CHAPTER 1

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Tariffs and the most favored nation clause

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Abstract

In an n country oligopoly model of intraindustry trade ($n \geq 3$), this paper explores the economics of the most-favored-nation (MFN) principle. Under the non-cooperative tariff equilibrium, each country imposes higher tariffs on low cost producers relative to high cost ones thereby causing socially harmful trade diversion. MFN adoption by each country improves world welfare by eliminating this trade diversion. Under linear demand, MFN adoption by the country with the average production cost is most desirable. High cost countries refuse *reciprocal* MFN adoption with other countries and also lose even if *others* engage in reciprocal MFN adoption amongst themselves. © 2003 Elsevier B.V. All rights reserved.

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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, all 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, [Horn and Mavroidis \(2000\)](#) and [Hoekman and Kostecki \(2001\)](#) note that MFN constitutes one of the pillars of the WTO system. At the core of MFN is the idea of non-discrimination. Yet, as noted by several recent surveys (see [Staiger, 1995](#); [Horn and Mavroidis, 2000](#)), there is no strong general case for non-

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discrimination in trade policy and the pervasiveness of MFN requires explanation. This paper develops a simple model to highlight the implications of MFN for equilibrium tariffs.¹ The model isolates the impact of MFN for tariff policies of individual countries when they cannot negotiate tariff levels directly.² The key motivating question is: Can countries achieve a mutually beneficial outcome by agreeing to constrain their choices via MFN given that they do not negotiate directly over tariff levels?

The model is partial equilibrium in nature and allows market size and production technology to differ across countries.³ Imperfect competition is central to the model and the trade that occurs is intraindustry. Furthermore, unlike Bagwell and Staiger (1999) and other related works where countries impose tariffs to improve their terms of trade, here tariffs are used to extract rents from foreign firms some of which go to the government as revenue and the rest to the local firm as profits (as in Brander and Spencer, 1984). It is worth emphasizing why a model of intraindustry trade with imperfect competition is a useful one for exploring MFN. First, as is well known, the bulk of trade between industrialized countries is intraindustry in nature and analyses of MFN that do not capture such trade might omit some important considerations. Second, and perhaps more importantly, as Brander and Spencer (1984) note, tariffs can improve global welfare in models of imperfect competition if they result in production being allocated in favor of efficient producers. Thus, it is natural to ask whether a regime of MFN tariffs is better or worse than one of tariff discrimination. From the viewpoint of global welfare maximization, tariff discrimination dominates MFN since a social planner can always choose not to discriminate. But are non-cooperatively chosen MFN tariffs preferable to similarly chosen discriminatory tariffs? The simple model developed here shows that this indeed can be the case.

The model is a three-stage game involving n ($n \geq 3$) countries. Production in each country is carried out by a single firm and markets are assumed to be segmented (so that equilibrium prices generally differ across countries).⁴ In the first stage, all countries simultaneously decide whether or not to commit to MFN (i.e., to non-discrimination). 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. An important result of the model is that under tariff discrimination each country levies higher tariffs on low cost exporters relative to high cost ones (see also Gatsios, 1990; Hwang and Mai, 1991; Choi, 1995). By definition, when a country grants MFN to all exporters to its market, it imposes the same tariff on all of them.

¹ Like existing literature, the paper restricts attention to tariffs. Furthermore, it focuses on MFN and abstracts from several other crucial aspects of trade agreements. For example, in recent work, Ethier (2000a,b) has highlighted the inter-relationships between MFN, reciprocity, unilateralism, and multilateralism. Bagwell and Staiger (1997) provide an overview of theoretical work dealing with MFN and reciprocity.

² See Ludema (1991) Caplin and Krishna (1988) for models in which countries can negotiate over tariffs.

³ For general equilibrium analyses of MFN, see Bagwell and Staiger (1999), and Takemori (1994).

⁴ See Brander and Krugman (1983) for an early treatment of the 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.

It turns out that country i 's MFN tariff is lower than its discriminatory tariff on country j if and only if country j 's cost of production is lower than the average production cost of all exporters to country i .

The results show that welfare gains from MFN adoption can arise even when countries cannot (or do not) negotiate over tariff levels because the constraints implied by MFN lower the inefficiency associated with the equilibrium use of beggar-thy-neighbor discriminatory tariffs. It is worth noting that while GATT rules require member countries to adopt MFN, they do not require that countries adopt free trade. In fact, tariff liberalization under the GATT has been achieved over many years via a series of tariff negotiations. Such negotiations have frequently proved to be time-consuming and MFN tariffs of many GATT-member countries have typically stayed positive and unrestricted from their unilaterally chosen levels for substantial lengths of time. The present paper shows that MFN adoption by member-countries (which was a requirement for GATT membership) may have yielded welfare gains during early years of the GATT despite the fact that tariffs of member countries were otherwise unrestricted during these years.⁵

The model is also suitable for addressing the contribution that individual countries make to global welfare if they decide to adopt MFN. Which country's adoption of MFN contributes most to world welfare? Interestingly, the country whose adoption of MFN is most valuable is the one with the *average production cost*. Intuitively, the country with the average production cost introduces the strongest distortion in world trade since it diverts more trade from low to high cost sources relative to any other country. For example, when $n = 3$, MFN adoption by the country with the intermediate cost is most valuable but it 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* to countries that do not belong to the WTO—witness the annual ritual in the US Congress over China's MFN status prior to China's accession to the WTO—examining the consequences of MFN under the assumption that MFN implies symmetric treatment of *all* trading partners misses some important aspects of MFN.⁶ In fact, existing literature has restricted attention to the case where MFN is either granted on a multilateral basis or not at all. By contrast, the present paper also examines a country's incentive to grant MFN to only a subset of its trading partners. How does the cost of granting MFN to a country depend upon its production cost? Does selective MFN adoption necessarily raise world welfare? This issue is especially interesting because the literature on preferential trade agreements has shown that selective trade liberalization can lower world welfare if it results in more trade diversion than creation. Finally, given that no country has a unilateral incentive to adopt MFN (of any kind: multilateral or selective), can *reciprocal* adoption of MFN (wherein

⁵ I thank Robert Staiger for providing the above interpretation of my results. This interpretation helps demonstrate the practical relevance of this paper.

⁶ 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.

country i and j agree to grant MFN only to each other) be sustained in equilibrium?⁷ For the case of $n = 3$, the main result is that the country with the highest production cost 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 lower cost gains more. Thus, if the bigger country also has the lower cost of production, the gains from reciprocal adoption are somewhat evenly distributed between the two countries.

The rest of the paper is organized as follows. Section 2 presents the basic model and contrasts tariff discrimination with MFN. Section 3 assumes linear demand and studies selective and reciprocal MFN. Section 4 concludes followed by Appendix A.

