countries necessarily improves world welfare.

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1. Introduction

The most favored nation (MFN) clause is an integral part of all multilateral trade agreements. For example, this clause constitutes the very first article of the General Agreement on Tariffs and Trade (GATT). Similarly, the other major multilateral agreements of the World Trade Organization (WTO) (such as the General Agreement on Trade in Services or the Agreement on Trade Related Aspects of Intellectual Property Rights) also contain an MFN clause. In fact, as Horn and Mavroidis (2000) note, along with national treatment, MFN constitutes one of the two pillars of the WTO.

At the core of MFN is the idea of non-discrimination. As Jackson (1997) notes: "The MFN obligation calls for each contracting party (of the GATT) to grant to every other contracting party the most favorable treatment that it grants to any other country." Yet, as noted by several recent surveys (see Staiger, 1995, and Horn and Mavroidis, 2000), the economics of MFN are not very well understood. Since there is no strong general case for non-discrimination in trade policy, the pervasiveness of MFN requires explanation. This paper develops some simple models to highlight the implications of MFN for equilibrium tariffs.[1] Furthermore, the goal is to isolate the implications of MFN for tariff policies of individual countries without requiring them to engage in *trade liberalization* (as in Ludema, 1991, Caplin and Krishna, 1998). The point here is to isolate how the principle of MFN *alone* affects equilibrium tariffs.

This paper explores two underlying reasons that may generate a rationale for tariff discrimination: in the model, both market size and production technology differ across countries. Furthermore, unlike Bagwell and Staiger (1999) and other related works where countries impose tariffs to improve their terms of trade, in the present model tariffs are used to extract rents from foreign firms (as in Brander

[1] The paper restricts attention to tariffs, as these were the original instrument to which MFN was applicable, at least in the context of the WTO. Furthermore, it focuses attention on the principle of MFN and abstracts from several crucial aspects of trade agreements. For example, in recent work, Ethier (2000a and 2000b) has highlighted the inter-relationships between MFN, reciprocity, unilateralism, and multilateralism. Also see Bagwell and Staiger (1997) for an overview of theoretical work dealing with MFN and reciprocity.

and Spencer, 1984). Hence, imperfect competition is central to the model and the trade that occurs is intraindustry. As in Brander and Krugman (1983), the model is partial equilibrium in nature and demand and cost conditions are parametrized in order to facilitate analytical derivations.[2]

The basic model is a three stage game involving three countries. Production in each country is carried out by a single firm and all firms sell in all markets that are assumed to be segmented (so that equilibrium prices generally differ across countries).[3] In the first stage, all countries simultaneously decide whether or not to commit to the MFN clause (i.e. to commit to non-discriminatory trade policies). Next, given their MFN commitments, countries choose their trade policies (a vector of specific import tariffs) to maximize their own welfare (defined as the sum of local firm's profits, consumer surplus, and tariff revenue). Finally, firms choose their output levels and consumption takes place. When free to discriminate across exporting countries, each country levies a higher tariff on the more efficient exporter (see also Gatsios, 1991, Hwang and Mai, 1991, and Choi, 1995). Under MFN, the (in)efficient exporter bears a (higher) lower tariff relative to the discriminatory tariff equilibrium. As might be expected, no country has a unilateral incentive to adopt MFN, and in equilibrium, each country chooses discriminatory tariffs.

The question then becomes whether, from the viewpoint of world welfare, such an outcome is desirable. It turns out that it is not: each country's MFN adoption increases aggregate world welfare. The intuition for this result is that MFN eliminates the bias against efficient production thereby ensuring that more of the world's output is produced at lower cost. Alternatively, each country's discriminatory tariffs divert trade from the efficient source toward the inefficient source and MFN improves world welfare by eliminating this trade diversion.

Since countries are asymmetric in the model, some natural questions arise:

[2] For general equilibrium analyses of MFN, see Bagwell and Staiger (1999), and Takemori (1994).

[3] See Brander and Krugman (1983) for an early treatment of effects of trade restrictions under segmented markets. More recently, in a model quite similar to ours, Krishna (1998) explores how regional trade agreements affect the incentives for multilateral liberalization.

Which country loses the most lose by adopting MFN? Which country's adoption of MFN contributes most to world welfare? Interestingly, the country whose adoption of MFN is the most valuable, i.e. the country with the *intermediate technology*, is precisely the one that loses the most from adopting MFN. This conflict between individual country incentives and world welfare implies that coordination (or international transfers) among countries over MFN must recognize that, despite its flavor of non-discrimination, MFN generates *asymmetric* losses and benefits for adopting and recipient countries.

Since MFN treatment can be extended on a *selective basis* – witness the annual ritual in the U.S. Congress over China's MFN status – examining the consequences of MFN under the assumption that MFN implies symmetric treatment of *all* trading partners misses some important aspects of MFN.[4] In fact, existing literature has restricted attention to the case where MFN is either granted on a multilateral basis or not at all.[5] By contrast, the present paper also examines a country's incentive to grant MFN to only a subset of its trading partners. The relevant questions are: how does the cost of granting MFN to a country depend upon its production efficiency?[6] Does selective MFN adoption necessarily raise world welfare? Since no country has a unilateral incentive to adopt MFN (of any kind: multilateral or selective), can *reciprocal* adoption of MFN (i.e. country i and j agree to grant MFN to each other) be sustained in equilibrium?[7] Accordingly, the model is extended to allow each country to offer MFN to any other country conditional on that country offering MFN in return. The main result here is that

[4] Often, MFN is viewed as 'symmetric treatment for all'. In fact, if country i grants country j MFN status, it simply agrees to treat country j *no worse than any other country*. Under selective MFN, the distinction between 'symmetric treatment for all' and 'treatment no worse than that given to another country' becomes crucial.

[5] See Jackson (1997) for a discussion of how MFN and multilateralism, while related, are quite distinct conceptually.

[6] Given the nature of equilibrium discriminatory tariffs, granting MFN to the inefficient exporter imposes no costs on a country since it can still employ its optimal discriminatory tariffs. By contrast, when granting MFN to the efficient exporter, an importing country is forced to treat the two exporters symmetrically.

[7] Note the distinction from *reciprocity* which applies to symmetric *trade liberalization* (see Bagwell and Staiger, 1997 and 1999).

the country with the least efficient technology has no incentive to engage in reciprocal adoption whereas the other two countries do. Furthermore, all else equal, the country with the bigger market gains less from reciprocal adoption whereas the country with the efficient technology gains more. Thus, if the bigger country also has the better technology, the gains from reciprocal adoption are somewhat evenly distributed between the two countries.

To capture the general forces behind the results, the model is generalized to allow for n countries, where $n > 3$. It is shown that results regarding the nature of discriminatory tariffs as well as the welfare implications of MFN hold in n country model, subject to some minor modifications. For example, a country suffers a higher tariff in the absence of MFN iff its marginal cost of production is lower than the *average* marginal cost of all its exporting competitors. An important implication of this result is that the distribution of technologies across countries determines *how many gain* and *how many lose* when any one country decides to adopt MFN. Similar to the three country model, MFN adoption by the country with the average technology generates the strongest welfare gains.

The idea of selective MFN is also explored in greater detail in the general model. We find that when granting MFN to only country j, country i finds it optimal to grant MFN to a set of countries with technologies less efficient than some threshold technology. However, such 'automatic' MFN status immiserizes the recipient countries relative to a world of optimal discriminatory tariffs. These distributional issues notwithstanding, selective MFN adoption raises world welfare.

The paper is organized as follows. Section 2 describes and analyzes the basic three country model and notes the implications of MFN for equilibrium tariffs. Section 3 considers the incentives for MFN adoption on the part of individual countries and studies the welfare effects of MFN. Section 4 studies reciprocal adoption while section 5 presents the general model. Section 6 concludes.

2. Basic model

There are three countries indexed by i, where $i = 1, 2$, or 3. There are two goods: x and y, and preferences over these goods are quasi-linear:

$$U(x, y) = u(x) + y$$

Good y is the numeraire good produced under perfect competition with constant returns to scale technology. Good x is produced by a monopolist in each country. We will refer to country i's monopolist as firm i. The marginal cost of production for firm i is given by c_i, where $c_3 \geq c_2 \geq c_1$.

Firms compete in quantities (Cournot competition) and make independent decisions regarding how much to sell in each market (i.e. markets are segmented). Firm i faces a specific tariff t_{ij} when exporting to country j, where $t_{ii} = 0$ for all i. These tariffs are endogenously determined (see below). Denote the tariff schedule of country i by $\mathbf{t_i} \equiv (t_{ji},\, t_{ki})$ and that of countries j and k by $\mathbf{t_{-i}}$, where $\mathbf{t_{-i}} \equiv (t_{ij},\, t_{kj}, t_{ik},\, t_{jk})$. And finally, denote the vector of all countries trade policies by $\mathbf{t}$, where $\mathbf{t} \equiv (t_{ji},\, t_{ki},\, t_{ji},\, t_{kj}, t_{ik},\, t_{jk})$.

