**Potential Pareto-improving Move towards Most
Favored Nation Tariffs**

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By

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Abstract

We use a multi-country asymmetric oligopolistic framework for segmented markets to study the welfare effects of reducing tariff discriminations — which we call a move towards Most Favored Nation tariffs. In our basic framework initial tariffs are arbitrary, and we consider unilateral reforms without and with reciprocity/retaliation. We extend the basic framework to allow for revenue constraints, unemployment and the case where the initial tariffs are at Nash optimal levels. We also consider multilateral reforms in the last scenario. Conditions under which such harmonizations are potentially Pareto-improving are derived and results compared across scenarios. Each scenario makes a significant difference to qualitative results.

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1 Introduction

There is voluminous literature on the desirability of moving taxes toward uniformity. This literature has many strands depending on the type of taxes and the type of markets one considers. One strand considers the implications of a move towards uniformity of domestic taxes across goods. The origin of this literature dates back to Atkinson and Stiglitz (1976) who show that, when income tax is set optimally, differential commodity taxation is inefficient. Hatta (1977), in the context of a closed economy and without considering a tax revenue constraint, examines the welfare implications of moving consumption taxes towards uniformity, while Hatta (1986), re-examines the implications of the above tax reforms under a revenue constraint. The broad argument here is that non-uniformity in commodity taxation distorts consumption choices and therefore is inefficient.[1]

Another strand examines the welfare implications of the uniformity of domestic taxes across tax jurisdictions — the issue of tax harmonization, starting with the seminal work by Keen (1987, 1989). While Keen (1987 and 1989) used a perfectly competitive framework, Keen and Lahiri (1993) and Keen, Lahiri, Raimondos-Mϕller (2002) use an oligopolistic framework for an integrated market. Likewise, the uniformity of environmental taxes has also been analyzed. Fullerton et al. (2010) examined the welfare implications of uniformity of domestic environmental taxes across heterogeneous firms within an industry. Hatzipanayotou et al. (2015) take the case of uniform environmental taxes across sectors of production both in the absence and in the presence of binding revenue constraints.

This paper considers a different kind of uniformity or harmonization: one of bringing closer discriminatory tariffs imposed by a country on imports from different countries for the same good. In other words, we analyze the phenomenon of 'most favored nation' (MFN) status in international economic relations. By according the MFN status to a trading partner, a country promises not to treat the trading partner less advantageously than any other

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[1]Panagariya and Rodrik (1993) provide a political-economic argument for having uniform tariffs across goods: uniformity leads to free-riding by lobby groups and thus lower levels of lobbying.

country. By joining the World Trade Organization (WTO) a country agrees to accord MFN status to the other members of the WTO. There are, however, important exceptions such as preferential treatment of developing countries and of members of regional free trade areas and customs unions. We shall examine the welfare implication of a move towards the MFN principle following the approach and methodology adopted by the tax reform literature.

We consider a model of oligopolistic segmented markets in an arbitrary number of countries, with an arbitrary number of symmetric firms in each country, and possibly asymmetries in the efficiency levels of firms across the countries.[2] In our basic framework initial tariffs are arbitrary. We pick any two of the tariffs in a country and examine the effect of a small move of both tariffs towards an weighted average of the two on the levels of welfare of that country and on global welfare.[3] We consider unilateral reforms by one country when other countries are passive and we also consider the scenario when the trading partners of the reforming country reciprocate/retaliate. Our results indicate that efficiency-enhancing tariff reforms may be opposed by tariff-reforming governments when the initial tariffs are arbitrary. Moreover, we find that this result is robust to unilateral tariff reforms where all tariffs imposed by the reforming country are changed while keeping an average of them constant. However, we find that the presence of reciprocal behavior, as well as considerations of the global welfare effect of a tariff reform, may increase the viability of efficiency-enhancing tariff reforms.

We then extend the basic framework to allow for revenue constraints, unemployment and to the case where the initial tariffs are at Nash optimal levels.[4] We show that global welfare unambiguously increases because of a tariff reform in the presence of initial optimal tariffs. This result is robust to alternative ways in which tariff reform is implemented. We also

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[2] Fruend (2000), Krishna (1998) and Ornelas (2007) are examples of the application of this type of framework to study preferential trade arrangements. Saggi (2004) applies a similar framework to study the welfare effects of the MFN clause.

[3] In the preferential trade agreements literautre, Raff (2001) investigates which countries would be chosen by an importing country on welfare grounds to be granted full preferential access to the importing country's market. He concludes that the least-efficient ones would be chosen given the external tariff on other (non-selected) countries. In this case, the question asks about the discrete deviations from the MFN rule under certain conditions.

[4] In a different context, Davidson, Martin and Matusz (1999) show that certain results derived under the assumption of full employment in traditional models may be significantly altered in the presence of unemployment.

consider multilateral reform of tariffs when the initial tariffs are optimal. In this case, we find that not all countries gain from such reforms: the country with most efficient (inefficient) firms gains (loses). We develop conditions under which such reforms are potentially Pareto-improving and the results are compared across scenarios. Each scenario makes a significant difference to the qualitative results.

Our approach to the analysis of the effect of MFN on welfare is somewhat different from those usually found in the literature. In the literature, the MFN equilibrium is the case where there is no discrimination, i.e., tariffs on imports from all trading partners are equal (see, for example, Bagwell and Staiger, 1999; Saggi, 2004; Saggi and Yildiz (2005)). In contrast, we consider a small move towards uniformity as, for example, in the literature on commodity tax harmonization discussed above (see, for example, Keen, 1987).[5] Our approach can be justified on a number of grounds and in reality we observe various forms of discrimination in treatment of countries for many reasons. First, the presence of preferential trading agreements brings in discrimination even among trade between WTO-member countries. Second, there are countries which are still not members of the WTO.[6] In these cases, WTO members are not required to extend MFN status to these countries, and the non-WTO members may apply discretionary tariffs at their discretion.

Third, many developing countries continue to receive preferential (special and differential) treatments under WTO rules. This enables developed countries to grant developing countries unilateral preferential access to their markets, and also allows developing countries to exchange preferential access through partial scope trade agreements. Fourth, Article XXIV of the WTO, for example, allow for many special circumstances,[7] and India and Pakistan

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[5]Thus, we adopt a piecemeal approach to tariff reform. This approach is part of a rich literature in international economics. Anderson and Neary (2007) employ this approach to investigate the feasibility in achieving increases in market access and welfare-enhancement under piecemeal tariff reforms, while Diewert et al. (1989) discuss the conditions under which piecemeal tax and tariff reforms are Pareto-improving, among several other papers.

[6]There are 43 countries that are members of the United Nations, but are not full members of the WTO.