2. Basic model

There are n countries indexed by $i = 1 \dots n$. There are two goods: x and y and preferences in country i over these goods are quasi-linear:⁸

$$U_i(x, y) = u_i(x) + y$$

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 refer to country i 's monopolist as firm i . The marginal cost of production for firm i is given by c_i , where $c_{i+1} \geq c_i$ for all $i = 1 \dots n$. Firms compete in quantities (Cournot competition) and make independent decisions regarding how much to sell in each market (i.e., markets are segmented). Firm j faces a specific tariff t_{ji} when exporting to country i where $t_{ii} = 0$ for all i . These tariffs are endogenously determined (see below). Country i 's tariff schedule $\mathbf{t}_i \equiv (t_{i1} \dots t_{in})$ is a $1 \times (n - 1)$ dimensional vector. Denote the tariff schedules of all countries other than i by $\mathbf{t}_{-i}$. And finally, denote the vector of all countries trade policies by $\mathbf{t}$ where $\mathbf{t} \equiv (\mathbf{t}_1 \dots \mathbf{t}_n)$.

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 simultaneously choose their tariff schedules. Finally, firms choose their output levels.

2.1. MFN versus tariff discrimination

To obtain a subgame perfect Nash equilibrium, we solve the model backwards. Due to market segmentation, there are n first-order conditions for profit maximization for each firm (one for each market $i = 1 \dots n$). In market i , exporting firm j 's first-order condition is given by

$$p_i + p_i' x_{ji} = t_{ji} + c_j \quad (1)$$

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

⁸ The utility function has a subscript since demand is allowed to differ across countries.

Let $X_i = \sum_j x_{ji}$, where $j = 1 \dots n$, denote the total output of good x sold in country i and let $X_{-i} = X_i - x_{ii}$ denote country i 's total imports of good x .

At the trade policy stage, countries simultaneously choose their tariff schedules to maximize their own welfare. Due to linear costs and market segmentation, a country's optimal tariff schedule turns out to be independent of the tariff schedules of other countries.⁹ As a result, from here on, the dependence of country i 's welfare on the tariffs of other countries is ignored. Country i solves:

$$W_i(\mathbf{t}_i) \equiv CS_i(\mathbf{t}_i) + \pi_{ii}(\mathbf{t}_i) + TR_i(\mathbf{t}_i) \quad (2)$$

where $CS_i = u(X_i) - p_i X_i$ denotes consumer surplus in country i ; $\pi_{ii} = (p_i - c_i)x_{ii}$ denotes the profit function of firm i in its own market; and $TR_i = \sum_{j \neq i} t_{ji}x_{ji}$ denotes country i 's total tariff revenue.

Let $\mathbf{t}_i^*$ country i 's optimal discriminatory tariff schedule where $\mathbf{t}_i^* \equiv \arg \max W_i(\mathbf{t}_i)$. To describe this optimal tariff schedule, we make two preliminary observations. First, from firm i 's perspective, a small increase in the tariff on firm j is equivalent to a small increase in the tariff on firm k :

$$\frac{\partial \pi_{ii}}{\partial t_{ji}} = \frac{\partial \pi_{ii}}{\partial t_{ki}} \quad \text{and} \quad \frac{\partial x_{ii}}{\partial t_{ji}} = \frac{\partial x_{ii}}{\partial t_{ki}}.$$

These equalities follow from the fact that the total output sold in country i (X_i) depends upon the sum of the tariff-included marginal costs of foreign firms and that firm i 's sales in its own market depend only on the level of total imports into its market and not on their distribution across exporters. Second,

$$\frac{\partial x_{zi}}{\partial t_{ji}} = \frac{\partial x_{zi}}{\partial t_{ki}} \quad \text{for all } z \neq j, k.$$

In other words, an increase in the tariff on firm j is equivalent to an increase in the tariff on firm k from the viewpoint of all firms other than j and k .

Using $u'(\cdot) = p_i$, country i 's first-order condition for tariff t_{ji} can be written as:

$$\frac{\partial W_i}{\partial t_{ji}} = -p_i' X_i \frac{\partial X_i}{\partial t_{ji}} + \frac{\partial \pi_{ii}}{\partial t_{ji}} + x_{ji} + t_{ji} \frac{\partial x_{ji}}{\partial t_{ji}} + \sum_{\substack{z \neq i \\ z \neq j}} t_{zi} \frac{\partial x_{zi}}{\partial t_{ji}} = 0, \quad j \neq k, i \quad (3)$$

⁹ A similar (strategic) independence of trade policies also arises in [Staiger \(1995\)](#) because demand is assumed to be independent across countries. Strategic 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 the tariff schedules of other countries.

Similarly, for $k \neq j, i$, we have:

$$\frac{\partial W_i}{\partial t_{ki}} = -p'_i X_i \frac{\partial X_i}{\partial t_{ki}} + \frac{\partial \pi_{ii}}{\partial t_{ki}} + x_{ki} + t_{ki} \frac{\partial x_{ki}}{\partial t_{ki}} + \sum_{\substack{z \neq i \\ z \neq k}} t_{zi} \frac{\partial x_{zi}}{\partial t_{ki}} = 0, \quad k \neq j, i \quad (4)$$

Subtracting (4) from (3) gives:

$$\left[x_{ji} + t_{ji} \frac{\partial x_{ji}}{\partial t_{ji}} - x_{ki} - t_{ki} \frac{\partial x_{ki}}{\partial t_{ki}} \right] + \left[\sum_{\substack{z \neq i \\ z \neq j}} t_{zi} \frac{\partial x_{zi}}{\partial t_{ji}} - \sum_{\substack{z \neq i \\ z \neq k}} t_{zi} \frac{\partial x_{zi}}{\partial t_{ki}} \right] = 0 \quad (5)$$

But

$$\sum_{\substack{z \neq i \\ z \neq j}} t_{zi} \frac{\partial x_{zi}}{\partial t_{ji}} - \sum_{\substack{z \neq i \\ z \neq k}} t_{zi} \frac{\partial x_{zi}}{\partial t_{ki}} = t_{ki} \frac{\partial x_{ki}}{\partial t_{ji}} - t_{ji} \frac{\partial x_{ji}}{\partial t_{ki}}$$

Using this, we can rewrite Eq. (5) as:

$$[x_{ji} - x_{ki}] + t_{ji} \left[\frac{\partial x_{ji}}{\partial t_{ji}} - \frac{\partial x_{ji}}{\partial t_{ki}} \right] - t_{ki} \left[\frac{\partial x_{ki}}{\partial t_{ki}} - \frac{\partial x_{ki}}{\partial t_{ji}} \right] \quad (6)$$

Further note that since

$$\frac{\partial x_{zi}}{\partial t_{ji}} = \frac{\partial x_{zi}}{\partial t_{ki}} \quad \text{for all } z \neq j, k \quad \text{and} \quad \frac{\partial X_i}{\partial t_{ji}} = \frac{\partial X_i}{\partial t_{ki}}$$

we must have:

$$\frac{\partial x_{ji}}{\partial t_{ji}} + \frac{\partial x_{ki}}{\partial t_{ji}} = \frac{\partial x_{ji}}{\partial t_{ki}} + \frac{\partial x_{ki}}{\partial t_{ki}}$$