Furthermore, assume that $u(x)$ is quadratic so that the demand curve for good x is linear in each country:

$$p_i = A_i - \sum_j x_{ji}(\mathbf{t}) \tag{2.1}$$

where x_{ji} denotes the output sold by firm j in country i and $i, j = 1, 2, 3$. To examine the implications of MFN, consider a three stage game. In the first stage, countries simultaneously decide whether or not to adopt MFN with respect to their tariff schedules. Each country has a binary decision: to commit to MFN or not. Next, countries choose their tariffs simultaneously. Finally, firms choose their output levels.

2.1. Discriminatory tariffs

To obtain a subgame perfect Nash equilibrium, we solve the model backwards. Suppose no country commits to MFN in the first stage. At the product market stage, there are three first order conditions for profit maximization for each firm (one for each market $i, j = 1, 2$, and 3):

$$p_i + p_i' x_{ji} = t_{ji} + c_j \tag{2.2}$$

Utilizing the demand functions in (2.1), the above first order conditions can be easily solved for equilibrium outputs and profits of all firms. These expressions are standard and are reported in the appendix.

Moving back, next consider the trade policy stage. At this stage, countries simultaneously choose their tariff schedules to maximize their own welfare. Country i solves:

$$\underset{t_{ji},\, t_{ki}}{Max} \;\; W_i(t_{ji},\, t_{ki}, \mathbf{t}_{-i}) \equiv CS_i(t_{ji},\, t_{ki}) + \pi_i(t_{ji},\, t_{ki}, \mathbf{t}_{-i}) + TR_i(t_{ji},\, t_{ki}) \tag{2.3}$$

where CS_i denotes consumer surplus in country i and is given by

$$CS_i = u(x_i) - p_i x_i,$$

$\pi_i(t_{ji},\, t_{ki}, \mathbf{t}_{-i})$ denotes the profit function of firm i and is given by

$$\pi_i = (p_i - c_i) x_{ii}$$

and $TR_i(t_{ji},\, t_{ki})$ denotes country i's total tariff revenue and it equals:

$$TR_i = \sum_{j \neq i} t_{ji} x_{ji}(t_{ji},\, t_{ki})$$

Since markets are segmented and marginal costs are constant, a country's tariff schedule depends neither upon the tariff schedules of other countries nor upon the size of their markets.[8] Solving the welfare problem specified in (2.3)

[8] A similar independence of trade policies also arises in Staiger (1995) because demand is assumed to be independent across countries. This independence is unlikely in the real world but, as Staiger (1995) notes, it is also not clear how a country's optimal tariff schedule *ought* to depend upon other countries schedules. Consequently, independence is a useful simplifying feature.

delivers country i's optimal discriminatory tariff schedule:

$$\mathbf{t_i^*} = \{t_{ji}^*,\, t_{ki}^*\} \equiv Arg \max W_i(t_{ji},\, t_{ki}, \mathbf{t}_{-i})$$

The following is shown in the appendix:

Proposition 1: *Country i's optimal tariff on country j (t_{ji}^*) is (i) increasing in its own market size (A_i); (ii) decreasing in the marginal costs of firms i and j; and (ii) increasing in the marginal cost of firm k. Furthermore, $c_j + t_{ji}^* \leq c_k + t_{ki}^*$* iff $c_j \leq c_k$.

The main point of proposition 1 is to demonstrate that there are two different reasons why optimal tariffs differ across countries. First, all else equal, a bigger country levies higher tariffs. This result is analogous to the well known idea that bigger countries have a stronger incentive to impose tariffs to improve their terms of trade. Here the motivation is to extract rents, and a bigger market implies there are more rents to be extracted. The second point of the above proposition is that each country imposes a higher tariff on the relatively efficient exporter.

Why is the discriminatory tariff schedule biased *against* the efficient exporter? Suppose country i were to treat both exporters symmetrically so that $t_{ji}^* = t_{ki}^*$. Now imagine a small change in country i's tariff policy whereby it increases t_{ji}^* by a small amount ε and decreases t_{ki}^* by the same amount such that country j remains the efficient supplier *under the new tariff schedule* (i.e., it still exports more to country i than country k). Such a policy change does not alter country i's total imports since these depend only upon the sum of marginal cost of the two exporters.[9] As a result, the only component of country i's welfare that is affected is tariff revenue. In fact, this policy change *increases* country i's total tariff revenue. We know

$$dTR_i = dt_{ji}^* x_{ji}^* + t_{ji}^* dx_{ji}^* + dt_{ki}^* x_{ki}^* + t_{ki}^* dx_{ki}^*$$

[9] It is a standard result that under Cournot competition with constant marginal costs of production, industry output (and therefore equilibrium price) only depends upon the sum total of marginal costs of all firms.

Since $dt^*_{ji} = \varepsilon$ and $dt^*_{ki} = -\varepsilon$, we have

$$\begin{aligned} dTR_i &= \varepsilon(x^*_{ji} - x^*_{ki}) + t^*_{ji}dx^*_{ji} + t^*_{ki}dx^*_{ki} \\ &= \varepsilon(x^*_{ji} - x^*_{ki}) + (t^*_{ji} - t^*_{ki})dx^*_{ji} + t^*_{ki}(dx^*_{ji} + dx^*_{ki}) \end{aligned}$$

Since country i's total imports are unchanged ($dx^*_{ji} + dx^*_{ki} = 0$) and because we began with $t^*_{ki} = t^*_{ji}$, we have

$$dTR_i = \varepsilon(x^*_{ji} - x^*_{ki}) > 0 \tag{2.4}$$

Thus, beginning at $t^*_{ki} = t^*_{ji}$, country i's tariff revenue (and total welfare) increases if it increases the tariff on the efficient exporter and decreases the tariff on the inefficient exporter. It is immediate from (2.4) that the bigger the technology gap between the two exporters, the stronger will be tariff discrimination.

The last part of proposition 1 states that the higher tariff on the efficient exporter does *not* reverse the true efficiency ranking of the two exporters. Why is it the *not* the case that $c_j + t^*_{ji} > c_k + t^*_{ki}$? Suppose it were. Since $c_j < c_k$, it must be that $t^*_{ji} > t^*_{ki}$. Now, imagine a small change in country i's tariff policy whereby it reduces t^*_{ji} by a small amount ε and increases t^*_{ki} by the same amount such that country j remains the inefficient supplier *under* the new tariff schedule. We can argue that tariff revenue must increase due to this policy change:

$$\begin{aligned} dTR_i &= \varepsilon(x^*_{ki} - x^*_{ji}) + t^*_{ji}dx^*_{ji} + t^*_{ki}dx^*_{ki} \\ &= \varepsilon(x^*_{ki} - x^*_{ji}) + (t^*_{ji} - t^*_{ki})dx^*_{ji} + t^*_{ki}(dx^*_{ji} + dx^*_{ki}) \end{aligned}$$

Since $dx^*_{ji} + dx^*_{ki} = 0$, we must have:

$$dTR_i = \varepsilon\underset{+}{(x^*_{ki} - x^*_{ji})} + \underset{+}{(t^*_{ji} - t^*_{ki})}\underset{+}{dx^*_{ji}} > 0$$

where $dx^*_{ji} > 0$ because country j's tariff has been reduced.

In other words, if the efficiency ranking were reversed due to tariffs, country i would be able to increase its tariff revenue by lowering the tariff on the truly efficient supplier (country j) and increasing it on country k. This argument applies as long as country i's tariff schedule forces the truly efficient source to actually become inefficient (i.e. $c_j + t^*_{ji} > c_k + t^*_{ki}$). Thus, if tariffs are optimally chosen, it must be that $c_j + t^*_{ji} \leq c_k + t^*_{ki}$. Note also that when $t^*_{ji} = t^*_{ki}$, we will have $x^*_{ki} < x^*_{ji}$ so that it is optimal for country i to increase its tariff on country j and lower it on country k. Thus, it must be that $t^*_{ji} > t^*_{ki}$ *and* $c_j + t^*_{ji} \leq c_k + t^*_{ki}$.

In equilibrium, each country implements its optimal tariff schedule $\{t^*_{ji}, t^*_{ki}\}$ for $i, j, k = 1, 2$ and 3, $i \neq j, i \neq k$ which discriminates against the efficient exporter.

How does a country's optimal policy change as a result of MFN adoption? We examine this question next.