[7]Article XXIV, for example, includes 'Taking into account the exceptional circumstances arising out of the establishment of India and Pakistan as independent States and recognizing the fact that they have long constituted an economic unit, the contracting parties agree that the provisions of this Agreement shall not prevent the two countries from entering into special arrangements with respect to the trade between them, pending the establishment of their mutual trade relations on a definitive basis.'

have only recently granted each other MFN status. Thus, most WTO member countries have significant leeway in discriminating tariffs.

In fact, Fugazza and Nicita (2013) shows how the complex network of trade preferences among countries has been responsible for varying degrees of tariff discrimination. They show that taking into account the direct effect of tariffs on a particular exporting country, as well as the relative preference margin granted to exporters, is paramount in explaining bilateral trade flows. Their dataset considers examples such as the case of Argentina, which is a member of different preferential trade agreements involving other developing countries.[8] In the case of exports to Argentina, members of the Common Market of the Southern Cone (MERCOSUR) receive an average preferential margin 12 percentage points higher than the rest of the world, while Mexico, which has partial scope agreements with different MERCOSUR members, receives a preferential margin 7 percentage points higher than the rest of the world. On the other side of the spectrum, their dataset shows that the US faces an average preferential margin 3 percentage points lower than other countries exporting to Argentina.[9,10]

Finally, WTO/GATT agreements are only commitments to 'bound tariffs', i.e., the country commits not to impose tariffs above a certain rate (see, for example, Bagwell and Staiger (2011)). But, in practice, more often than not, these bound tariffs are not binding. For example, Foletti et al. (2011) show that the average tariff overhanging (bound minus the applied MFN tariff) across countries is eleven percentage points, and it reaches more than thirty-five percentage points across low income countries. This implies that most countries have significant policy space to implement tariff reforms of the type considered here. For example, if the reform involves raising tariffs against WTO members, that shall not be against

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[8]See Estevadeorda et al. (2008) for details on preferential programs involving Latin American countries. Fugazza and Nicita's (2013) dataset can be downloaded from "http://www.unctad.info/en/Trade-Analysis-Branch/Data-And-Statistics/Other-Databases/"

[9]These numbers correspond to the relative preferential margin (RPM) as detailed on page 10 of Fugazza and Nicita (2013). Notice that this measure of relative market access can only differ from zero if tariffs differ across countries at the product level (6-digit of the Harmonized System), which implies the presence of tariff discrimination.

[10]Foletti et al. (2011) show that tariff overhanging in Argentina was twenty-eight percentage points in 2008. This suggests that Argentina and other members of MERCOSUR, have significant policy space to implement tariff reforms as suggested by their discriminatory tariff schedule.

WTO rules as long as there is some tariff overhang.[11]

The lay out of the paper is as follows. Section 2 sets up the basic framework with initial arbitrary tariffs and the tariff reform rules. In Section 3, we examine the welfare effects of unilateral reforms without and with reciprocity. Section 4 extends the basic framework to include the presence of unemployment and revenue constraint. In section 5, the initial tariffs are at Nash-optimal levels. Finally, in section 6 some concluding remarks are made.

2   The Model

We consider an m-country oligopolistic framework where the market for the oligopolistic good in each country is segmented. The oligopolistic good x is produced in country k by n_k firms. The total number of firms in the oligopolistic industry is denoted by n , i.e., $n = \sum_{k=1}^{m} n_k$. The oligopolistic firms face a constant marginal cost of production. We assume that the oligopolistic firms within a country are symmetric, but can be asymmetric across countries. The marginal cost of firms in country k is denoted c_k.

Let $x_{i,j}$ denote the quantity of good x produced by a firm located in country j and sold in country i. The total amount of good x originating in country j and sold in country i is then described by $n_j x_{i,j}$, and the total amount of good x sold in country i is denoted by $x_i = \sum_{k=1}^{m} n_k x_{i,k}$. The governments apply tariffs on the imports of the oligopolistic good. The notation for tariffs follows a similar pattern of the notation used for production: $t_{i,j}$ denotes the tariff applied by country i on imports from country j.[12] Country i's tariff vector is described by $\mathbf{t}'_i = (t_{i,1}, t_{i,2}, ..., t_{i,m})$. The set of tariffs applied by the various countries in our model can be described in a matrix form by $\mathbf{t} = (\mathbf{t}_1, \mathbf{t}_2, ..., \mathbf{t}_m)$.[13]

Country i consumers' preferences are described by an indirect utility function assumed

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[11] Kee et al. (2013) use bilateral tariff data to investigate the degree to which countries have on average increased their tariff barriers during the financial crisis of 2008. They find that just a few countries significantly increased their trade barriers. Included in this group are WTO members such as Argentina, Turkey and China.

[12] Clearly, $t_{i,i} = 0$. If countries i and j are members of the Free Trade Area, then also $t_{i,j} = 0$.

[13] All vectors are column vectors, and for a vector z, the transpose of it is denoted by z'.

to be of the form $h_i(p_i, Z_i) = v(p_i) + Z_i$ where p_i is the consumer price of the oligopoly good in country i and Z_i denotes lump-sum income. In Section 4, we extend this framework to include the presence of a revenue constraint, where we assume that the government can raise revenue by imposing tariffs and a consumption tax, and also consider the presence of unemployment. The function $v(p_i)$ is such that the inverse demand function takes the general form $p_i = f_i(x_i)$ with $f_i' < 0$. We assume the demand function to satisfy:[14]

Assumption 1 $f_i'(X) + x f_i''(X) < 0$ *for any X and x satisfying $X \geq x \geq 0$, and for all i*

Due to the assumptions of segmented markets and constant unit/marginal costs, the price in country i is not affected by tariffs imposed by country j $(j \neq i)$. Thus, the reduced form of social welfare can be written as:

$$W_i(\mathbf{t}) = n_i \pi_i(\mathbf{t}) + \sum_k t_{i,k} n_k x_{i,k}(\mathbf{t}_i) + CS_i(\mathbf{t}_i), \tag{1}$$

where the first term represents profits in the oligopolistic sector,

$$\pi_i(\mathbf{t}) = \sum_k \pi_{k,i} = \sum_k \left[p_k - c_i - t_{k,i} \right] x_{k,i}. \tag{2}$$

The second term captures the contribution from tariff revenues to social welfare while CS_i $(= v(p_i))$ represents the consumers' surplus with $dCS_i = -x_i dp_i$.