As a result Eq. (6) becomes:

$$[x_{ji} - x_{ki}] + (t_{ji} - t_{ki}) \left[\frac{\partial x_{ji}}{\partial t_{ji}} - \frac{\partial x_{ji}}{\partial t_{ki}} \right] = 0 \quad (7)$$

The expression in the square brackets in the above equation is negative because

$$\frac{\partial x_{ji}}{\partial t_{ji}} < 0 < \frac{\partial x_{ji}}{\partial t_{ki}}.$$

Furthermore, we know that

$$x_{ji} - x_{ki} = \frac{(c_j + t_{ji}) - (c_k + t_{ki})}{p'_i(\cdot)} \quad (8)$$

Substituting from Eq. (8) into (7) and simplifying gives:

$$(t_{ji} - t_{ki}) \left[1 + \underbrace{\left(\frac{\partial x_{ji}}{\partial t_{ji}} - \frac{\partial x_{ji}}{\partial t_{ki}} \right) p'_i(.)}_{> 0} \right] = c_k - c_j \quad (9)$$

which implies $t_{ji} > t_{ki}$ iff $c_k > c_j$. Note also that $c_k - c_j > t_{ji} - t_{ki}$ since the term in square brackets on the left hand side is bigger than 1.

Proposition 1. *Under tariff discrimination, country i 's optimal tariff on country j is higher than its tariff on country k iff country j has a lower cost of production than country k : $t_{ji}^* \geq t_{ki}^*$ iff $c_k \geq c_j$. Furthermore, the true cost ranking of countries is preserved under optimal tariff discrimination: $t_{ji}^* + c_j \leq t_{ki}^* + c_k$ iff $c_k \geq c_j$.¹⁰*

To see the intuition for this result, suppose $n = 3$ and imagine country i treats both exporters symmetrically so that $t_{ji}^* = t_{ki}^*$. Now consider 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 low cost supplier *under the new tariff schedule*. 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.¹¹ In fact, it is shown below that this policy change *increases* country i 's total tariff revenue without altering any other component of its welfare. We know

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

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

$$dTR_i = \varepsilon(x_{ji}^* - x_{ki}^*) + (t_{ji}^* - t_{ki}^*)dx_{ji}^* + t_{ki}^*(dx_{ji}^* + dx_{ki}^*)$$

Using $dx_{ji}^* + dx_{ki}^* = 0$ and $t_{ki}^* = t_{ji}^*$, we have

$$dTR_i = \varepsilon(x_{ji}^* - x_{ki}^*) > 0 \quad (10)$$

Thus, beginning at $t_{ki}^* = t_{ji}^*$, country i 's tariff revenue increases if it raises its tariff on the low cost exporter and lowers it on the high cost exporter. Note from (10) that the bigger the cost differential between the two exporters, the stronger will be tariff discrimination.

The last part of Proposition 1 states that the higher tariff on the low cost exporter does *not* reverse the true cost ranking of the two exporters. Why is it *not* the case that

¹⁰ Incidentally, since countries have asymmetric production costs, it is possible that the social planner may employ discriminatory tariffs. See Section 2.2 for more details.

¹¹ See Bergstrom and Varian (1985) for a general result regarding the independence of Nash equilibria of the distribution of agents' characteristics and Varian (1992), Chapter 16) for an illustration of the Cournot case with constant costs.

$c_j + t_{ji}^* > c_k + t_{ki}^*$? Suppose it were. Since $c_j < c_k$, it must be that $t_{ji}^* > t_{ki}^*$. Now, consider 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 high cost supplier under the new tariff schedule. It is easy to show that country i 's tariff revenue must increase due to this policy change:

$$dTR_i = \varepsilon(x_{ki}^* - x_{ji}^*) + (t_{ji}^* - t_{ki}^*)dx_{ji}^* + t_{ki}^*(dx_{ji}^* + dx_{ki}^*)$$

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

$$dTR_i = \varepsilon(x_{ki}^* - x_{ji}^*)_+ + (t_{ji}^* - t_{ki}^*)_+ dx_{ji}^* > 0_+$$

where $dx_{ji}^* > 0$ because country j 's tariff has been reduced. In other words, if the cost ranking were reversed due to tariffs, country i would be able to increase its tariff revenue by lowering the tariff on the true low cost exporter and increasing it on the other exporter. This argument applies as long as country i 's tariff schedule forces the true low cost 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 $c_j + t_{ji}^* \leq c_k + t_{ki}^*$.¹²

Now consider country i 's optimal MFN tariff. Under MFN, country i solves:

$$W_i^M(t_i) \equiv CS_i(t_i) + \pi_{ii}(t_i) + t_i X_{-i} \quad (11)$$

Let t_i^M denote country i 's optimal MFN tariff. The problem under MFN differs from the problem in (2) in only respect: now country i imposes the same tariff t_i on all exporters. Country i 's first-order condition under MFN is given by:

$$\frac{\partial \partial W_i}{\partial \partial t_i} = -p_i' \frac{\partial \partial X_i}{\partial \partial t_i} X_{-i} + (p_i - c_i) \frac{\partial \partial x_{ii}}{\partial \partial t_i} + X_{-i} + t_i \frac{\partial \partial X_{-i}}{\partial \partial t_i} = 0 \quad (12)$$

The above equation defines the optimal MFN tariff t_i^M

$$t_i^M = \frac{\left(p_i' \frac{\partial \partial X_i}{\partial \partial t_i} - 1 \right) (X_{-i}) - (p_i - c_i) \frac{\partial \partial x_{ii}}{\partial \partial t_i}}{\frac{\partial \partial X_{-i}}{\partial \partial t_i}} \quad (13)$$

¹² The above analysis abstracts from the situation where a country chooses to impose prohibitive tariffs on inefficient producers. Such tariffs may very well be infeasible in the real world. Furthermore, for the case of linear demand, we later provide conditions under which it is never in a country's interest to impose prohibitive tariffs.

Note that when $t_{ji} = t_{ki} = t_i$ for all $j, k \neq i$, we must have:

$$\begin{aligned}\frac{\partial \partial X_i}{\partial \partial t_i} &= (n-1) \frac{\partial \partial X_i}{\partial \partial t_{ji}} = (n-1) \frac{\partial \partial X_i}{\partial \partial t_{ki}}, \\ \frac{\partial \partial p_i}{\partial \partial t_i} &= (n-1) \frac{\partial \partial p_i}{\partial \partial t_{ji}} = (n-1) \frac{\partial \partial p_i}{\partial \partial t_{ki}}, \quad \text{and} \\ \frac{\partial x_{ii}}{\partial t_i} &= (n-1) \frac{\partial x_{ii}}{\partial t_{ji}} = (n-1) \frac{\partial x_{ii}}{\partial t_{ki}}\end{aligned}$$