2.2. Tariffs under MFN

Since a country's tariff schedule has no affect on another country's tariffs, if one country were to adopt MFN, the other countries would still implement their optimal tariff schedules. Under MFN, country i solves the following problem:

$$\underset{t_i}{Max} \;\; W^M_i(t_i, \mathbf{t}_{-i}) \equiv CS_i(t_i, \mathbf{t}_{-i}) + \pi_i(t_i, \mathbf{t}_{-i}) + t_i \sum_{j \neq i} x_{ij}(t_i, \mathbf{t}_{-i}) \tag{2.5}$$

The problem above differs from the problem in (2.3) in only respect: now country i imposes the same tariff t_i on both exporters. Define country i's optimal MFN tariff as

$$t^M_i \equiv Arg \max W^M_i(t_i, \mathbf{t}_{-i})$$

This tariff is derived in the appendix. The result below notes some of its properties:

Proposition 2A: *Country i's MFN tariff has the following properties: (i) it increasing in its own market size (A_i); (ii) decreasing in the marginal cost of production of all firms (iii) is bound by its unconstrained optimal tariffs:* $t^*_{ki} \leq t^M_i \leq t^*_{ji}$ *iff* $c_k \geq c_j$ *and (iv)* $2t^M_i = t^*_{ki} + t^*_{ki}$.

The last part of the above proposition is crucial. It informs us that if country i adopts a symmetric tariff schedule, it *does not* lower tariffs on both countries. Instead, it increases its tariff on the inefficient exporter and decreases it on the efficient exporter. Thus, MFN adoption by a country has *distributional* implications for its trading partners.

Since

$$t_i^M = \frac{t_{ji}^* + t_{ki}^*}{2}$$

equilibrium price in a country does *not* depend upon whether or not it commits to MFN. However, tariff revenue declines due to MFN adoption. Since $t_{ji}^* - t_i^M = t_i^M - t_{ki}^*$, the tariff reduction enjoyed by the efficient exporter is equal in magnitude to the tariff increase suffered by the inefficient exporter. However, since $c_j + t_{ji}^* < c_k + t_{ki}^*$, the tariff reduction applies to a larger volume of imports than the tariff increase. As a result, total tariff revenue of country i falls if it adopts MFN. Since tariff policies are independent across countries, the adoption of MFN by a country constrains its choice set without altering the choices of others. As a result, *no country has a unilateral incentive to adopt MFN*.[10]

Note also that it is *not* immediately obvious that the adoption of MFN is actually welfare improving since MFN adoption by country i does *not* result in unambiguous trade liberalization. Define world welfare as the sum of welfare in each country:

$$W(\mathbf{t}) \equiv \sum_{i=1}^{3} W_i(\mathbf{t})$$

Proposition 3: *Each country's MFN adoption increases world welfare.*

The above proposition is an important result of the paper and it delivers strong support for the MFN principle. World welfare improves due to MFN since discriminatory tariffs encourage production with inefficient technologies (recall that each country's optimal discriminatory tariff is higher on the efficient exporter). By removing the bias against efficient production, MFN ensures that more of the world's output is produced at lower cost than is possible under discriminatory trade policies.[11]

Given the asymmetry across countries, two natural questions arise: Who loses the most from MFN adoption? Which country's MFN adoption is most valuable

[10] Furthermore, given that a country's optimal policy is independent of other countries' policies, it does not matter whether MFN decisions are made simultaneously or sequentially so long as they are made non-cooperatively.

[11] Of course, MFN adoption by a country is not welfare improving in the Pareto sense.

for world welfare?

Proposition 4: *The country whose MFN adoption is most valuable for world welfare, i.e. country 2, is the one that loses the most by adopting MFN. Among countries 1 and 3, the country whose MFN adoption is relatively more valuable loses relatively more by adopting MFN.*

How much an importing country loses from MFN adoption depends upon the degree of technological asymmetry between its trading partners. Adoption of MFN hurts country 2 the most because it loses the most tariff revenue by such a policy change: under MFN it is forced to treat two highly asymmetric sources of supply symmetrically. Country 2's optimal tariffs introduce the strongest distortion in world trade: they divert production from the most efficient source (country 1) to the least efficient source (country 3). By contrast, if either country 1 or country 3 do not abide by MFN, the distortion introduced is smaller since production is re-allocated between countries that do not differ as much from each other in production efficiency as do countries 1 and 3.

Adoption of MFN is more costly for country 3 than it is for country 1 if the technology gap between countries 1 and 2 is bigger than the technology gap between countries 2 and 3, precisely the conditions under which country 3's MFN adoption is more valuable for world welfare than is country 1's MFN adoption.

3. Reciprocal adoption of MFN

The logic of the GATT is *not* that each country unilaterally adopt MFN but rather that each member country adopt MFN on a multilateral basis. Thus, a natural question is: given that no country will adopt MFN unilaterally, are any two countries willing to adopt MFN on a *reciprocal* basis? If so, how does this willingness depend upon their market sizes and production technologies?[12]

To answer these questions, consider a modified version of our basic model. In the first stage of the game, any country can offer reciprocal MFN adoption to any

[12] Since coordination may be costly and one should expect those countries that have the most to gain from such cooperation to be one's that initiate the process.

other country. Under reciprocal MFN adoption, each country agrees to impose a tariff on the other that is no higher than its tariff on the third country.

For any country, the cost of agreeing to reciprocal adoption with another is the loss in tariff revenue implied by MFN whereas the benefit is the increase in profits enjoyed by its own firm due to a (potentially) lower tariff.

Proposition 5: *The country with the least efficient technology (country 3) refuses reciprocal adoption with either of the other two counties (1 and 2). Furthermore, it loses even if the other two countries agree to reciprocal adoption with each other.*

An implication of the above result is that in the absence of side-payments and transfers between countries, the country with the least efficient technology will not only refuse an offer of reciprocal adoption by either country but also oppose a move toward the reciprocal adoption of MFN clause by the *other two* countries.[13] The intuition here is simple: the MFN tariff of both countries 1 and 2 on country 3 is higher than their respective discriminatory tariffs. Thus, both countries 1 and 2 can pass over some of the cost of reciprocal adoption to country 3 while retaining any benefits for themselves.

But do countries 1 and 2 necessarily agree to reciprocal adoption? If so, how are the gains from this agreement split between the two? The following proposition indicates that two parameters determine how the gains from reciprocal adoption are split between the two countries:

Proposition 6: *If market size in countries 1 and 2 are equal (i.e. $A_1 = A_2$) then country 1 gains more from reciprocal adoption than country 2 (since $c_1 \leq c_2$). If technology is symmetric in the two countries (i.e. $c_1 = c_2$), the country with the smaller market size gains more from reciprocal adoption.*

When market sizes are symmetric, country 1 enjoys a greater reduction in the tariff it faces than is enjoyed by country 2 when both grant MFN to each other. When technologies are symmetric across the two countries, any given tariff concession results in greater increase in profits for the country exporting

[13] Reciprocal adoption of MFN between efficient countries is similar to the formation of a preferential trade agreement: they agree to mutual trade liberalization coupled with an increase in tariffs on the inefficient country.

to the bigger market since the concession applies to a larger volume of exports. An important implication of the above proposition is that if the smaller country also has the more efficient technology, the bigger country may not find reciprocal adoption to be in its interest. Clearly, the more symmetric they are with respect to each other (in terms of both market size and technology), the more likely it is that both gain. In fact, it is easy to show that countries 1 and 2 *necessarily* gain from reciprocal adoption if $A_1 = A_2$ and $c_1 = c_2$.[14] The real world analog of our result above is that we should expect countries that are similar to each other to initiate the process of reciprocal adoption of MFN, as indeed has been the historical experience. Of course, when countries 1 and 2 are symmetric, part of what each loses from granting MFN is offset by what the other gains. As noted earlier, the 'extra gains' come at the expense of country 3 who ends up facing higher tariffs from both countries.

Note that in the three-country model, if the two efficient countries grant MFN to each other, the third country ends up facing a higher tariff relative to the optimal discriminatory tariff (although it is treated no worse than any of the efficient countries). Since such automatic MFN treatment immiserizes the inefficient country, there is no free-rider problem.[15]

To examine the robustness of the fundamental results of the basic model, a world of n countries is considered next.

4. General model

Suppose there are n countries each with one firm and let c_i denote country i's marginal cost of production, where $c_1 \leq c_2 \leq ... \leq c_n$. As before, let t_{ji} denote the tariff facing country j's firms exports to country i.

[14] Note also that even if countries 1 and 2 are asymmetric, the above proposition implies that symmetry along one dimension need not be inimical to reciprocal adoption so long as it is counterbalanced by asymmetry along the other direction.

[15] The usual notion of free riding in the context of MFN refers to trade liberalization: any tariff reduction by a member country of the WTO automatically extends to all member countries, regardless of their willingness to liberalize in return (which creates room for reciprocity).