2.1   Production and Consumption Choices

In this section, we consider that firms make production choices taking as given the tariff matrix $\mathbf{t}$. As markets are segmented, we can simply describe the equilibrium outcomes in country i. We consider the case of Cournot oligopolistic competition, which implies that an oligopolist in country j solves the following problem with respect to country i's market:

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[14]This assumption corresponds to 'normal' case in Seade (1980) and to strategic substitutes in Bulow et al. (1985) and Dixit (1986).

$$\max_{x_{i,j}} \; [p_i - c_j - t_{i,j}] \, x_{i,j},$$ taking as given the output of all other firms for that market. This optimization problem gives rise to the following first-order condition:[15]

$$f_i' x_{i,j} + p_i = c_j + t_{i,j} \quad \text{for all } j, \tag{3}$$

which implies that

$$x_{i,j} - x_{i,k} = [(t_{i,k} - t_{i,j}) + (c_k - c_j)]/(-f_i') \tag{4}$$

Thus, a firm's sales in country i differs from its competitors' sales according to the difference in the effective marginal costs of exports, i.e. tariffs plus marginal costs of production. We now carry out a few comparative static exercises with respect to tariffs and these will be used for examining the welfare effects of tariff reforms. First,

$$dp_i = f_i' dx_i. \tag{5}$$

Then, multiplying expression (3) by n_j and summing over countries, we write:

$$f_i' x_i + n p_i = \sum_k n_k c_k + \sum_k n_k t_{i,k}, \tag{6}$$

and then, differentiate it, and use (5) to get:

$$\Delta_i dx_i = \sum_k n_k dt_{i,k}, \tag{7}$$

where $\Delta_i = (n+1)f_i' + x_i f_i'' < 0$ from assumption 1. An increase in overall protection in country i reduces total consumption there and increases price. Notice that expression (7) suggests that changes in the total sales of the oligopolistic good only depends on changes in the aggregate level of protection. This happens since marginal costs are constant and (5) and (6) suggest that the effects of tariffs and marginal costs on total sales are separable.

Also, totally differentiating equation (3), and using (5) and (7), we get:

$$f_i' dx_{i,j} = dt_{i,j} - (f_i' + x_{i,j} f_i'') \sum_k n_k dt_{i,k}/\Delta_i. \tag{8}$$

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[15]To save on notation, the fact that quantities and prices are a function of the tariffs, are implicit.

An increase in tariffs on country j reduces imports from it, but an increase in tariffs against its competitors increases imports from country j. Substituting (3) in (2), we can first express profits accrued by a firm located in country j for sales in country i as described by the following relationship:

$$\pi_{i,j} = -f_i'(x_{i,j})^2, \tag{9}$$

and then totally differentiate it to obtain:

$$d\pi_{i,j} = -(x_{i,j})^2 f_i'' dx_i - 2f_i' x_{i,j} dx_{i,j}. \tag{10}$$

We shall now use expressions (5) - (10) to examine the effects of tariff reform on welfare. But before that, we shall formally describe the type of reform we consider.

2.2 Description of Tariff Reform

We adopt a simple also useful approach to describe a move towards non-discriminatory tariffs in country i. Our framework considers that tariff reform may involve any pair of tariffs employed by country i. In particular, the reform may include a marginal decrease of the higher of the two tariffs while it increases marginally the lower, keeping all other discriminatory tariffs, and a weighted average of these two tariffs, unchanged. In subsection 3.2.2, we extend the analysis by considering the situation where the reforming country changes all tariffs while keeping an average of them constant. We denote the benchmark (initial) higher tariff applied by country i by $t_{i,h}$ and the lower tariff by $t_{i,l}$. In particular, the tariff reform under consideration maintains the following average between $t_{i,h}$ and $t_{i,l}$ constant:

$$A = \lambda_i t_{i,l} + (1 - \lambda_i) t_{i,h}, \tag{11}$$

where $\lambda_i \in [0,1]$ and we shall consider different values for it below. In this scenario, tariff reform in country i is summarized by the following formulae (with δ as a positive scalar[16]):

$$dt_{i,l} = \delta (A - t_{i,l}) \qquad \text{and} \qquad dt_{i,h} = \delta (A - t_{i,h}). \tag{12}$$

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[16]Parameter δ represents a small number that guarantees that the changes introduced by the tariff reform are marginal in nature rather than discrete.

It is clear that replacing the average tariff A from (11) in (12) gives

$$dt_{i,l} = \delta (1 - \lambda_i)(t_{i,h} - t_{i,l}) \qquad \text{and} \qquad dt_{i,h} = -\delta \lambda_i (t_{i,h} - t_{i,l}), \qquad (13)$$

which implies that $dt_{i,l} \geqslant 0$ and $dt_{i,h} \leqslant 0$ given that $t_{i,h} > t_{i,l}$.[17] Similarly, we denote the marginal cost of the firms subject to the higher (lower) tariff in country i by c_h (c_l).[18]

2.3   Welfare Effects of Tariff Reform

In this subsection we shall develop the basic equation describing the change in welfare level for country i related to tariff reforms implemented in that country or in other trade partners. The effects of tariff reforms on country i's welfare is described by the following expression:

$$dW_i = -x_i dp_i + \sum_j n_j t_{i,j} dx_{i,j} + \sum_j n_j x_{i,j} dt_{i,j} + n_i d\pi_{i,i} + n_i \sum_{j \neq i} d\pi_{j,i}. \qquad (14)$$

The first term gives the effects of tariff reforms on consumer surplus, the second and the third terms are effects on tariff revenue, the fourth term represents the effects of tariff reforms in country i on domestic firms' profits, and the last term gives the effects of reforms in other countries on the profits of country i's firms. The last term is an outcome of market segmentation: tariff reforms in other countries only affect country i through changes in sales and profits derived from them. Equation (14) is rewritten substituting dp_i, $dx_{i,j}$ and $dt_{i,j}$ as

$$dW_i = \frac{(2n_i x_{i,i} - x_i)f_i' + n_i(x_{i,i})^2 f_i''}{\Delta_i} \sum_j n_j dt_{i,j} \qquad (15)$$

$$+ \frac{1}{f_i'} \sum_j n_j t_{i,j} dt_{i,j} - \frac{\sum_j n_j t_{i,j}(f_i' + x_{i,j} f_i'')}{f_i' \Delta_i} \sum_k n_k dt_{i,k} + \sum_j n_j x_{i,j} dt_{i,j}$$

$$+ n_i \sum_{j \neq i} \left[\frac{1}{\Delta_j} \left(2x_{j,i} f_j' + x_{j,i}^2 f_j'' \right) \sum_k n_k dt_{j,k} \right] - n_i \sum_{j \neq i} 2x_{j,i} dt_{j,i},$$

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[17]The tariff changes described by expression (12) guarantee by construction that $\lambda_i(t_{i,l} + dt_{i,l}) + (1 - \lambda_i)(t_{i,h} + dt_{i,h}) = \lambda_i t_{i,l} + (1 - \lambda_i) t_{i,h}$.