Evaluating the first-order condition under discrimination in (3) at $t_{ji} = t_{ki} = t_i$ and using the above relationships gives:

$$\frac{\partial W_i}{\partial t_{ji}} \Big|_{t_{ji}=t_{ki}=t_i} = \frac{-p_i'}{n-1} \frac{\partial X_i}{\partial t_i} X_{-i} + \frac{p_i - c_i}{n-1} \frac{\partial x_{ii}}{\partial t_i} + x_{ji} + t_i \frac{\partial X_{-i}}{\partial t_i}$$

Evaluating this equation at the optimal MFN tariff t_i^M gives:

$$\frac{\partial W_i}{\partial t_{ji}} \Big|_{t_{ji}=t_{ki}=t_i^M} = \frac{(n-1)x_{ji} - X_{-i}}{n-1} > 0 \quad \text{iff } c_j < \bar{c}_{-i} \equiv \frac{\sum_{k \neq i} c_{ki}}{n-1}$$

Thus, starting at the optimal MFN tariff t_i^M , country i gains from increasing its tariffs on countries that are low cost relative to the average cost exporter and lowering them on the rest. Our second main result is as follows:

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

$$t_{ji}^* \geq t_i^M \quad \text{iff } c_j \leq \frac{\sum_{k \neq i} c_k}{n-1}.$$

The above proposition informs us that MFN adoption by a country has distributional implications for its trading partners. When a country adopts MFN, its lowest cost trading partner necessarily gains while the highest cost one necessarily loses. In general, the *distribution* of production costs 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, country 3 gains from country 1's MFN adoption iff $2\delta \leq \lambda$. If this 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 production costs would all of them benefit from MFN adoption by any one country.¹³

2.2. Welfare effects of MFN

Define world welfare as the sum of welfare in each country:

$$W(\mathbf{t}_i, \mathbf{t}_{-i}) \equiv \sum_{i=1}^n W_i(\mathbf{t}_i, \mathbf{t}_{-i})$$

Due to market segmentation, a country's trade policy has no effect on any other aspect of welfare in other countries except their exporting profits. As a result, to evaluate the effects of MFN adoption by a country on world welfare it is sufficient to consider the sum of welfare in country i and the total profits of exporters in the rest of the world. MFN adoption by country i improves world welfare iff

$$W_i(\mathbf{t}_i^*) + \sum_{j \neq i} \pi_{ji}(\mathbf{t}_i^*) \geq W_i(t_i^M) + \sum_{j \neq i} \pi_{ji}(t_i^M)$$

where

$$W_i(\mathbf{t}_i^*) = u(X_i(\mathbf{t}_i^*)) - p_i X_i(\mathbf{t}_i^*) + (p_i - c_i) x_{ii}(\mathbf{t}_i^*) + \sum_{j \neq i} t_{ji} x_{ji}(\mathbf{t}_i^*)$$

and

$$\sum_{j \neq i} \pi_{ji}(\mathbf{t}_i^*) = \sum_{j \neq i} (p_i - c_i - t_{ji}^*) x_{ji}(\mathbf{t}_i^*).$$

Of course, replacing the optimal discriminatory tariffs by the optimal MFN tariff yields the relevant welfare metric under MFN. After making the appropriate substitutions, we have that MFN adoption by country i improves world welfare iff

$$W^M - W^D = u(X_i(t_i^M)) - u(X_i(\mathbf{t}_i^*)) + \sum_{j=i}^n c_j (x_{ji}(t_i^M) - x_{ji}(\mathbf{t}_i^*)) > 0 \quad (14)$$

The above inequality implies that, in principle, there are two possible reasons why MFN might improve world welfare. First, if $X_i(t_i^M) > X_i(\mathbf{t}_i^*)$, i.e., total world output sold in country i maybe higher under MFN than under discrimination (i.e., MFN can improve welfare if it leads to some degree of aggregate trade liberalization). Second, and more surprisingly, MFN can contribute to world welfare even if leads to no aggregate trade liberalization so long as *the change in outputs of all firms selling in country i (caused due to MFN) is negatively correlated with their marginal costs of production*. In other words, MFN adoption by country i improves world welfare if, *on average*, it leads to an increase

¹³ Note, however, that the adoption of MFN by a country constrains its choice set without altering the choices of others. Thus, no country has a unilateral incentive to adopt MFN.

in the output of low cost producers relative to high cost ones.¹⁴ This result delivers strong support for the MFN principle. 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 tariff discrimination.

It is trivial to note that a social planner seeking to maximize global welfare would prefer a regime of discrimination to one of MFN since he/she can always choose not to discriminate. But how does the nature of socially optimal tariff discrimination compare with the equilibrium of non-cooperative tariff game? The solution to the following problem yields the socially optimal tariff schedule of country i :¹⁵

$$\max_{\mathbf{t}_i} WW(\mathbf{t}_i) = W_i(\mathbf{t}_i) + \sum_{j \neq i} \pi_{ji}(\mathbf{t}_i)$$

The first-order condition for tariff t_{ji} , where $j \neq i$, is given by

$$\frac{\partial WW(\mathbf{t}_i)}{\partial t_{ji}} = \frac{\partial W_i(\mathbf{t}_i)}{\partial t_{ji}} + \sum_{j \neq i} \frac{\partial \pi_{ji}(\mathbf{t}_i)}{\partial t_{ji}} = 0$$

Using Eqs. (1) and (3), the above first-order condition can be written as:

$$\frac{\partial WW}{\partial t_{ji}} = (p_i - c_j) \underbrace{\frac{\partial x_{ji}}{\partial t_{ji}}}_{<0} + \sum_{k \neq j} (p_i - c_k) \underbrace{\frac{\partial x_{ki}}{\partial t_{ji}}}_{<0}$$

The interpretation of the above equation is straightforward. Suppose $c_j = c_i = c$ for all j , then we have:

$$\frac{\partial WW}{\partial t_{ji}} = (p_i - c) \underbrace{\frac{\partial X_i}{\partial t_{ji}}}_{<0} < 0$$

In other words, when all countries have the same cost, a tariff on country j by country i lowers world welfare by lowering total output sold in country i . However, when countries have asymmetric costs, tariffs can potentially improve world welfare.¹⁶ This is because a tariff on country j allocates market share in favor of all other producers and such a change improves world welfare when country j is *sufficiently high cost compared to the rest of the world* so that $p_i - c_j$ is small relative to $p_i - c_k$, $k \neq j$. Note, however, that under the non-cooperative tariff game, individual countries actually impose higher tariffs on low cost producers. Thus, MFN adoption reduces the distortion imposed by non-cooperative discriminatory tariffs.

¹⁴ As will be shown below, under linear demand MFN improves welfare even though it does not result in any trade liberalization.

¹⁵ Of course, one needs to solve the tariff problems of all countries to obtain the socially optimal structure of tariff protection in the world but due to market segmentation it is sufficient to consider only one country's problem.

¹⁶ See Appendix A for further details for the case of linear demand.

3. Further analysis

Assume that $u_i(x)$ is quadratic so that the demand curve for good x is linear in each country:

$$p_i = A_i - \sum_j x_{ji}(\mathbf{t}_i) \quad (15)$$

where x_{ji} denotes the output sold by firm j in country i and $i, j = 1 \dots n$. One advantage of the linear demand assumption is that we can capture market size of a country by the parameter A_i .