4.1. Discriminatory tariffs

After appropriate substitutions, welfare in country i can be written as

$$W_i(\mathbf{t}_i) = \frac{X_i^2(\mathbf{t}_i)}{2} + x_{ii}^2(\mathbf{t}_i) + \sum_{j \neq i} t_{ji} x_{ji}(\mathbf{t}_i)$$

where

$$X_i(\mathbf{t}_i) = \sum_{j=1}^{n} x_{ji}(\mathbf{t}_i)$$

denotes the total output sold in country i. It is easy to show that total output sold in country i decreases with any of its tariffs

$$\frac{\partial X_i}{\partial t_{ji}} = -\frac{1}{n+1} < 0 \text{ for } j \neq i$$

whereas country i's output and country k's exports to country i increase with the tariff on country j:

$$\frac{\partial x_{ii}}{\partial t_{ji}} = \frac{\partial x_{ki}}{\partial t_{ji}} = \frac{1}{n+1} > 0 \text{ for } j \neq i \text{ and } j \neq k$$

Finally, as expected, country j's exports to country i decrease with the tariff t_{ji}:

$$\frac{\partial x_{ji}}{\partial t_{ji}} = -\frac{n}{n+1} \text{ for } j \neq i.$$

Using the above equations, the first order conditions for welfare maximization for country i, can be written as

$$\frac{\partial W_i}{\partial t_{ji}} = -\frac{X_i}{n+1} + \frac{2x_{ii}}{n+1} + x_{ji} + \sum_{\substack{k \neq j \\ k \neq i}} \frac{t_{ki}}{n+1} - \frac{n t_j}{n+1}, \text{ for } j \neq i \tag{4.1}$$

Using the output levels from Cournot competition, we have:

$$x_{ki}(\mathbf{t}_i^*) - x_{ji}(\mathbf{t}_i^*) = c_j + t_{ji} - (c_k + t_{ki}) \tag{4.2}$$

Furthermore, using the first order conditions (4.1), we have

$$t_{ji}^* - t_{ki}^* = x_{ji}(\mathbf{t}_i^*) - x_{ki}(\mathbf{t}_i^*) \tag{4.3}$$

Using the last two equations, we get

$$t_{ji}^* - t_{ki}^* = \frac{c_k - c_j}{2}$$

The crucial feature of proposition 1 (the rationale for tariff discrimination) holds even in a world of n countries: each country imposes a higher tariff on efficient exporters and the efficiency ranking of countries is preserved under optimal tariffs, just as it is preserved under MFN tariffs.

Summing country i's first order conditions yields:

$$2X_i(T_i) + (n-3)x_{ii}(T_i) - 2T_i = 0 \tag{4.4}$$

where

$$T_i = \sum_{k \neq i} t_{ki}$$

is the sum of country i's tariffs. An important feature of equation (4.4) is that the total output imported by country i as well as the output of its own firm is a function of *only the sum* of its tariff rates T_i and does *not* depend upon the distribution of country i's tariffs across countries. This result is a consequence of two assumptions: firms compete in quantities and marginal cost is constant. Under these assumptions, each firm's output (and profits) depends only the sum of the marginal costs of all of its competitors, and a change in the tariff schedule of country i which does not alter T_i has no effect on the total output sold in the country (of course, exports of individual countries do change). Thus, the sum T_i can be usefully thought of as the *total protection* implemented by country i. We can solve equation (4.4) for the total protection in country i:

$$T_i^* = \frac{3(n-1)A_i + (n-5)C_{-i} - (n-1)(n-2)c_i}{n+7} \tag{4.5}$$

where C_{-i} equals the sum of marginal costs of all firms other than firm i:

$$C_{-i} = \sum_{k \neq i} c_k$$

It is easy to see that country i's total protection is increasing in its market size, decreasing in its marginal cost, and increasing in the sum of the marginal cost of all other countries (so long as $n > 5$).

Finally, the optimal tariff on country j is easily obtained from equations (4.1) and (4.5)[16]:

$$t_{ji}^* = \frac{1}{n-1}\left[\frac{C_{-i} - (n-1)c_j}{2} + T_i^*\right] \text{ for } j \neq i. \tag{4.6}$$

An interpretation of the above formula is provided after a discussion of country i's MFN tariffs.

4.2. Tariffs under MFN

Suppose country i were to grant MFN to all of its trading partners and let t_i denote its MFN tariff. Country i's optimal MFN tariff solves the following problem:

$$\underset{t_i}{Max} \;\; W_i(t_i) = \frac{X_i^2(t_i)}{2} + x_{ii}^2(t_i) + \sum_{j \neq i} t_{ji} x_{ji}(t_i)$$

The first order condition for this problem is given by

$$\frac{dW_i}{dt_i} = -2X_i + 2x_{ii}(n-3) - 2(n-1)t_i = 0, \text{ for } j \neq i \tag{4.7}$$

Let country i's total protection under MFN be defined by

$$T_i^M \equiv (n-1)t_i^M$$

[16] Note that, as in the three country model, country 1's optimal tariff on country j is increasing in its own market size, decreasing in firm j's marginal cost, and increasing in the marginal costs of all other firms (see proposition 1).

so that

$$t_i^M = \frac{T_i^M}{n-1}$$

We can rewrite equation (4.7) as:

$$\frac{dW_i}{dt_i} = -2X_i + 2x_{ii}(n-3) - 2T_i^M = 0$$

Since total output sold in country i as well as the output of the local firm depend only upon the total protection in country i, this last equation along with equation (4.4) implies that

$$T_i^M = T_i^*.$$

In other words, total (or average) protection in country i does *not* change when it grants MFN to all other countries.[17]

The optimal tariff formula in equation (4.6) immediately implies:

$$t_{ji}^* - t_i^M = \frac{-1}{n-1}\left[\frac{(n-1)c_j - C_{-i}}{2}\right] \text{ for } j \neq i.$$

which yields a generalization of proposition 2:

Proposition 2B: *Country i's optimal discriminatory tariff on country j is higher than its MFN tariff iff country j's marginal cost of production is lower than the average marginal cost of all exporters to country i:*

$$t_{ji}^* \geq t_i^M \text{ iff } c_j \leq \frac{C_{-i}}{n-1}$$

Thus, as in the basic model, when country i grants MFN to all, its most efficient trading partner necessarily gains while the least efficient one necessarily loses. However, the general model brings to light an additional insight that is not captured in the three country model: the *distribution* of technologies across countries determines *how many gain* and *how many lose* when any one country decides to grant MFN to all.

Suppose $n = 4$ and $c_2 = c$, $c_3 = \delta + c$, and $c_4 = \lambda + c$ where $\lambda \geq \delta$. Then,

[17]In fact, a stronger result is proved later in the paper (see proposition 8):

country 3 gains from country 1's MFN adoption iff

$$\delta + c \leq \frac{\lambda + c + c}{2} \Longleftrightarrow 2\delta \leq \lambda$$

If the last condition fails, the adoption of MFN by country 1 hurts countries 3 and 4 and benefits only one country 2. Thus, if one were to divide the world into a group of developed and lesser-developed countries, the above result implies that only if developed countries have relatively similar technologies should we expect all of them to benefit from MFN adoption by any one country.

As in the basic model, no country has a unilateral incentive to adopt MFN (proposition 3) and the equilibrium of the extended game (where all countries choose whether or not to adopt MFN) results in each country adopting its unconstrained optimal tariff schedule. The issue then is whether a world with MFN is an improvement over this outcome.

4.3. Welfare effects of MFN

Let country i adopt MFN toward all of its trading partners. Output and consumer welfare in all other countries is unaffected since they continue to stick with their optimal discriminatory tariffs. Second, consumers in country i are also unaffected since total output sold in country i depends only the level of total protection which is the same with or without MFN. The only issue is whether the sum of the loss suffered by country i due to decline in its tariff revenue and the loss in profits of those that face higher tariffs under MFN is dominated by the gain accruing to those that enjoy lower tariffs. World welfare improves iff

$$\sum_{j \neq i} (p(X_i(\mathbf{t_i^*})) - c_j - t_{ji}^*) x_{ji}(\mathbf{t_i^*}) + \sum_{j \neq i} t_{ji}^* x_{ji}(\mathbf{t_i^*}) < \sum_{j \neq i} (p(X_i(t_i^M)) - c_j - t_i^M) x_{ji}(t_i^M) + t_i^M \sum_{j \neq i} x_{ji}(t_i^M)$$

which can be rewritten as

$$\sum_{j \neq i} (p(X_i(\mathbf{t_i^*})) - c_j) x_{ji}(\mathbf{t_i^*}) < \sum_{j \neq i} (p(X_i(t_i^M)) - c_j) x_{ji}(t_i^M).$$

Since $T_i^M = T_i^*$, we have $p(X_i(\mathbf{t_i^*})) = p(X_i(t_i^M))$ and $\sum_{j \neq i} x_{ji}(\mathbf{t_i^*}) = \sum_{j \neq i} x_{ji}(t_i^M)$. The above inequality simplifies to:

$$\sum_{j \neq i} c_j (x_{ji}(\mathbf{t_i^*}) - x_{ji}(t_i^M)) > 0 \tag{4.8}$$

In other words, *world welfare improves when country i grants MFN status to all iff the increase in exports of each of its trading partners (caused due to MFN) is negatively correlated with their marginal costs of production.*

Thus, *if on average*, exports of efficient countries increase whereas those of inefficient countries decrease when country i adopts MFN, such a policy change improves world welfare. The intuition for this proposition is clear. Since total world output does not change due to MFN, adoption of MFN by any country improves welfare, if it improves the allocation of production across the world (i.e. if it moves production from higher cost locations to lower cost locations on average).