[18]Notice that c_h may be greater or lower than c_l since we consider both arbitrary and optimal initial values of tariffs.

where the term in the first line represents the net effect of a tariff reform in country i on its own consumer and producer surpluses, while the terms in the second line describe the effects on its tariff revenue. The terms in the third line represent the effects of tariff reforms implemented by other countries on profits of the firms based in country i. We can further conclude that for general tariff reforms the following apply:

$$\sum_j n_j dt_{i,j} = (t_{i,h} - t_{i,l}) \delta \left[n_l (1 - \lambda_i) - n_h \lambda_i \right], \tag{16}$$

$$\sum_j n_j t_{i,j} dt_{i,j} = (t_{i,h} - t_{i,l}) \delta \left[n_l t_{i,l} (1 - \lambda_i) - n_h t_{i,h} \lambda_i \right],$$

$$\sum_j n_j x_{i,j} dt_{i,j} = (t_{i,h} - t_{i,l}) \delta \left[n_l x_{i,l} (1 - \lambda_i) - n_h x_{i,h} \lambda_i \right].$$

Having derived the basic welfare equation, we shall now consider two main scenarios. In the first, we assume that the reform is unilateral, i.e., the reform takes place only in country i and not in other countries, and also assume that initial tariffs are set at arbitrary levels. We believe that these cases are important since initial tariffs may not be optimal from a social welfare point of view due to political economy considerations. In particular, we consider the welfare effects of general reforms, in which case we consider general values for parameter λ_i. We also consider the effects of a specific reform in the presence and in the absence of reciprocity/retaliation. These are taken up in the next section. In the second case, we consider the presence of optimal initial tariffs coupled with the implementation of unilateral and multilateral tariff reforms. In this case, we investigate the welfare effects of specific tariff reforms on the reforming country and on the world economy.

3 Arbitrary Initial Tariffs

3.1 General Unilateral Reforms

In this section, we consider the effects of tariff reforms in country i without specifying particular values for λ_i. We search for conditions under which unilateral reforms enhance

the welfare of the reforming country i. In particular, we assume that initial tariffs are not necessarily optimal from a social welfare point of view. We substitute (16) in (15), and use (3) and (6), to obtain the following expression describing welfare changes in country i due to tariff reforms:

$$dW_i = \beta_i \underbrace{[n_l(1-\lambda_i) - n_h\lambda_i]}_{\text{Term 1}} \cdot \left[\underbrace{\{2n_i x_{i,i} f'_i + n_i(x_{i,i})^2 f''_i\} f'_i - \sum_j n_j t_{i,j}(f'_i + x_{i,j} f''_i)}_{\text{Term 2}} \right]$$

$$+ \beta_i \underbrace{[n_l(1-\lambda_i) - n_h\lambda_i]}_{\text{Term 1}} \left[\underbrace{-\left\{p_i + \sum_j n_j(c_j + t_{ij})\right\} f'_i - p_i x_i f''_i}_{\text{Term 3}} \right]$$

$$+ \beta_i(-\Delta_i) \left[\underbrace{\lambda_i\{n_l(2t_{i,l} + c_l) + n_h(2t_{i,h} + c_h)\} - n_l(2t_{i,l} + c_l)}_{\text{Term 4}} \right], \tag{17}$$

where $\beta_i = (t_{i,h} - t_{i,l})\,\delta/(f'_i\Delta_i) > 0$. Terms 1-4 represent the welfare effects of unilateral tariff reforms on the reforming country, while the terms that are described in the third line of (15) are zero since they represent the effects of tariff reforms in countries other than i.

From (17) we identify sufficient conditions for welfare gains for the reforming economy ($dW_i > 0$). Note that Term 1 is non-negative when $\lambda_i \leq n_l/(n_l + n_h)$. Also, under assumption 1, $2n_i x_{i,i} f'_i + n_i(x_{i,i})^2 f''_i$ and $f'_i + x_{i,j} f''_i$ are negative, which implies that Term 2 is positive. Also, $\{p_i + \sum_j n_j(c_j + t_{ij})\} f'_i + p_i x_i f''_i$ is negative, which implies that Term 3 is positive. Therefore, $dW_i \geq 0$ if Terms 1 and 4 are non-negative which is the case if the condition $n_l(2t_{i,l} + c_l)/\{n_l(2t_{i,l} + c_l) + n_h(2t_{i,h} + c_h)\} \leq \lambda_i \leq n_l/(n_l + n_h)$ is satisfied.[19] Formally,

Proposition 1 *Consider a general unilateral tariff reform in the form of (13) in country i, starting from arbitrary initial tariff rates. The reform will be welfare enhancing if*

$$\frac{n_l(2t_{i,l} + c_l)}{\{n_l(2t_{i,l} + c_l) + n_h(2t_{i,h} + c_h)\}} \leq \lambda_i \leq \frac{n_l}{n_l + n_h}.$$

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[19]It can be verified that a λ_i exists if $2(t_{i,w} - t_{i,l}) \geq c_l - c_w$.

Note that the average tariff level $\sum_j n_j dt_{i,j}$ decreases, and therefore consumers' surplus increases, if and only if $\lambda_i < n_l/(n_l + n_h)$ (see (16)). The left-hand inequality in the proposition is sufficient for tariff revenue to increase.

Having considered this general case, we can now consider two specific cases. In the first case country i only raises the tariff against country l's imports, i.e., $\lambda_i = 0$. This applies to the case of a developed country that increases the tariff on a particular product exported by a developing country under the Generalized System of Preferences or under a different unilateral preferential trade regime governed by the Enabling Clause. This policy change would apply to countries that have 'graduated' to developed status or whose exports have exceeded a pre-determined threshold in the form of "competitive need limits" and market share limitations imposed by the developed country.[20] In this case, (17) reduces to

$$\frac{1}{\beta_i n_l} \cdot dW_i = \left\{ 2n_i x_{i,i} f'_i + n_i (x_{i,i})^2 f''_i \right\} f'_i - \sum_j n_j t_{i,j} (f'_i + x_{i,j} f''_i)$$

$$- (p_i - 2t_{i,l} - c_l)[f'_i + x_i f''_i] + \left[n(2t_{i,l} + c_l) - \sum_j n_j (t_{i,j} + c_j) \right] f'_i.$$

Using assumption 1, we find that the first line of dW_i is positive while its second line is positive depending on the size of $t_{i,l}$ and c_l. In particular, the terms that compose the second line are positive if the effective marginal cost faced by firms located in country l to export to country i, $t_{i,l} + c_l$, is low relative to the average cost faced by firms located in other countries. This is likely to be satisfied in unilateral preferential programs such as the Generalized System of Preferences, since, in this case, preferential tariffs are usually zero.