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

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

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

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

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

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

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

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

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

$$\frac{\partial W_i}{\partial t_{ji}} = -\frac{X_i}{n+1} + \frac{2x_{ii}}{n+1} + x_{ji} + \sum_{\substack{k \neq j \\ k \neq i}} \frac{t_{ki}}{n+1} - \frac{nt_j}{n+1}, \quad \text{for } j \neq i \quad (16)$$

Using the output levels from Cournot competition, we have:

$$x_{ki}(\mathbf{t}_i) - x_{ji}(\mathbf{t}_i) = c_j + t_{ji} - (c_k + t_{ki}) \quad (17)$$

Furthermore, using the first-order conditions (16), we have

$$t_{ji} - t_{ki} = x_{ji}(\mathbf{t}_i) - x_{ki}(\mathbf{t}_i) \quad (18)$$

Using the last two equations, we get $2(t_{ji}^* - t_{ki}^*) = c_k - c_j$. This equation illustrates Proposition 1 for linear demand: each country imposes higher tariffs on low cost exporters and the cost ranking of countries is preserved under optimal discriminatory tariffs.

Summing country i 's first-order conditions yields:

$$2X_i(T_i) + (n-3)x_{ii}(T_i) - 2T_i = 0 \quad (19)$$

where $T_i = \sum_{k \neq i} t_{ki}$ is the sum of country i 's tariffs. An important feature of Eq. (19) 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 Eq. (19) for the equilibrium level of total protection in country i :

$$T_i^* = \frac{3(n-1)A_i + (n-5)C_{-i} - (n-1)(n-2)c_i}{n+7} \quad (20)$$

where $C_{-i} = \sum_{k \neq i} c_k$ is the sum of marginal costs of all firms other than firm i . It is easy to see that country i 's equilibrium level of total protection T_i^* 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 Eqs. (16) and (20):

$$t_{ji}^* = \frac{1}{n-1} \left[\frac{C_{-i} - (n-1)c_j}{2} + T_i^* \right] \quad \text{for } j \neq i \quad (21)$$

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

3.1 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:

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

The first-order condition for this problem is given by

$$\frac{dW_i}{dt_i} = -2X_i + 2x_{ii}(n-3) - 2(n-1)t_i = 0, \quad \text{for } j \neq i \quad (22)$$

Let country i 's total protection under MFN be defined by $T_i^M \equiv (n-1)t_i^M$ so that

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

We can rewrite Eq. (22) as:

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

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 Eq. (19) 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 An immediate implication of this result is that MFN adoption by a country does *not* alter its market equilibrium price and total imports. Thus, under linear demand, the only cost of MFN adoption for a country is the loss in tariff revenue it experiences due to its inability to discriminate between exporting countries.

The optimal tariff formula in Eq. (21) immediately implies:

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

The above equation illustrates Proposition 2 for linear demand.

3.2. Welfare under linear demand

Under linear demand, we have shown that $T_i^M = T_i^*$. As a result, we have $p(X_i(t_i^*)) = p(X_i(t_i^M))$ and $\sum_{j \neq i} x_{ji}(t_i^*) = \sum_{j \neq i} x_{ji}(t_i^M)$. Then, Eq. (14) immediately implies that country i 's MFN adoption improves world welfare iff

$$\sum_{j \neq i} c_j (x_{ji}(t_i^*) - x_{ji}(t_i^M)) > 0 \quad (23)$$

Thus, *if on average*, exports of low cost countries increase, whereas those of high cost ones decrease when country i adopts MFN, such a policy change improves world welfare. This 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), we have

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

¹⁷ In fact, a stronger result is proved later in the paper (see Lemma 3).

Thus, inequality (23) 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

$$(n-1) \sum_{j \neq i} c_j^2 > \left[\sum_{j \neq i} c_j \right]^2 \quad (24)$$

delivering inequality (23) in terms of exogenous parameters n and c_j , $j \neq i$. It is shown in Appendix A that inequality (24) always holds. Thus, under linear demand, MFN necessarily improves world welfare.

Note that MFN adoption by a country can easily create many losers and few winners and yet improve total world welfare. Suppose the global distribution of costs is as follows: $c_2 = c$ and $c_j = \phi c$, for $j = 3 \dots n$, 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.

Since countries are asymmetric, its worth asking whether MFN adoption by any two countries is equally valuable for world welfare or not.

Proposition 3. *Adoption of MFN by country i is more beneficial for the world than adoption by country j iff $(c_i - c_j)(2\bar{c} - c_i - c_j) > 0$ where $\bar{c} \equiv C/n$ denotes the average production cost. Furthermore, if only one country is to adopt MFN, it should be the country with the average production cost $\bar{c}$.*¹⁸

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 costs, or when their average cost $c_i + c_j/2$ is equal to the average over all countries $\bar{c}$. 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 production cost (i.e., $\bar{c} - c_i = c_j - \bar{c}$). The intuition is clear: tariff discrimination by the country with the average production cost diverts trade from the lowest cost countries to the highest cost ones. Furthermore, if no country has exactly the average cost (easily possible since the number of countries is finite), then the country *closest* to the average should be the one to adopt MFN first.

According to the definition of MFN, 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). But what is country i 's optimal tariff schedule when it grants MFN to *only a subset* of countries? Is it possible that selective MFN adoption might have adverse *efficiency consequences*?

¹⁸ For $n = 3$, country 2 (the one with the intermediate production cost) loses the most from MFN adoption. Thus, there is a direct conflict between individual country incentives and the social desirability of MFN adoption.

3.3. Selective MFN

The following result (proved in Appendix A) describes country i 's optimal tariff schedule under selective MFN:

Proposition 4. *When country i grants MFN to country j , there exists some country s who has higher cost than country j such that all countries that are high cost relative to country s automatically receive MFN along with country j .*

If country j 's cost declines, the set of countries that receive automatic MFN treatment (when country j is given MFN by country i) expands. Intuitively, the lower a recipient country's cost, the higher the tariff it faces under tariff discrimination 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 , where $n = M + N + 1$. Let t_i be country i 's MFN tariff 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:

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

To address the welfare implications of selective MFN, we first need the following lemma:

Lemma 3. *Country i 's average tariff is independent of the number of countries (M) it grants MFN.*

The logic of this result is given below (supporting calculations are in Appendix A). When choosing its tariffs, country i solves:

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

subject to the MFN constraints: $t_i \leq \min\{t_{ki} : k \in N\}$. Let λ_k be the Lagrange multiplier associated with constraint $k : t_i - t_{ki} \leq 0$. The MFN tariff must satisfy the following condition:

$$\frac{\partial W_i}{\partial t_i} - \lambda = 0 \quad \text{where} \quad \lambda \equiv \sum_k \lambda_k \quad \text{and} \quad \lambda_k \geq 0 \quad \text{for all } k \in N \quad (25)$$

whereas the first-order conditions for discriminatory tariffs are given by:

$$\frac{\partial W_i}{\partial t_{ki}} - \lambda_k = 0 \quad \text{for all } k \in N \quad (26)$$