The above result can also be stated in terms of exogenous parameters. Since the sum of all tariffs is the same under the two scenarios (MFN to all by country i versus no MFN), the difference between country j's exports to country i under the optimal discriminatory tariff schedule and its exports under the MFN tariff equals

$$x_{ji}(\mathbf{t_i^*}) - x_{ji}(t_i^M) = t_i^M - t_{ji}^* = \frac{1}{2}\left[c_j - \frac{C_{-i}}{n-1}\right]$$

Thus, inequality (4.8) can be written as

$$\sum_{j \neq i} c_j \frac{1}{2}\left[c_j - \frac{C_{-i}}{n-1}\right] > 0$$

which is the same as

$$(n-1)\sum_{j \neq i} c_j^2 > \left[\sum_{j \neq i} c_j\right]^2 \tag{4.9}$$

delivering inequality (4.8) in terms of exogenous parameters n and c_j, $j \neq i$. It is shown in the appendix that the above inequality always holds so that proposition 3 holds in the n country model.

It is worth emphasizing that the adoption of MFN by a country can easily create many losers and few winners and yet improve total world welfare. Suppose the distribution of technologies has two widely separated peaks: $c_2 = c$ and $c_j = \phi c$, for $j = 3...n$, where $\phi > 1$ and consider MFN adoption by country 1. If ϕ is large enough, the adoption of MFN by country 1 implies that only the tariff on country 2 falls whereas tariffs on *all other* countries increase.

An interesting tension highlighted by the three country model was that the country whose adoption of MFN is most valuable is the one that loses the most from doing so (proposition 4). What aspect of this insight can be generalized to a n country world?

Proposition 4B: *Adoption of MFN by country i is more beneficial for the world than adoption by country j iff*

$$(c_i - c_j)(2\overline{c} - c_i - c_j) > 0$$

where $\overline{c} \equiv C/n$ denotes the average technology. Furthermore, if only one country is to adopt MFN, it should be the country with the average technology $\overline{c}$.

Several interesting things can be inferred from the above proposition. First, adoption of MFN by country i is as beneficial for the world as that by country j either when they have identical technologies, or when their average efficiency $\frac{c_i+c_j}{2}$ is equal to the average over all countries $\overline{c}$. In other words, the adoption of MFN by any two countries is equally beneficial for world welfare so long as their technologies are *equi-distant* from the average technology (i.e. $\overline{c} - c_i = c_j - \overline{c}$). The intuition is clear: the country with the average technology diverts trade from the most efficient countries to the least efficient countries via its discriminatory tariffs.

Furthermore, given that country i is more efficient than country j, it is better to have country i adopt MFN rather than country j iff the average efficiency of the two countries is below the average over all countries (i.e. $\frac{c_i+c_j}{2} > \overline{c}$). Conversely, if the two countries on average are more efficient than the country with the average technology, it is better to have the more efficient of the two adopt MFN. These two statements together imply that, if no country has exactly the average technology (easily possible since the number of countries is finite), then the country *closest* to the average should be the one to adopt MFN first.

In the three country model, if a country grants MFN to its efficient trading partner, the inefficient country automatically receives MFN treatment. However, in the general n country model, this is not the case. By definition, if country i grants MFN to country j, it simply agrees to treat it *no worse* than the other countries (i.e. the tariff on country j can be *no higher* than the tariffs on all other countries). What is country i's optimal tariff schedule when it grants MFN to only one country? How does this tariff schedule depend upon the identity of the country being granted MFN? Suppose country 1 is granted MFN by country i. As is known, in the absence of MFN, the lowest tariff falls on country n, the one with the worst technology. Thus, if country i grants MFN to country 1, it may be able to readjust tariffs only on countries 1 and n, *without altering the tariffs on any of the other trading partners* so long as the readjusted common tariff on countries 1 and n does not exceed the tariff on any of the other countries. But this may not be always feasible, and if so, country i may have to grant MFN to some other countries as well. Thus a new issue arises: selective MFN treatment to efficient countries need not result in MFN treatment being extended to countries with intermediate technologies. This lack of 'automatic' MFN raises the possibility of efficiency ranking of countries not being preserved under selective MFN. Presumably, this possibility can have *both efficiency and distributional consequences.*

4.4. Selective MFN in the general model

The following result (proved in the appendix) describes the effects of selective MFN on a country's optimal tariff schedule:

Proposition 7: *When country i grants MFN to country j, there exists some country s who is less efficient than country j such that all countries that are less efficient than country s automatically receive MFN treatment along with country j.*

Thus, as country j's technology improves, the set of countries that receive automatic MFN treatment (when country j is given MFN by country i) expands.

Intuitively, the more efficient a country, the higher the tariff it faces under optimal tariffs and larger the number of constraints that the MFN granting country must contend with.

Let M be the set (and the number) of countries that have MFN with country i and let N be the set (and the number) of countries that do not have MFN with country i. Since there are n countries and country i itself does not belong to either set, we must have $n = M + N + 1$. Let t_i be country's MFN tariff on all countries in the set M and let x_{mi} be the exports of a typical MFN country m to country i. Similarly, let the exports of a typical non-MFN country be given by x_{ki} and the associated tariff by t_{ki}. Let X_{MI} and X_{NI} be the aggregate exports of MFN and non-MFN countries respectively:

$$X_{MI} = \sum_{k \in M} x_{mi} \text{ and } X_{NI} = \sum_{k \in N} x_{ki}$$

We have:

Proposition 8: *Country i's average tariff is independent of the number of countries (M) it chooses to grant MFN.*

The logic of this result is given below. All supporting calculations are in the appendix. When choosing its tariffs, country i solves:

$$\underset{\mathbf{t}_i, \mathbf{t}_{ki}}{Max} \;\; W_i(t_i, \mathbf{t}_{ki}) = \frac{X_i^2(t_i, \mathbf{t}_{ki})}{2} + x_{ii}^2(t_i, \mathbf{t}_{ki}) + \sum_{k \neq i} t_{ki} x_{ki}(t_i, \mathbf{t}_{ki})$$

subject to the constraints implied by MFN:

$$t_i \leq \min\{t_k : k \in N\}$$

Let λ_k be the Lagrange multiplier associated with constraint $k : t_i - t_k \leq 0$. The MFN tariff must satisfy the following condition:

$$\frac{\partial W_i}{\partial t_i} - \lambda = 0 \text{ where } \lambda \equiv \sum_k \lambda_k \text{ and } \lambda_k \geq 0 \text{ for all } k \in N \tag{4.10}$$

whereas the first order conditions for optimal tariffs for countries in the set N are given by:

$$\frac{\partial W_i}{\partial t_{ki}} - \lambda_k = 0 \text{ for all } k \in N \tag{4.11}$$

From calculations in the appendix, we know that

$$\frac{\partial W_i}{\partial t_i} = \frac{-MX_i}{n+1} + \frac{2x_{ii}M}{n+1} + X_{MI} - \frac{Mt_i(N+2)}{n+1} + \frac{M\sum_{k\in N} t_{ki}}{n+1}$$

and that

$$\frac{\partial W_i}{\partial t_{ki}} = \frac{-X_i}{n+1} + \frac{2x_{ii}}{n+1} + x_{ki} - \frac{nt_{ki}}{n+1} + \frac{\sum_{\substack{j\in N \\ j\neq k}} t_{ji}}{n+1} + \lambda_k = 0 \text{ for all } k \in N.$$

with the associated complementary slackness conditions

$$\lambda_k(t_i - t_{ki}) = 0 \text{ for all } k \in N. \tag{4.12}$$

Note there are N such first order conditions: one for each non-MFN country. Summing these first order conditions and simplifying, we have

$$-NX_i + 2Nx_{ii} + (n+1)X_{NI} + NT_i^M - (M+2)T_i^N + \lambda(n+1) = 0 \tag{4.13}$$

where

$$T_i^M = Mt_i \text{ and } T_i^N = \sum_{j\in N} t_{ki}$$

Equation (4.10) can be written as

$$-MX_i + 2Mx_{ii} + (n+1)X_{MI} + MT_i^N - (N+2)T_i^M - \lambda(n+1) = 0 \tag{4.14}$$

Adding (4.13) and (4.14) and using $X_i = x_{ii} + X_{MI} + X_{NI}$ and $n = N + M + 1$, we have:

$$2X_i(T_i) + (n-3)x_{ii}(T_i) - 2T_i = 0 \text{ where } T_i = T_i^M + T_i^N.$$

Note that this equation is identical to equation (4.4). Thus, country i's total protection T_i *does not* depend upon M and it equals T_i^* reported in equation

(4.5).

A central question remains: what are the welfare implications of selective MFN? From the literature on preferential trade agreements, we know that selective trade liberalization can lower world welfare if it results in more trade diversion than creation. Selective and/or reciprocal MFN adoption, can in principle, also have similar consequences. Does it?