Turning to the other extreme case, namely $\lambda = 1$, where country i lowers the tariff on country h's imports. This is the case when a country decides unilaterally to liberalize trade

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[20]See Hoekman and Özden (2005), Özden and Reinhardt (2005), and Kee et al. (2007) for a list of alternatives available for developed countries to change the market access granted to developing countries under unilateral preferential agreements. This list also includes the presence of annual or periodic reviews to determine eligibility — at the product, country, and product-country levels, the creation of special programs limited to certain countries and products — such as the creation of the Caribbean Basin Trade Partnership Act in 2000 — to extend the preferences under the Caribbean Basin Initiative program to textile and apparel goods, and reviews of rules of origin requirements.

by decreasing some of its tariffs. This is line with the idea proposed under the 'Concertina Rule' that reduces the highest tariff imposed by a country.[21] In this case, (17) becomes

$$\frac{1}{\beta_i n_h} \cdot dW_i = - \left\{ 2n_i x_{i,i} f_i' + n_i (x_{i,i})^2 f_i'' \right\} f_i' + \sum_j n_j t_{i,j} (f_i' + x_{i,j} f_i'')$$

$$(p_i - 2t_{i,h} - c_h)[f_i' + x_i f_i''] - \left\{ n(2t_{i,h} + c_h) - \sum_j n_j (t_{i,j} + c_j) \right\} f_i'.$$

Here we find that, under assumption 1, $dW_i < 0$ if the effective marginal cost faced by firms located in country h to export to country i, $t_{i,h} + c_h$, is relatively small. Formally,

Corollary 1 *Consider a unilateral tariff reform where country i increases (decreases) the tariff applied on imports from country l (h). The reform is welfare enhancing (reducing) if the initial value of the effective marginal cost faced by country l (h) firms is relatively low.*

Next, we consider the case of more specific reforms by setting a particular value of parameter λ_i, and check for the conditions under which the reform is welfare enhancing for the reforming country and for the world. Moreover, we also consider the role played by reciprocity in determining the welfare effects of specific tariff reforms.

3.2 Specific Reforms

In this section, we investigate the welfare effects of a specific tariff harmonization reform in country i when the initial tariffs are set at arbitrary levels. We consider the effects of specific reforms in the welfare of country i and of the world. Initially, we assume that tariffs do not change in any country other than i, but later we relax this assumption in order to consider the role played by reciprocity in determining welfare levels.

We define a reform as specific if it defines a particular value for parameter λ_i. This allows further simplifications to (15) by specifically describing the terms $dt_{i,j}$. More importantly, our

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[21] Anderson and Neary (2007) consider whether unilateral trade policies that enhance welfare necessarily overlap with policies that increase market access in a perfectly competitive environment. In this case, they consider the welfare effects of the 'Concertina Rule' among other strategies.

main concern is to describe a move towards MFN tariffs, where tariffs tend to be harmonized, but may not be at free trade levels. For this reason, we focus on a tariff reform under which the government in country i decreases a particular tariff $t_{i,h}$ and increases another tariff $t_{i,l}$, where we continue to assume that $t_{i,h} > t_{i,l}$.

In this case, we choose a specific value of λ_i, the weight used in (11)-(13), as $\lambda_i = n_l/(n_l + n_h)$. The choice of weight λ_i is in line with expressions (7) and (8) that suggest that tariffs weighted by the number of firms are central in determining the equilibrium quantity, and, therefore, also important in determining the equilibrium price.[22] Moreover, this choice of tariff reform is in line with the condition described in Proposition 1.

With this choice of weight λ, we can use (13) to immediately obtain:

$$\sum_j n_j dt_{i,j} = n_l \delta (1 - \lambda) (t_{i,h} - t_{i,l}) - n_h \delta \lambda (t_{i,h} - t_{i,l}) = 0. \tag{18}$$

The term $\sum_j n_j dt_{i,j}$ represents a change in the aggregate level of protection in country i, and (18) indicates that, with our choice of weight λ_i, the reform does not change the level of protection in country i. As a result, expressions (5), (7), and (8) indicate that the equilibrium price, output of firms in country i and total sales of the oligopolistic good do not change with the reform, i.e $dx_i = dx_{i,i} = dp_i = 0$.

Next we consider the welfare effects of this specific harmonizing tariff reform on the reforming country and on the world. Later on, we also consider reciprocal behavior.

3.2.1 Unilateral Specific Reform

Substituting (4) and (18) into (15) we obtain:

$$dW_i = dTR_i = \left[-\frac{\delta n_l n_h (t_{i,h} - t_{i,l})}{f_i' (n_l + n_h)} \right] [2 (t_{i,h} - t_{i,l}) + (c_h - c_l)]. \tag{19}$$

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[22]In the appendix, we derive the welfare effects of import-weighted unilateral tariff reforms as an alternative and show that the results are robust to this alternative specification.

where $d\text{TR}_i$ represents the changes in tariff revenue collected by country i caused by a tariff reform. From (19), the following proposition follows.

Proposition 2 *Starting from arbitrary initial values of tariff rates, a specific unilateral tariff reform in the form of (13) in country i will increase welfare in that country if and only if*

$$t_{i,h} - t_{i,l} > (c_l - c_h)/2. \tag{20}$$

The intuition behind the above proposition can be explained as follows. In this case, the tariff reform described by (11)-(13) keep the aggregate level of protection $(\sum n_k t_{i,k})$ in country i constant as indicated by expression (18). Thus, it neither affects the equilibrium price in country i nor the profits of the firms based in this country as indicated by (10). The only aspect of country i's welfare affected by the tariff reform is the tariff revenue term which increases if and only if (20) holds.[23] Notice an important point that directly results from Proposition 2. A sufficient condition for welfare in country i to increase is that $c_h > c_l$. This is because if $c_h > c_l$, the tariff that is reduced has a lower base than the one which is raised and therefore the reform raises tariff revenue unambiguously. Formally,

Corollary 2 *Starting from arbitrary initial values of tariff rates, a sufficient condition for a specific unilateral tariff reform in the form of (13) in country i to increase welfare in that country is $c_h > c_l$, and a necessary condition for it to reduce welfare there is $c_l > c_h$.*

Corollary 2 suggests that a sufficient condition for welfare increase in country i is to implement a reform that increases the tariff on the low-marginal cost firms while decreasing the tariff on high-marginal cost firms, $c_h > c_l$. In this case, reducing tariff discrimination would lead to a decrease in the overall efficiency of the oligopolistic industry through the

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[23]The effect of tariff reforms on tariff revenue depends on the changes in the tariff rate $dt_{i,j}$, given the tariff base $x_{i,j}$, and on the changes in the tariff base $dx_{i,j}$, given the tariff rate $t_{i,j}$. Since we change two tariffs, differences in the tariff bases of the two tariff rates becomes important when calculating the first effect. Changes in the tax bases depend only on the changes in the tax rate (see (8)), but changes in the tax rate affects via the difference between the tax bases which in turn depends on the effective marginal costs (that is, tariffs and marginals costs of production; see (4)). Therefore, the overall effect is that changes in the tariffs is multiplied by a factor of two.

promotion of inefficient firms from country h relative to more efficient firms from country l, suggesting a possible tension between global efficiency and welfare gains in country i.