From calculations in Appendix A, the first-order condition for an MFN country is:

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

and that for a typical non-MFN country is:

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

with the associated complementary slackness conditions

$$\lambda_k(t_i - t_{ki}) = 0 \quad \text{for all } k \in N. \quad (27)$$

Summing the N first-order conditions for non-MFN countries, we have

$$-NX_i + 2Nx_{ii} + (n+1)X_{NI} + NT_i^M - (M+2)T_i^N + \lambda(n+1) = 0 \quad (28)$$

where $T_i^M = Mt_i$ and $T_i^N = \sum_{j \in N} t_{ji}$. Eq. (25) can be written as

$$-MX_i + 2Mx_{ii} + (n+1)X_{MI} + MT_i^N - (N+2)T_i^M - \lambda(n+1) = 0 \quad (29)$$

Adding (28) and (29) and using $X_i = x_{ii} + X_{MI} + X_{NI}$ and $n = N + M + 1$, we have:

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

Note that this equation is identical to Eq. (19). Thus, country i 's total (or average) protection T_i does not depend upon M and it equals T_i^* reported in Eq. (20). Consider now the welfare implications of selective MFN:

Proposition 5. *If while granting MFN selectively to another country (on either a unilateral or a 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 .*

Suppose country i grants country j MFN and along with it finds it optimal to extend MFN to some other countries who all have *higher costs than country j* (this must be the case given Proposition 4).¹⁹ Such a policy change necessarily improves world welfare because it allocates production in favor of country i at the expense of higher cost producers without altering total world production. The logic is as follows. Let q be any

¹⁹ Of course if only the highest cost exporter receives MFN, all countries face optimal discriminatory tariffs.

arbitrary non-MFN country (that must be high cost relative to 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, Eqs. (26) and (27) imply that $2(t_{qi} - t_{pi}) = c_p - c_q$, where p and q are any two non-MFN countries. This is exactly the same relationship that emerges when country i practices full tariff discrimination. 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 non-MFN countries. More generally, one of the following three statements must hold: (i) $2[(t_{qi} + \alpha) - (t_{pi} + \alpha)] = c_p - c_q$ 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., $\alpha = 0$.²⁰

If discriminatory tariffs are retained on non-MFN countries, there is no trade diversion or creation *among the non-MFN countries* relative to full tariff discrimination. For MFN recipients, the true cost ranking is trivially retained since they all face the same tariff. In fact, their total exports to country i are the same as under full tariff discrimination except that the bias against low cost exporters inherent to the tariff discrimination is removed. Thus, when country i grants MFN to country j on a selective basis, world welfare improves because exports of low cost suppliers *among the set* of MFN countries increase while those of high cost suppliers decrease while the total exports of non-MFN countries (and of all countries together) are unaffected relative to full tariff discrimination.

3.4. Reciprocal 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 costs?²¹

To answer these questions, consider the case of $n = 3$ where $c_1 \leq c_2 \leq c_3$. In the first stage of the game, any country can offer reciprocal MFN to any other country. Reciprocal MFN adoption between two countries simply implies that 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 MFN 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. It's clear that in the absence of side-payments and transfers between countries, the country with the highest cost will not only refuse an offer of reciprocal adoption by either of the other countries but also oppose a move toward the

²⁰ 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 Lemma 3 (constancy of average tariff). 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.

²¹ Since coordination may be costly, one should expect those countries that have the most to gain from such cooperation to be ones that initiate the process.

reciprocal MFN between the *other two* countries.²² The logic is transparent: the MFN tariff of both countries 1 and 2 on country 3 is higher than their respective discriminatory tariffs. Thus, country 3 has nothing to gain from being granted MFN whereas countries 1 and 2 can pass over some of the cost of reciprocal MFN to country 3 while retaining any potential benefits for themselves.

Under what circumstances do countries 1 and 2 agree to reciprocal MFN? If so, how are the gains from this agreement split between the two? The following proposition is proved in Appendix A:

Proposition 6. *Assume $n=3$. If the markets of countries 1 and 2 are of equal size (i.e., $A_1=A_2$) then country 1 gains more from reciprocal MFN than country 2 (since $c_1 \leq c_2$). If the two countries have the same cost (i.e., $c_1 = c_2$) then the country with the smaller market gains more from reciprocal MFN.*

When markets of the two countries are of equal size, 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 costs are symmetric across the two countries, any given tariff concession results in greater increase in profits for the country exporting to the bigger market since the concession applies to a larger volume of exports. Thus, if the smaller country also has the lower cost then 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 costs), the more likely it is that both gain. In fact, it is shown in Appendix A that if $A_1 = A_2$ and $c_1 = c_2$ then countries 1 and 2 *necessarily* gain from reciprocal adoption.²³ 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.

Finally, we comment on the case where n is an arbitrary number. It is easy to see that the logic behind Proposition 6 still applies. Suppose countries i and j have the same cost and that this cost is lower than the average cost over all countries. 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

²² Reciprocal adoption of MFN between low cost 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 high cost country.

²³ 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.

in tariff revenue of the MFN granting country. Thus, when countries are fully symmetric, both enjoy a net gain from reciprocal MFN adoption.

4. Conclusion

This paper develops a simple model that sheds light on the economics of the MFN principle. The model compares a world with MFN to one without and asks whether MFN has value even when countries do not negotiate over tariff levels. The analysis clarifies the role MFN plays within multilateral trade agreements such as the GATT. Overall, the results deliver strong support for MFN from the viewpoint of world welfare. In particular, it is shown that in the non-cooperative equilibrium, countries end up pursuing beggar-thy-neighbor policies under which efficient exporters face higher tariffs than inefficient ones. MFN improves upon this outcome by reducing the inefficiency associated with the use of such discriminatory tariffs.

Since no country has a unilateral incentive to adopt MFN, 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 countries with relatively low production costs may agree to reciprocal adoption. However, such reciprocal adoption harms the high cost country even as it improves aggregate world welfare.

The robustness of Proposition 2 (the relationship between the nature of tariff discrimination and production efficiency) to the assumption of cost-linearity deserves comment. As [Hwang and Mai \(1991\)](#) have shown, linearity of costs is not crucial for Proposition 2 but is needed for tractability. If one allows for local production and exports in a model with non-linear costs, there is strategic interdependence between trade policies of countries and the analysis becomes quite complicated. Finally, it is worth noting that MFN adoption is a decision that applies at the economy-wide level, whereas the model presented here is a partial equilibrium one. However, the model does have an interesting implication for a world of multiple industries. Suppose there are two industries in each country. Then, if a country is relatively low cost in only one industry with respect to other countries, MFN adoption by its trading partners will benefit one industry and hurt the other so that the net effect will be ambiguous. These issues deserve future research.²⁴

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²⁴ The model also assumes that each country is perfectly informed about cost conditions in other countries. See [McCalman \(2002\)](#) and [Ozerturk and Saggi \(2002\)](#) for analyses of MFN under incomplete information.