Proposition 9: *If while granting MFN selectively to another country (on either unilateral or reciprocal basis) country i retains its optimal discriminatory tariff on even a single non-MFN country, world welfare increases relative to full tariff discrimination by country i.*

This result lends strong support to the MFN principle and its logic is as follows. Suppose country i grants country j MFN status and along with it finds it optimal to give MFN to some other countries who are all *less efficient than country* j (as it must from proposition 7).[18] Such a policy change necessarily improves world welfare because it allocates production in favor of country i at the expense of less efficient producers without altering total world production. The logic is as follows. Let q be any arbitrary non-MFN country (that must be more efficient than country j). We know that all non-MFN countries face strictly higher tariffs relative to country i's MFN tariff t_{ji} (i.e. $t_{qi} - t_{ji} > 0$). As a result, equations (4.12) and (4.11) imply that $t_{qi} - t_{pi} = \frac{c_p - c_q}{2}$, where p and q are any two non-MFN countries. This is exactly the same relationship that emerges when country i chooses fully discriminatory tariffs. Thus, if country i retains its optimal discriminatory tariff on *any* country to which it does not grant MFN, it will do so for all other non-MFN countries. More generally, one of the following three statements is true: (i) $(t_{qi} + \alpha) - (t_{pi} + \alpha) = \frac{c_p - c_q}{2}$ where $\alpha > 0$, i.e., tariffs on all non-MFN countries are higher than their respective discriminatory tariffs by the same amount or (ii) they are all lower by the same amount, i.e., $\alpha < 0$, or (iii) they are exactly the same, i.e., $\alpha = 0$. [19]

[18] Of course if only the least efficient exporter receives MFN, all countries face optimal discriminatory tariffs.

[19] Statement (ii) can be ruled out by the definition of MFN (which requires MFN countries to face lower tariffs than non-MFN countries) and from proposition 8 (constancy of average tariff).

If discriminatory tariffs are retained on non-MFN countries, there is no trade diversion or creation *within this set* relative to the optimal discriminatory tariff scenario. For those that receive MFN, true efficiency ranking continues to apply since they all face the same tariff. In fact, their total exports to country i are the same as under optimal tariffs except that the bias against efficient exporters inherent to the discriminatory tariff regime is removed. Thus, when country i grants MFN to country j on a selective basis, world welfare improves because exports of efficient suppliers *among the set* of MFN countries increase while those of inefficient suppliers fall while the total exports of non-MFN countries (and of all countries together) are unaffected relative to the world of discriminatory tariffs.

Finally, recall that in the basic model, reciprocal adoption is acceptable to symmetric efficient countries whereas the inefficient country always loses form it. In the general model, these results still hold. Suppose countries i and j are have the same technology and that this technology is more efficient than the average technology. If they grant each other MFN, they lower tariffs on each other. As a result, each loses some tariff revenue but gains some exporting profits. Since they are symmetric, their gains and losses are equal. But why does the profit gain necessarily outweigh the tariff revenue loss? The logic for this is as follows. We know MFN adoption by any country increases world welfare and that only the country that receives MFN experiences an increase in exports whereas exports of others either decline or stay the same (if their tariffs remain unchanged). Thus, only the MFN recipient gains while others lose or are unaffected. Since aggregate world welfare necessarily increases, the increase in profits of the MFN recipient must dominate the loss in tariff revenue of the MFN granting country. Thus, when countries are fully symmetric, both enjoy a net gain from reciprocal MFN adoption.

In other words, *all* non-MFN countries can face higher tariffs relative to the discriminatory tariffs scenario only if all MFN countries face still higher tariffs. Since T_i is constant, this possibility cannot arise. Statement (i) cannot be ruled out and that is why the proposition is a conditional statement.

5. Conclusion

This paper develops a simple model to shed light on the economics of the MFN principle. The analysis assigns a central role to asymmetries across countries, both with respect to market size and technology. The model is useful for comparing a world with MFN to one without and for clarifying the role MFN plays within multilateral trade agreements such as the GATT. Results deliver strong support for the MFN principle from the viewpoint of world welfare even though the assumptions underlying the model imply that MFN results in no *aggregate* trade liberalization. In fact, this feature of the model is what allows an examination of MFN distinct from trade liberalization.

In our model, individual countries have no incentive to adopt MFN and the less efficient a country's technology, the more it loses from adopting MFN. Furthermore, inefficient countries object to MFN adoption by other countries since they face higher tariffs in a world with MFN. An interesting tension exists between individual country incentives and world welfare: the country with the intermediate technology has the most to lose from adopting MFN and yet it is the country whose adoption of MFN is most valuable for world welfare.

Since no country has an no unilateral incentive to grant MFN to other countries, the model is extended to allow countries to grant MFN to each other on a reciprocal basis. In a world of three countries, it is shown that the countries with the relatively efficient technologies may agree to reciprocal adoption. In fact, the more symmetric they are, the more likely it is that they both gain from granting MFN to each other. However, such reciprocal adoption harms the inefficient country even though it improves world welfare.

The basic model is generalized to a world of n countries. By and large, the insights captured by the three country model remain valid in the general model. In addition, the general model also sheds additional light on the economics of MFN. For example, relative to a world with no MFN, each country's MFN tariff on countries with below average technologies exceeds its optimal discriminatory tariff. The implication is that the *distribution of technologies across countries* is crucial for determining the identities of winners and losers from MFN. Even in the general model, there is a strong presumption that MFN improves aggregate world welfare, despite the fact that it does not benefit everyone. Since the analysis is conducted in a partial equilibrium model, the results suggest that issue linkages or tariff concessions over different goods may be necessary for all countries to benefit from MFN. In a one good world, where no transfers are feasible, not all countries would want to adopt MFN, even when such adoption is to proceed on a reciprocal basis.

6. Appendix

Proof of those propositions that are not proven in the text and derivations for the n country case are given below.

Proposition 1

Using the demand function and the first order conditions for profit maximization, equilibrium output levels of all firms are easily calculated. We have:

$$x_{ji} = \frac{A_i - 3(c_j + t_{ji}) + c_i + c_k + t_{ki}}{4}$$

Using the output level of all firms, the welfare function of country i can be computed. Optimal tariffs are chosen to maximize aggregate welfare $W_i(t_{ji}, t_{ki})$:

$$\underset{t_{ji},\, t_{ki}}{Max} \;\; W_i(t_{ji}, t_{ki}) \equiv \frac{X_i^2(t_{ji}, t_{ki})}{2} + x_{ii}^2(t_{ji}, t_{ki}) + \sum_{j \neq i} t_{ji} x_{ji}(t_{ji}, t_{ki})$$

where

$$X_i(t_{ji}, t_{ki}) = \sum_j x_{ji}(t_{ji}, t_{ki})$$

Solving the above maximization problems yields country i's optimal tariffs

$$t_{ji}^* = \frac{6A_i + 3c_k - 7c_j - 2c_i}{20}$$

Thus, we have:

$$t_{21}^* - t_{31}^* = \frac{c_3 - c_2}{2} > 0$$

The other properties of the optimal tariff reported in proposition 1 follow from inspection of the optimal tariff formulae reported above. Note also that

$$c_2 + t_{21}^* - (t_{31}^* + c_3) = c_2 - c_3 + \frac{c_3 - c_2}{2} = \frac{c_2 - c_3}{2} < 0.$$

Proposition 2A

The MFN tariff is chosen to solve the following problem:

$$\underset{t_i}{Max}\ W_i(\mathbf{t}_i) \equiv \frac{X_i^2(\mathbf{t}_i)}{2} + x_{ii}^2(\mathbf{t}_i) + \sum_{j \neq i} t_i x_{ji}(\mathbf{t}_i)$$

Solving the above maximization problem yields country i's MFN tariff:

$$t_i^M = \frac{3A_i - C}{10} \text{ where } C = \sum_j c_j$$

Furthermore,

$$t_{ji}^* - t_i^M = \frac{c_k - c_j}{4} > 0 \text{ iff } c_k > c_j.$$

Note also that

$$t_{ji}^* - t_i^M = t_i^M - t_{ki}^* \Leftrightarrow t_{ki}^* + t_{ji}^* = 2t_i^M$$

Proposition 3

This result can be proved by directly calculating world welfare under the scenario where no country adopts MFN with scenarios where one, two, or all three adopt MFN. Equilibrium outputs and tariffs have already been reported above. Using these, we can directly calculate:

$$W(t_i^M, \mathbf{t}_{-i}^*) - W(\mathbf{t}^*) = \frac{(c_k - c_j)^2}{4} > 0$$

where $\mathbf{t}_{-i}^*$ is the vector of optimal trade policies of other countries and $\mathbf{t}^*$ is the vector of optimal trade policies of all countries. Alternatively, one can argue as follows. MFN Adoption by a country implies that its tariff on the efficient exporter falls whereas that on the inefficient exporter increases by the same amount. Such a shift in market share increases total exporting profits since the tariff reduction applies to a larger volume of exports that is produced at lower cost. Since no other party is affected due to the change in the tariff structure, world welfare improves due to MFN adoption.