We now turn to the effect of the unilateral reform in country i on global welfare. If there is an increase in global welfare, we can say that the reform is potentially Pareto improving in the sense that, with appropriate lump-sum transfers, all countries can be made better off. Note that as far as reforms in country i are concerned, the world welfare changes can be derived from the following expression:

$$W_{WR,i}\left(\mathbf{t}\right) = W_i\left(\mathbf{t}\right) + \sum_{j \neq i} n_j \pi_{i,j}\left(\mathbf{t}_i\right), \tag{21}$$

which shows that the world welfare effects of unilateral tariff reform in country i is derived by considering the welfare effects in country i and the effects on profits related to the sales of firms located in other countries selling in this country. Totally differentiating (21) we obtain:

$$dW_{WR,i} = d\mathrm{TR}_i + \sum_{j \neq i} n_j d\pi_{i,j}\left(\mathbf{t}_i\right) = d\mathrm{TR}_i - \sum_{j \neq i} \left(2 f_i' n_j x_{i,j} dx_{i,j} + n_j f_i'' x_{i,j}^2 dx_i\right)$$

$$= d\mathrm{TR}_i - 2\left(x_{i,l} n_l dt_{i,l} + x_{i,h} n_h dt_{i,h}\right) = \left[-\frac{\delta n_l n_h \left(t_{i,h} - t_{i,l}\right)}{f_i'\left(n_l + n_h\right)}\right]\left(c_l - c_h\right), \tag{22}$$

From (22), the following proposition follows.

Proposition 3 *Consider a specific unilateral tariff reform as in (13) in country i, starting from arbitrary initial values. The reform will increase welfare if and only if $c_l > c_h$.*

The above results are explained as follows. From (22), we know that changes in welfare is the sum of changes in tariff revenue (which is the change in welfare for the reforming country) and changes in the profits of firms selling to that country's market. From corollary 2 we know that when $c_h > c_l$ the reform increases tariff revenue. However, when $c_l > c_h$, the reform increases the average efficiency in the industry by increasing the market share and profits of the more efficient firms. In this case, total profits of foreign firms increase with the reform and, consequently, the aggregate welfare of non-reforming countries increases.

16

Therefore, when we put a similar weight on tariff revenue and on profits of foreign firms, a sufficient condition for the reform to be global welfare improving is $c_l > c_h$. These results indicate that there is a tension between the conditions to increase global welfare and to increase the welfare of the reforming country. Moreover, the results also suggest that an efficiency-enhancing reform is potentially Pareto improving.

3.2.2 Reforming more than two tariffs

In our preceding analysis, we have assumed that a government picks two of the many tariffs and reduce (raise) the higher (lower) of the two, keeping the average of the tariffs constant (see (12) in subsection 2.2). In this subsection, we shall generalize that analysis by considering a case when the government changes all the tariffs under its disposal but keeps the average constant. The average that is maintained here is

$$A = \sum_j \lambda_{i,j} t_{i,j}, \quad \text{with} \quad \sum_j \lambda_{i,j} = 1, \tag{23}$$

and the reform formula is

$$dt_{i,j} = \delta(A - t_{i,j}), \quad \text{for all} \ \ i \neq j = 1, \cdots m. \tag{24}$$

We consider the case here with $\lambda_{i,j} = n_j/n$. With this, from (23) and (24), we get

$$\sum_j n_j dt_{i,j} = \delta \sum_j n_j((A - t_{i,j})) = \delta n(A - A) = 0, \tag{25}$$

$$\sum_j n_j t_{i,j} dt_{i,j} = -\delta \left[\sum_j n_j (t_{i,j} - A)^2 \right] < 0, \tag{26}$$

$$\sum_j n_j x_{i,j} dt_{i,j} = \delta \sum_j n_j x_{i,j}(A - t_{i,j}) = \frac{\delta}{n} \left[\sum_k n_k x_{i,k} \sum_j n_j t_{i,j} - \sum_j n_j x_{i,j} t_{i,j} \sum_k n_k \right]$$

$$= \frac{\delta}{n} \left[\sum_j t_{i,j} n_j \sum_k n_k (x_{i,k} - x_{i,j}) \right] = -\frac{\delta}{n f_i'} \sum_j n_j t_{i,j} \sum_k n_k \left[t_{i,j} - t_{i,k} + c_j - c_k \right]$$

$$= -\frac{\delta}{f_i'} \sum_j n_j (t_{i,j} - A)^2 - \frac{\delta}{f_i'} \sum_k n_k c_k (t_{i,k} - A). \tag{27}$$

Since $\sum_j n_j dt_{i,j} = 0$ (see (25)), we have $dp_i = dx_i = dx_{ii} = 0$ and only tariff revenue matters. From (15) we get

$$dW_i = \frac{1}{f_i'} \sum_j n_j t_{i,j} dt_{i,j} + \sum_j n_j x_{i,j} dt_{i,j}, \tag{28}$$

where the first term is positive because of (26) and a sufficient condition for $dW_i > 0$ is that the second term on the right hand side of (27) is positive. Formally,

Proposition 4 *Consider a specific unilateral tariff reform as in (23)-(24) in country i, starting from arbitrary initial values of tariff rates. The reform will increase welfare if*

$$\sum_k n_k c_k \left(t_{i,k} - A \right) > 0$$

Proposition 4 suggests that a sufficient condition for the reforming country to benefit from a tariff harmonizing reform is to find a positive correlation between that country's initial tariffs and the marginal cost of firms that export to that country. This implies that the higher the marginal cost of firms from country j, the higher should be initial tariffs imposed by country i on imports from country j. This is certainly in line with the findings of Proposition 2 that suggests that a sufficient condition for an increase in the welfare of the reforming country is to implement an efficiency reducing tariff reform.

3.2.3 Specific Reform under Reciprocity/Retaliation

In the last subsection, we considered the effects of a specific tariff harmonizing reform where country i changes all tariffs while keeping an average of them constant. For tractability, in this subsection we return to the case where the reforming country increases the tariff applied on country l, and decreases the tariff on country h. In this case, we focus on a situation where a tariff reform in country i may spur reciprocal/retaliatory behavior from other countries. As noted above, many countries have the ability to change tariffs while fulfilling their WTO obligations since its members negotiate tariff bounds rather than applied

tariffs, and preferential agreements are also recognized as legitimate parts of that multilateral agreement. Thus, under many circumstances, countries may have the ability to reciprocate.