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Appendix A

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

Derivations for the n country case under linear demand

Solving for the product market equilibrium yields:

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

where

$$T_{-j} = T_i - t_{ji} = \sum_{k \neq j} t_{ki} \quad \text{and} \quad C_{-i} = C - c_i = \sum_j c_j - c_i.$$

Thus,

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

and

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

Social planner's problem under linear demand

Suppose that $n = 3$, and consider the social planner's choice of country 1's tariffs. It is easy to show that:

$$\frac{\partial WW}{\partial t_{31}} - \frac{\partial WW}{\partial t_{21}} = c_3 - c_2 > 0$$

As a result, the two first-order conditions will never admit an interior solution with positive (but non-prohibitive) tariffs on both countries at the same time. Imposing $t_{21} = 0$ gives

$$\left. \frac{\partial WW}{\partial t_{31}} \right|_{t_{21}=0} = \frac{-t_{31} + 11c_3 - 5(c_1 + c_2) - A_1}{16} \quad (\text{A.1})$$

Starting at $t_{31} = 0$, world welfare declines with an increase in t_{31} if

$$11c_3 - 5(c_1 + c_2) < A_1 \quad (\text{A.2})$$

This inequality is sufficient to ensure that the social planner imposes zero tariffs on both exporters and it holds when the market size in country 1 is big enough relative to the cost asymmetry between countries 2 and 3.

Ruling out prohibitive tariffs in the non-cooperative equilibrium:

Suppose $n = 3$ and consider the equilibrium in country 1. Prohibitive tariffs will not be used if

$$x_{31} \Big|_{t_1=t_1^M} > 0 \Leftrightarrow A_1 > 7c_3 - 3(c_2 + c_1) \quad (\text{A.3})$$

If condition (A.2) holds then (A.3) is automatically satisfied since $c_3 \geq c_2 \geq c_1$.

Proof of inequality (24)

We need to show that

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

We prove the above inequality by induction. For $n = 3$, let $i = 3$. Without loss of generality we have: $2c_1^2 + 2c_2^2 > (c_1 + c_2)^2 \Leftrightarrow (c_2 - c_1)^2 > 0$. Suppose the inequality holds for $n = m - 1$, so that

$$(m-2) \sum_{j \neq i} c_j^2 > \left[\sum_{j \neq i} c_j \right]^2. \quad (\text{A.4})$$

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

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

We know

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

Given (A.4), if we can show that

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

then we are done. Simplifying, the above inequality can be rewritten as

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

which necessarily holds since it is the same as:

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

Proof of Proposition 3

Let $\Delta W^i \equiv W_w(t_i^M, t_{-i}^*) - W_w(t^*)$. 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 $(c_i - c_j)[2C - n(c_i + c_j)]$. Thus,

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

Suppose $c_i = \bar{c}$. Then,

$$\Delta W^i - \Delta W^j = \frac{(\bar{c} - c_j)[2\bar{c} - \bar{c} - c_j]}{2n(n-1)} = \frac{[\bar{c} - c_j]^2}{2n(n-1)} > 0 \quad \text{for } j \neq i.$$

Supporting calculations for Proposition 4

Let $C_M \equiv \sum_{k \in M} c_k$ and $C_N \equiv \sum_{k \in N} c_k$ so that $C = C_M + C_N + c_i$. Standard calculations show that

$$\begin{aligned} x_{ki} &= \frac{A_i - n(c_k + t_{ki}) + (C_{-k} + T_{-k})}{n+1} \quad \text{where } T_{-k} = T_i - t_{ki} \\ &= Mt_i + \sum_{\substack{j \in N \\ j \neq k}} t_{ji}. \end{aligned} \tag{A.5}$$

Summing (A.5) over all non-MFN countries, we have:

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

which immediately gives:

$$\frac{\partial X_{NI}}{\partial t_{ki}} = -\frac{(M+2)}{N+1} < 0 \quad \text{and} \quad \frac{\partial X_{NI}}{\partial t_i} = \frac{MN}{n+1} > 0.$$

Also,

$$\frac{\partial x_{ki}}{\partial t_{ki}} = \frac{-n}{n+1} < 0; \quad \frac{\partial x_{ki}}{\partial t_i} = \frac{M}{n+1} > 0; \quad \text{and} \quad \frac{\partial x_{ki}}{\partial t_{ji}} = \frac{\partial x_{ii}}{\partial t_{ji}} = \frac{1}{n+1} > 0.$$

Further,

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

for all $m \in M$ where

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

We have:

$$\frac{\partial x_{mi}}{\partial t_i} = -\frac{N + 2}{n + 1} < 0 \quad \text{and} \quad \frac{\partial x_{ki}}{\partial t_i} = \frac{\partial x_{ii}}{\partial t_i} = \frac{M}{n + 1} > 0.$$

Summing over all M countries, we have:

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

It immediately follows that

$$\frac{\partial X_{MI}}{\partial t_i} = -\frac{M(N + 2)}{n + 1} \quad \text{and} \quad \frac{\partial X_{MI}}{\partial t_{ki}} = \frac{M}{n + 1} > 0.$$

Proof of Proposition 4

Proposition 4 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 who is high cost relative to country j (i.e., $c_p > c_j$) it must find it optimal to grant MFN to all countries who are high cost relative to country p .*

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

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

such that $t_{ji} \leq t_{ki}$ for all $k \neq i, j$.

The first-order condition with respect to the MFN recipient's tariff (t_{ji}) is:

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

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

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

From the last two equations, we have $x_{ji} - x_{ki} + t_{ki} - t_{ji} = \lambda + \lambda_k$ and we know that, under Cournot competition $x_{ki} - x_{ji} = c_j + t_{ji} - c_k - t_{ki}$. The last two equations together imply

$$2(t_{ki} - t_{ji}) = c_j - c_k + \lambda + \lambda_k \quad (\text{A.6})$$

Consider two non-MFN countries p and q where $c_q > c_p$. From Eq. (A.6), we have

$$2(t_{pi} - t_{qi}) = c_p - c_q + \lambda_q - \lambda_p \quad (\text{A.7})$$

Now, first we will show that if p gets MFN, when j is given MFN, so must country q , where $c_q > c_p$. Note that if p gets MFN given that j has MFN, it must be that $t_{pi} = t_{ji}$. As a result, from Eq. (A.7), we must have

$$c_j - c_p + \lambda + \lambda_p = 0 \quad \text{or} \quad \lambda = c_p - c_j - \lambda_p. \quad (\text{A.8})$$

From Eq. (A.6) it follows that $2(t_{qi} - t_{ji}) = c_j - c_q + \lambda + \lambda_q$. Substituting from (A.7) into (A.8) gives $2(t_{qi} - t_{ji}) = c_p - c_q + \lambda_q - \lambda_p$. Since $t_{qi} \geq t_{ji}$, it must be that $\lambda_q - \lambda_p > 0$ (because $c_p - c_q < 0$). But all multipliers are non-negative: $\lambda_q > \lambda_p \geq 0$. 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, it must be that $t_{qi} = t_{ji}$.