Proposition 4

It is also straightforward to show that

$$u_i = W_i(t_i^M, \mathbf{t}_{-i}^*) - W_i(\mathbf{t}^*) = -\frac{(c_k - c_j)^2}{8} < 0$$

Since $c_1 \leq c_2 \leq c_3$, we have

$$u_2 \leq u_1 \text{ and } u_2 \leq u_3$$

Finally,

$$u_1 - u_3 = \frac{(c_1 - c_2)^2}{8} - \frac{(c_3 - c_2)^2}{8} < 0 \text{ iff } c_3 - c_2 < c_2 - c_1$$

We know

$$W(t_i^M, \mathbf{t}_{-i}^*) - W(\mathbf{t}^*) = \frac{(c_k - c_j)^2}{4}$$

Clearly, this difference is maximized when $i = 2$.

Proposition 6

When $A_1 = A_2 = A$, it is easy to show that

$$W_1(t_1^M, t_2^M, t_3^*) - W_2(t_1^M, t_2^M, t_3^*) = \frac{(c_2 - c_1)(4A_2 - 33c_1 + 62c_3 - 33c_2)}{80} > 0$$

Similarly, when $c_1 = c_2$, we have

$$W_1(t_1^M, t_2^M, t_3^*) - W_2(t_1^M, t_2^M, t_3^*) = \frac{(c_3 - c_2)(A_2 - A_1)}{80} > 0 \text{ iff } A_2 > A_1$$

implying that country 1 gains more than country 2 iff country 2's market is bigger.

Derivations for the n country case

From solving the product market equilibrium, we have

$$x_{ii} = \frac{A_i - nc_i + C_{-i} + T_i}{n+1} \text{ and } x_{ji} = \frac{A_i - n(c_j + t_{ji}) + (C_{-j} + T_{-j})}{n+1}$$

where

$$T_{-j} = T_i - t_{ji} = \sum_{k \neq j} t_{ki},$$

$$C_{-i} = C - c_i = \sum_j c_j - c_i.$$

Thus,

$$x_{ki} - x_{ji} = \frac{n(c_j - c_k) + (C_{-k} + T_{-k}) - (C_{-j} + T_{-j})}{n+1} = c_j + t_{ji} - (c_k + t_{ki})$$

also,

$$X_i = \frac{nA_i - C - T_i}{n+1} = \frac{nA_i - C - T_i^M - T_i^N}{n+1}$$

Proof of inequality 4.9

We need to show that

$$(n-1) \sum_{j \neq i}^{n} c_j^2 > \left[\sum_{j \neq i}^{n} c_j \right]^2$$

We prove the above inequality by induction. For $n = 3$, let $i = 3$. Without loss of generality we have:

$$\begin{aligned} 2c_1^2 + 2c_2^2 &> (c_1 + c_2)^2 \\ &\Leftrightarrow (c_2 - c_1)^2 > 0. \end{aligned}$$

Suppose the inequality holds for $n = m - 1$, so that

$$(m-2) \sum_{j \neq i}^{m-1} c_j^2 > \left[\sum_{j \neq i}^{m-1} c_j \right]^2. \tag{6.1}$$

Now if we can show that it holds for $n = m$, we are done. So we need to show that

$$(m-1) \sum_{j \neq i}^{m} c_j^2 > \left[\sum_{j \neq i}^{m} c_j \right]^2.$$

We know

$$(m-1)\sum_{j\neq i}^{m} c_j^2 = (m-1)\left[\sum_{j\neq i}^{m-1} c_j^2 + c_m^2\right] = (m-2)\sum_{j\neq i}^{m-1} c_j^2 + \sum_{j\neq i}^{m-1} c_j^2 + (m-1)c_m^2.$$

Using (6.1), we know

$$(m-2)\sum_{j\neq i}^{m-1} c_j^2 > \left[\sum_{j\neq i}^{m-1} c_j\right]^2$$

Thus, if we can show that

$$\begin{aligned}\left[\sum_{j\neq i}^{m-1} c_j\right]^2 + \sum_{j\neq i}^{m-1} c_j^2 + (m-1)c_m^2 \quad &> \quad \left[\sum_{j\neq i}^{m} c_j\right]^2 = \left[\sum_{j\neq i}^{m-1} c_j + c_m\right]^2 \\ &= \quad \left[\sum_{j\neq i}^{m-1} c_j\right]^2 + c_m^2 - 2c_m\sum_{j\neq i}^{m-1} c_j\end{aligned}$$

then we are done. Simplifying, we can rewrite the above as

$$\begin{aligned}&\sum_{j\neq i}^{m-1} c_j^2 + (m-2)c_m^2 - 2c_m\sum_{j\neq i}^{m-1} c_j \\ \Leftrightarrow \quad & c_1^2 + c_2^2 ... + c_{m-1}^2 + (m-2)c_m^2 - 2c_m c_1 - ...2c_m c_{m-1}.\end{aligned}$$

The above inequality necessarily holds because we can rewrite it as:

$$\sum_{\substack{j\neq i\\ j\neq m}}^{m-1} (c_j - c_m)^2 > 0.$$

Proposition 4B

Let

$$\Delta W^i \equiv W_w(t_i^M, \mathbf{t}_{-i}^*) - W_w(\mathbf{t}^*)$$

We know that

$$\Delta W^i = \frac{1}{2(n-1)}\left[(n-1)\sum_{j\neq i} c_j^2 - \left[\sum_{j\neq i} c_j\right]^2\right]$$

Thus,

$$2(n-1)(\Delta W^i - \Delta W^j) = (n-1)\left[\sum_{j\neq i} c_j^2 - \sum_{k\neq j} c_k^2\right] - \left[\sum_{j\neq i} c_j\right]^2 + \left[\sum_{k\neq j} c_k\right]^2$$

The right hand side of the above equation equals

$$(n-1)(c_j^2 - c_i^2) + (C - c_i)^2 - (C - c_j)^2$$

which is the same as

$$n(c_j - c_i)(c_i + c_j) + 2C(c_i - c_j)$$

which equals

$$(c_i - c_j)[2C - n(c_i + c_j)]$$

Thus,

$$\Delta W^i \geq \Delta W^j \Leftrightarrow \frac{c_i - c_j}{2(n-1)}\left[2C - n(c_i + c_j)\right] > 0$$

Suppose country i has the average technology so that $c_i = \overline{c}$. Then,

$$\begin{aligned}
\Delta W^i - \Delta W^j &= \frac{\overline{c} - c_j}{2(n-1)}\left[2C - n(\overline{c} + c_j)\right] \text{ for } j \neq i \\
&= \frac{\overline{c} - c_j}{2n(n-1)}\left[2\overline{c} - \overline{c} - c_j\right] \text{ for } j \neq i \\
&= \frac{\left[\overline{c} - c_j\right]^2}{2n(n-1)} > 0 \text{ for } j \neq i.
\end{aligned}$$

Thus, welfare gains for the world are strongest when the country with the average technology adopts MFN.

Supporting calculations for proposition 8

Let

$$C_M \equiv \sum_{k\in M} c_k \text{ and } C_N \equiv \sum_{k\in N} c_k$$

so that

$$C = C_M + C_N + c_i$$

Standard calculations show that

$$x_{ki} = \frac{A_i - n(c_k + t_{ki}) + (C_{-k} + T_{-k})}{n+1} \tag{6.2}$$

where

$$T_{-k} = T_i - t_{ki} = Mt_i + \sum_{\substack{j \in N \\ j \neq k}} t_{ji}.$$

Summing (6.2) over all non-MFN countries, we have the total output sold by all non-MFN countries in country i:

$$\begin{aligned} X_{NI} &= \sum_{k \in N} x_{ki} = \frac{NA_i - n(C_N + \sum_{k \in N} t_{ki}) + (NC - C_N + MNt_i) + (N-1) \sum_{k \in N} t_{ki}}{n+1} \\ &= \frac{NA_i - (n+1)C_N + (N-n-1)T_i^N + N(C + T_i^M)}{n+1} \end{aligned}$$

which immediately gives:

$$\frac{\partial X_{NI}}{\partial t_{ki}} = \frac{-n + N - 1}{n+1} = -\frac{(M+2)}{N+1} < 0$$

Also,

$$\frac{\partial X_{NI}}{\partial t_i} = \frac{MN}{n+1} > 0$$

Note

$$\frac{\partial x_{ki}}{\partial t_{ki}} = \frac{-n}{n+1} < 0$$

and

$$\frac{\partial x_{ki}}{\partial t_i} = \frac{M}{n+1} > 0$$

Also,

$$\frac{\partial x_{ki}}{\partial t_{ji}} = \frac{\partial x_{ii}}{\partial t_{ji}} = \frac{1}{n+1} > 0$$