In this particular case, we assume that country i implements the same tariff reform described in the previous section and we use the same weight on tariffs applied by this country, $\lambda_i = n_l/(n_l + n_h)$. In this context, reciprocity means that country l increases the tariff on country i, while country h decreases the tariff on country i. We can express the effect of a tariff reform in country i under reciprocity by the following expression:

$$dW_i = dTR_i + n_i \left(d\pi_{l,i} + d\pi_{h,i} \right) \tag{29}$$

A comparison between (20) and (29) indicates that reciprocity only affects country i by changing the profits of firms based in that country for sales in countries l and h, $d\pi_{l,i}$ and $d\pi_{h,i}$. Thus, the conclusions regarding the effects of tariff reform in country i on its tariff revenues are still as described in Proposition 2 and Corollary 2. The effects of tariff reciprocity on the profits of firms in country i, is derived using (10)

$$d\pi_{h,i} = \frac{1}{\Delta_h} \left(2x_{h,i}f_h' + x_{h,i}^2 f_h'' \right) n_i dt_{h,i} - 2x_{h,i}dt_{h,i}$$

$$= -\frac{x_{h,i}dt_{h,i}}{\Delta_h} \left[2(n+1-n_i)f_h' + (2x_h - n_ix_{h,i})f_h'' \right] \geq 0, \tag{30}$$

where we can conclude that since $(2x_h - n_ix_{h,i})/\ 2(n+1-n_i) < 2x_h/\ 2(n+1-n_i) < x_h$, Assumption 1 applies and the term in brackets is negative. Since $dt_{h,i} < 0$ by reciprocity and, also by Assumption 1, we know that $\Delta_h < 0$, then the result applies. Notice also that we used the fact that country h only changes (decreases) the tariff on country i. A similar analysis applies to $d\pi_{l,i}$ but, in this case, the term is negative given that exporters based in country i face an increase in the tariff applied by country l.

Next, we need to investigate the net change in the profits of firms based in country i given that they face an increase in the tariff to sell in country l while face a decrease in the tariff to sell in country h. We consider a specific definition of reciprocity which has an

intuitive appeal. To be more specific, we consider the following formula:

$$n_i x_{h,i} dt_{h,i} = n_h x_{i,h} dt_{i,h}, \qquad n_i x_{l,i} dt_{l,i} = n_l x_{i,l} dt_{i,l}, \tag{31}$$

where $n_h x_{i,h}$ and $n_l x_{i,l}$ represent the (initial) market access (amount exported) enjoyed by countries h and l in country $i's$ market, respectively. The definition of reciprocity described in expressions (31) is in line with the definition used by Limão (2006) and Limão and Kara-caovali (2008) where changes in trade policy ($dt_{i,h}$ and $dt_{i,l}$) are reciprocated based on market access concessions (Bagwell and Staiger (1999)). The application of expressions (31) on the expressions describing the tariff reform (13), yields the following reciprocated tariff changes in countries l and h:

$$dt_{l,i} = \frac{n_l n_h \delta \left(t_{i,h} - t_{i,l}\right) x_{i,l}}{\left(n_l + n_h\right) n_i x_{l,i}}, \quad dt_{h,i} = -\frac{n_l n_h \delta \left(t_{i,h} - t_{i,l}\right) x_{i,h}}{\left(n_l + n_h\right) n_i x_{h,i}}, \tag{32}$$

where it is clear that $dt_{l,i} > 0$ and $dt_{h,i} < 0$ since we assume that $t_{i,h} > t_{i,l}$. We use (32) to investigate how the changes in the profits of firms based in country i (see (30)) affect the welfare of that reforming country. For simplicity, we assume that the demand function in each market is linear ($f'' = 0$) in this exercise. We substitute (32) into (30) to obtain:

$$n_i(d\pi_{h,i} + d\pi_{l,i}) = \frac{2\delta n_l n_h(n + 1 - n_i)(t_{i,h} - t_{i,l})(x_{i,h} - x_{i,l})}{(n + 1)(n_l + n_h)} \tag{33}$$

$$= -\frac{2\delta n_l n_h(n + 1 - n_i)(t_{i,h} - t_{i,l})(t_{i,h} - t_{i,l} + c_h - c_l)}{(n + 1)(n_l + n_h)(-f_i')}$$

where we used (4) to replace $x_{i,h} - x_{i,l}$.

We now directly consider the change in the welfare level in the reforming economy in the presence of reciprocity. We use (19) and (33) in (29) to obtain the following expression for the change in the welfare level for country i:

$$dTR_i + n_i(d\pi_{h,i} + d\pi_{l,i}) = -\frac{\delta n_l n_h(t_{i,h} - t_{i,l})}{(n_l + n_h)f_i'}. \tag{34}$$

$$\left[2(t_{i,h} - t_{i,l}) + (c_h - c_l) - \frac{2(n + 1 - n_i)(t_{i,h} - t_{i,l} + c_h - c_l)}{n + 1}\right]$$

$$= -\frac{\delta n_l n_h(t_{i,h} - t_{i,l})}{(n_l + n_h)f_i'(n + 1)} \left[2n_i(t_{i,h} - t_{i,l}) - (n + 1 - 2n_i)(c_h - c_l)\right].$$

We can use expression (34) to obtain the following proposition.

Proposition 5 *Starting from arbitrary initial values of tariff rates, a specific unilateral tariff reform in the form of (13) in the presence of reciprocity will increase welfare in the reforming country i if and only if*

$$t_{i,h} - t_{i,l} > (n + 1 - 2n_i) (c_h - c_l) / (2n_i). \tag{35}$$

A comparison between conditions (20) and (35) highlight the role played by reciprocity in changing the welfare level of the reforming economy. In particular, condition (35) suggests that tariff reforms that increase the efficiency of the oligopolistic industry may not be a necessary condition to decrease welfare of the reforming economy. This could be the case if the number of domestic firms (n_i) is less than half of the total number of firms (n). In this case, a sufficient condition for welfare improvement is to increase the tariff on the high marginal cost firms $c_l > c_h$, which corresponds to a tariff reform that increases the efficiency of the industry. Thus, a direct implication of condition (35) is that a relatively low number of domestic firms implies that an efficient tariff reform represents a sufficient condition for an increase in the welfare of the reforming country. This is outlined in the following result.

Corollary 3 *Starting from arbitrary initial values of tariff rates, and assuming that domestic firms represent less than half of the firms present in an industry, a sufficient condition for a specific unilateral tariff reform in the form of (13) in the presence of reciprocity to increase welfare in the reforming country is $c_l > c_h$ and a necessary condition to decrease welfare in that economy is $c_h > c_l$.*

Putting these results in perspective, Propositions (3) and (5) highlight that considerations related to reciprocity, as well as related to the welfare effects of tariff reforms in the world economy, seem to make reforms that increase efficiency more viable. This is in line with the idea that fear of retaliation is an important component of international relations.

Blonigen and Bown (2003) provide evidence that fear of retaliation reduces the likelihood of antidumping measures by the United States. Likewise, Bown (2008) shows that fear of retaliation also plays an important role in encouraging defendants to comply with the deliberations made by the WTO's dispute settlement.

4 Unemployment and Revenue Constraints

In this section, we extend our model to consider the effects of tariff harmonizing reforms under the presence of unemployment and under the presence of revenue constraints. Both cases are important considerations in policy circles. We investigate these issues by assuming that tariff reforms are unilateral, initial tariffs are arbitrary, and that tariff reforms are specific in nature. We assume away the effects of reciprocal/retaliatory tariff behavior in order to focus on the insights contributed by unemployment and revenue constraints. Moreover, we consider these two extensions one at a time.