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 low cost relative to country j (i.e., $c_q < c_j$), it will not grant MFN to any country who is low cost relative to 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:

$$2(t_{qi} - t_{ji}) = c_j - c_q + \lambda + \lambda_q > 0 \quad (\text{A.9})$$

Since $t_{qi} - t_{ji} > 0$, the complementary slackness condition ($\lambda_q(t_{qi} - t_{ji}) = 0$) implies that $\lambda_q = 0$. From (A.9), we must have $\lambda > c_q - c_j - \lambda_q = c_q - c_j$. Let p be any country who is low cost relative to country q , i.e., $c_p < c_q$. To show that country p does not get MFN, it is sufficient to show that $t_{pi} - t_{ji} > 0$. We know that $2(t_{pi} - t_{ji}) = c_j - c_p + \lambda + \lambda_p$. But $\lambda > c_q - c_j$ so that $c_j - c_p + \lambda + \lambda_p > c_q - c_p + \lambda_p > 0$. Thus, it must be that $t_{pi} > t_{ji}$.

Proof of Proposition 6

Let G_j^{jk} denote the gain to country j of reciprocal MFN adoption with country k . Simple calculations yield

$$G_1^{12} - \frac{2}{5}c_3c_2 - \frac{3}{80}c_3^2 - \frac{3}{8}c_3c_1 - \frac{1}{8}c_2^2 - \frac{3}{20}c_2c_1 + \frac{23}{80}c_1^2 - \frac{1}{20}A_2c_1 + \frac{1}{20}A_2c_3$$

Replacing c_2 by c_1 and A_2 by A_1 in the above formula yields G_2^{12} . Reciprocal MFN between 1 and 2 occurs iff $G_1^{12} \geq 0$ and $G_2^{12} \geq 0$. When $A_2 = A_1 = A$, we have

$$[G_1^{12} - G_2^{12}]_{A_2=A_1=A} = \frac{(c_2 - c_1)(4A + 62c_3 - 33(c_1 + c_2))}{80}$$

Note that since $A > c_3 \geq c_2 \geq c_1$, we must have $G_1^{12} - G_2^{12}|_{A_2=A_1=A} > 0$. Further, when $c_2 = c_1 = c$, we have

$$[G_1^{12} - G_2^{12}]_{c_2=c_1=c} = \frac{(c_3 - c)(A_2 - A_1)}{20} > 0 \text{ iff } A_2 > A_1.$$

Finally, if $c_1 = c_2 = c$ then $[G_1^{12} - G_2^{12}]_{A_2=A_1=A} = 0$. Denote this common gain by G^{12} . We have

$$G^{12} = \frac{(c_3 - c)(4A - 3c_3 - c)}{80} > 0.$$

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Erratum

Erratum to “Tariffs and the Most Favored Nation clause” [J. Int. Econ. 63 (2004) 341–368]

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The publisher regrets that a number of errors occurred in the original printing of this article. The corrected text follows below:

1. On page 348, the eighth line from the top is **incorrectly stated** as:

$$dTR_i = \varepsilon (x_{ki}^* - x_{ji}^*)_+ + (t_{ji}^* - t_{ki}^*)_+ dx_{ji}^* > 0_+.$$

The **correct** line is:

$$dTR_i = \varepsilon (x_{ki}^* - x_{ji}^*)_+ + (t_{ji}^* - t_{ki}^*)_+ dx_{ji}^* > 0.$$

2. On page 348, Eq. (12) is **incorrectly stated** as:

$$\frac{\partial W_i}{\partial t_i} = -p_i' \frac{\partial X_i}{\partial t_i} X_{-i} + (p_i - c_i) \frac{\partial x_{ii}}{\partial t_i} + X_{-i} + t_i \frac{\partial X_{-i}}{\partial t_i} = 0.$$

The **correct** Eq. (12) is:

$$\frac{\partial W_i}{\partial t_i} = -p_i' \frac{\partial X_i}{\partial t_i} X_{-i} + (p_i - c_i) \frac{\partial x_{ii}}{\partial t_i} + X_{-i} + t_i \frac{\partial X_{-i}}{\partial t_i} = 0.$$

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3. On page 348, Eq. (13) is **incorrectly stated** as:

$$t_i^M = \frac{\left(p' \frac{\partial \partial X_i}{\partial \partial t_i} - 1\right)(X_{-i}) - (p_i - c_i) \frac{\partial \partial x_{ii}}{\partial \partial t_i}}{\frac{\partial \partial X_{-i}}{\partial \partial t_i}}.$$

The **correct** Eq. (13) is:

$$t_i^M = \frac{\left(p' \frac{\partial X_i}{\partial t_i} - 1\right)(X_{-i}) - (p_i - c_i) \frac{\partial x_{ii}}{\partial t_i}}{\frac{\partial X_{-i}}{\partial t_i}}$$

4. On page 349, lines 2 and 3 are **incorrectly stated** as:

$$\frac{\partial \partial X_i}{\partial \partial t_i} = (n-1) \frac{\partial \partial X_i}{\partial \partial t_{ji}} = (n-1) \frac{\partial \partial X_i}{\partial \partial t_{ki}},$$

$$\frac{\partial \partial p_i}{\partial \partial t_i} = (n-1) \frac{\partial \partial p_i}{\partial \partial t_{ji}} = (n-1) \frac{\partial \partial p_i}{\partial \partial t_{ki}}, \text{ and}$$

The **corrected** lines 2 and 3 are as follows:

$$\frac{\partial X_i}{\partial t_i} = (n-1) \frac{\partial X_i}{\partial t_{ji}} = (n-1) \frac{\partial X_i}{\partial t_{ki}},$$

$$\frac{\partial p_i}{\partial t_i} = (n-1) \frac{\partial p_i}{\partial t_{ji}} = (n-1) \frac{\partial p_i}{\partial t_{ki}}, \text{ and}$$

5. On page 351, the equation in line 14 as **incorrectly stated** as

$$\frac{\partial WWW}{\partial t_{ji}} = (p_i - c_j) \underbrace{\frac{\partial x_{ji}}{\partial t_{ji}}}_{<0} + \sum_{k \neq j} (p_i - c_k) \underbrace{\frac{\partial x_{ki}}{\partial t_{ji}}}_{<0}.$$

The **corrected** equation is

$$\frac{\partial WWW}{\partial t_{ji}} = (p_i - c_j) \underbrace{\frac{\partial x_{ji}}{\partial t_{ji}}}_{<0} + \sum_{k \neq j} (p_i - c_k) \underbrace{\frac{\partial x_{ki}}{\partial t_{ji}}}_{>0}.$$

6. On page 355, the third line below Proposition 3, the expression $c_i + c_j/2$ is **incorrect**. The **correct** expression is $(c_i + c_j)/2$.

7. On pages 356 and 357, in Eqs. (25), (26), and (27) the word 'forall' is incorrect; the correct phrase is 'for all'.