Further, standard calculations show that

$$x_{mi} = \frac{A_i - n(c_m + t_i) + C_{-m} + T_{-m}}{n+1}$$

for all $m \in M$ where

$$T_{-m} = (M-1)t_i + \sum_{k \in N} t_{ki} = T_i - t_i \text{ and } T_i = Mt_i + \sum_{k \in N} t_{ki}.$$

We have:

$$\frac{\partial x_{mi}}{\partial t_i} = \frac{-n+M-1}{n+1} = -\frac{N+2}{n+1} < 0$$

and

$$\frac{\partial x_{ki}}{\partial t_i} = \frac{\partial x_{ii}}{\partial t_i} = \frac{M}{n+1} > 0$$

Summing over all M countries, we have the total output sold by MFN countries, in country i:

$$\begin{aligned} X_{MI} &= \sum_{k \in M} x_{mi} = \frac{MA_i - n(C_M + Mt_i) + MC - C_M + (M-1)Mt_i + M\sum_{k \in N} t_{ki}}{n+1} \\ &= \frac{MA_i - (n+1)C_M + (M-n-1)T_i^M + M(C + T_i^N)}{n+1} \end{aligned}$$

It immediately follows that

$$\frac{\partial X_{MI}}{\partial t_i} = \frac{M(M-n-1)}{n+1} = -\frac{M(N+2)}{n+1}$$

and

$$\frac{\partial X_{MI}}{\partial t_{ki}} = \frac{M}{n+1} > 0.$$

Proof of proposition 7

Proposition 7 follows from the following two lemmas (proved below):

Lemma 1: *Suppose country i wishes to grant country j MFN. If, in doing so, it finds it optimal to grant MFN to any country p less efficient that country j (i.e. $c_p > c_j$) it must find it optimal to grant MFN to all countries less efficient than country p.*

Suppose country i wishes to grant country j MFN. It solves:

$$\begin{aligned}\underset{\mathbf{t}_{ki},t_{ji}}{Max}\, W_i(\mathbf{t}_{ki},t_{ji}) &= \frac{X_i^2(\mathbf{t}_{ki},t_{ji})}{2}+x_{ii}^2(\mathbf{t}_{ki},t_{ji})+\sum_{k\neq i} t_{ki}x_{ki}(\mathbf{t}_{ki},t_{ji}) \;+t_{ji}x_{ji} \\ \text{such that } t_{ji} &\leq t_{ki} \text{ for all } k\neq i,j.\end{aligned}$$

The first order condition with respect to t_{ji} is:

$$\frac{-X_i}{n+1}+\frac{2x_{ii}}{n+1}+x_{ji}-\frac{nt_{ji}}{n+1}+\frac{\sum_{\substack{k\neq i\\ k\neq j}} t_{ki}}{n+1}-\lambda \;=0, \text{ where } \lambda\equiv\sum_{\substack{k\neq i\\ k\neq j}}\lambda_k=0$$

and for any other country k, where $k\neq j,i$, we must have:

$$\frac{-X_i}{n+1}+\frac{2x_{ii}}{n+1}+x_{ki}-\frac{nt_{ki}}{n+1}+\frac{\sum_{\substack{m\neq i\\ m\neq j\\ m\neq k}} t_{mi}}{n+1}+\lambda_k=0$$

From the last two equations, we have

$$x_{ji}-x_{ki}+t_{ki}-t_{ji}=\lambda+\lambda_k$$

We also know that, under Cournot competition,

$$x_{ki}-x_{ji}=c_j+t_{ji}-c_k-t_{ki}$$

The last two equations together imply

$$t_{ki}-t_{ji}=\frac{c_j-c_k+\lambda+\lambda_k}{2} \tag{6.3}$$

Consider two non-MFN countries p and q where $c_q>c_p$. From equation (6.3), we have

$$t_{pi}-t_{qi}=\frac{c_p-c_q+\lambda_q-\lambda_p}{2} \tag{6.4}$$

Now, first we will show that if p gets MFN, *when j is given MFN*, so must country q, where $c_q>c_p$. First note that if p gets MFN given that j has MFN, it must be that $t_{pi} = t_{ji}$. As a result, from equation (6.3), we must have

$$\frac{c_j - c_p + \lambda + \lambda_p}{2} = 0 \text{ or } \lambda = c_p - c_j - \lambda_p. \tag{6.5}$$

We know from equation (6.3) that

$$t_{qi} - t_{ji} = \frac{c_j - c_q + \lambda + \lambda_q}{2}$$

Substituting from (6.5) into the above equation from (6.5) we have

$$t_{qi} - t_{ji} = \frac{c_j - c_q + c_p - c_j - \lambda_p + \lambda_q}{2} = \frac{c_p - c_q + \lambda_q - \lambda_p}{2}$$

Since we must have $t_{qi} \geq t_{ji}$, it must be that $\lambda_q - \lambda_p > 0$ (because $c_p - c_q < 0$). But all multipliers are non-negative, so it must be that $\lambda_q > \lambda_p \geq 0$. As a result, the MFN constraint applicable to country q (i.e. $t_{qi} \geq t_{ji}$) must bind or else the relevant complementary slackness condition ($\lambda_q(t_{qi} - t_{ji}) = 0$) will fail. Thus, we must have $t_{qi} = t_{ji}$: country q must also have MFN treatment.

Lemma 2: *When wishing to grant MFN to only country j, if country i does not find it optimal to grant MFN to some country q who is more efficient than country j (i.e. $c_q < c_j$), it will not grant MFN to any country more efficient that country q.*

Suppose country j is to be granted MFN and country i finds it optimal to *not* grant MFN to country q. Then, we must have:

$$t_{qi} - t_{ji} = \frac{c_j - c_q + \lambda + \lambda_q}{2} > 0 \tag{6.6}$$

Since $t_{qi} - t_{ji} > 0$, the complementary slackness condition ($\lambda_q(t_{qi} - t_{ji}) = 0$) implies that $\lambda_q = 0$. From (6.6), we must have

$$\lambda > c_q - c_j - \lambda_q = c_q - c_j$$

Let p be any country more efficient than country q, i.e. $c_p < c_q$. To show that country p *does not get* MFN, all we need to show is that $t_{pi} - t_{ji} > 0$. We know that

$$t_{pi} - t_{ji} = \frac{c_j - c_p + \lambda + \lambda_p}{2}$$

But

$$\lambda > c_q - c_j$$

so that

$$\begin{aligned} c_j - c_p + \lambda + \lambda_p &> c_j - c_p + c_q - c_j + \lambda_p \\ &= c_q - c_p + \lambda_k > 0 \end{aligned}$$

Thus, it must be that $t_{pi} > t_{ji}$: country p does not receive MFN status.

References

[1] Bagwell, Kyle, and Robert. W. Staiger. "GATT-Think." mimeo, 1997.

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

[3] Brander, James A. and Paul Krugman. "A 'Reciprocal Dumping' Model of International Trade." *Journal of International Economics*, 1983, 15, 313-323.

[4] Brander, James A. and Barbara J. Spencer. "Tariff Protection and imperfect competition." In ed. H. Kierzkowski *Monopolistic Competition and International Trade*, Oxford University Press, 1984.

[5] Caplin, Andrew, and Kala Krishna. "Tariffs and the Most Favored Nation Clause: A Game Theoretic Approach." *Seoul Journal of Economics* 1998, 1, 267-289.

[6] Choi, Jay Pil. "Optimal Tariffs and the Choice of Technology: Discriminatory Tariffs vs. the Most Favored Nation Clause." *Journal of International Economics*, January 1995, 143-160.

[7] Ethier, Wilfred J. "Unilateralism in a Multilateral World." 2000a, mimeo.

[8] Ethier, Wilfred J. "Reciprocity, Non-Discrimination, and a Multilateral World." 2000b, mimeo.

[9] Gatsios, Konstantine. "Preferential Tariffs and the 'Most Favoured Nation' Principle: A Note." *Journal of International Economics*, 1990, 28, 365-373.

[10] Horn, Henrik and Petros C. Mavroidis. "Economic and Legal Aspects of the Most-Favored Nation Clause." mimeo, 2000.

[11] Hwang H., and Mai, C.-C. "Optimum Discriminatory Tariffs Under Oligopolistic Competition." *Canadian Journal of Economics*, 1991, XXIV, 693-702.

[12] Jackson, John H. *The World Trading System: Law and Policy of International Economic Relations*, 2nd edition, 1997, The MIT Press, Cambridge, MA.

[13] Krishna, Pravin. "Regionalism and Multilateralism: A Political Economy Approach." *The Quarterly Journal of Economics*, 1998, 227-251.

[14] Ludema, Rodney. "International Trade Bargaining and the Most-Favored-Nation Clause." *Economics and Politics*, 1991, 3, 1-20.

[15] Staiger, Robert. W. "International Rules and Institutions for Trade Policy." In G.M. Grossman and K. Rogoff, eds., *The Handbook of International Economics*, 1995, vol. 3, North Holland, 1495-1551.

[16] Takemori, Shumpei. "The Most Favored Nation Clause." *Keio Economic Studies*, 1994, 31(1), 37-50.