4.1 Unemployment

To consider the case of unemployment, we now model the production of a numeraire good explicitly. In particular, we assume that it uses a constant returns to scale technology, with two factors of production named as labor and land. Land is specific to this sector, but labor is freely mobile between the two sectors. The production function of the numeraire sector in country i is given by $A_i = G_i(L_{ai}, \bar{V}_i) = L_{ai}g_i(v_i)$, where L_{ai} is labor used in this sector, $\bar{V}_i$ is the inelastically supplied amount of land, and $v_i = \bar{V}_i/L_{ai}$.

The price of the numeraire good is unity and wage rate, $\bar{\omega}_i$, is assumed to be rigid and common to both sectors. This rigidity gives rise to unemployment. The first-order profit maximizing condition in this sector is:

$$\bar{\omega}_i = g_i(v) - v_i g_i'(v_i), \quad \sigma_i = g_i'(v_i), \tag{36}$$

where σ_i is the rental rate on land. Expression (36) indicates that since $\bar{\omega}_i$ is assumed to be rigid, and the amount of land ($\bar{V}_i$) is perfectly inelastic, the amount of labor employed into the numeraire sector (L_{ai}) is constant.

The oligopolistic sector uses only labor and we also assume, for simplicity, that one unit of production requires $c_i/\bar{\omega}$ unit of labor. Thus total labor employed in country i is

$$L_i = L_{ai} + (c_i/\bar{\omega}_i)n_i \sum_j x_{j,i}. \tag{37}$$

Because of the presence of unemployment, we have to redefine welfare as

$$W_i(\mathbf{t}) = n_i\pi_i(\mathbf{t}) + \sum_k t_{i,k}n_k x_{i,k}(\mathbf{t}_i) + CS_i(\mathbf{t}_i) + \sigma_i\bar{V}_i + \bar{\omega}_i L_i, \tag{38}$$

where the last two terms are the factor income of land and labor, respectively. Note that expression (36) indicates that tariff reforms will have no effect on σ and L_a, i.e., $dv = d\sigma = dL_a = 0$. This implies that tariff reforms only affect country i if it changes domestic production so that $d(\sigma_i\bar{V}_i + \bar{\omega}_i L_i) = n_i c_i \sum_j dx_{j,i}$ will be different from zero.

We continue to assume that the tariff reform is specific by choosing the same value used in the previous Section for the parameter that describes the weight of the average tariff, $\lambda_i = n_l/(n_l+n_h)$. This implies that expression (18) remains valid, and, therefore, the specific tariff reform does not alter the price level (p_i) in the reforming country i. Consequently, domestic firms and consumers are not affected by the tariff reform since total sales (x_i) do not change. In this case, the conclusions in Proposition 2 about the welfare effect of the tariff reform for the reforming economy remain valid even in the presence of unemployment.

The same does not apply to the world welfare effect of this specific reform as described in Proposition 3. In this case, the tariff on country l's imports increases, while the opposite happens to the tariff on imports from country h. Thus, the reform directly affects the employment level in these trade partners since it affects the incentives of firms based in these countries to export to the reforming country i. In general, the world welfare effect of

23

a tariff reform in country i can be derived from the following expression:

$$W_{WR,i}(\mathbf{t}) = W_i(\mathbf{t}) + \sum_{j \neq i} n_j \pi_{i,j}(\mathbf{t}_i) + \sum_{j \neq i} \sigma_j \bar{V}_j + \bar{\omega}_j L_j, \tag{39}$$

which indicates that the world welfare effect can be derived by considering the welfare effect in country i, and also the effect on profits and on employment income in countries other than i. Totally differentiating expression (39) we obtain:

$$\begin{aligned}
dW_{WR,i} &= d\text{TR}_i + \sum_{j \neq i} n_j d\pi_{i,j}(\mathbf{t}_i) + \sum_{j \neq i} n_j c_j dx_{i,j} \\
&= dTR_i - \sum_{j \neq i} \left(2 f_i' n_j x_{i,j} dx_{i,j} + n_j f_i'' x_{i,j}^2 dx_i \right) + \sum_{j \neq i} n_j c_j dx_{i,j} \\
&= dTR_i - 2 \left(x_{i,l} n_l dt_{i,l} + x_{i,h} n_h dt_{i,h} \right) + \frac{n_h c_h dt_{i,h} + n_l c_l dt_{i,l}}{f_i'} = 0
\end{aligned}$$

where $d\text{TR}_i + \sum_{j \neq i} n_j d\pi_{i,j}(\mathbf{t}_i)$ is given by expression (22), and we used expressions (4) and (13) in deriving $(n_h c_h dt_{i,h} + n_l c_l dt_{i,l})/f_i'$. Formally,

Proposition 6 *Starting from arbitrary initial values of tariff rates and in the presence of unemployment, a specific unilateral tariff reform in the form of (13) in country i will have no effect on global welfare*

Comparing Proposition 3 with Proposition 6, we note that the consideration of unemployment changes the qualitative nature of the results significantly. This happens since considerations of efficiency and job creation have some conflicting elements in it: higher marginal costs reduces efficiency of production, but increases employment for a given level of output. Notice that we assume that one unit of production requires $c_i/\bar{\omega}$ unit of labor. Thus, marginal costs and the amount of labor needed to produce one unit of output are positively related in our analysis. A reform that increases efficiency benefits the more efficient firms, which generates a small increase in employment, at the expense of less efficient firms, which causes a substantial loss in employment. This is the reason why the magnitude of the welfare effect in absolute terms is lower in the presence of unemployment than without it.

4.2 Revenue Constraints

Gawande et al. (2015) provide evidence that tariff revenues are weighted more heavily than consumer and producer surpluses by governments in developing countries with weak tax systems. In this subsection, we consider such a situation with $\rho_i > 1$ attached to tariff revenue.[24] Moreover, we assume that there is also consumption taxation, and such a tax on the oligopolistic good in country i denoted by τ_i. This enables us to model different situations since the degree to which a country relies on tariff revenues in order to provide for public goods varies substantially across nations. We continue to assume that initial tariffs are arbitrary, and that the tariff reform is unilateral and specific, i.e., the reforming country i applies the weight $\lambda_i = n_l/(n_l + n_h)$. This implies that (18) remains valid, i.e., the domestic price and total sales, do not change with the tariff reform.

In this case, the reduced form of social welfare can be written as: $W_i(\mathbf{t}) = n_i \pi_i(\mathbf{t}) + \rho_i G_i + CS_i(\mathbf{t}_i)$, where G_i represents revenue raised by the government from tariffs and consumption tax, $G_i = \sum_k t_{i,k} n_k x_{i,k}(\mathbf{t}_i) + \tau_i x_i$. We consider the welfare effect on country i and in the world of this unilateral tariff reform. Notice that the tariff reform does not affect the consumer and producer surpluses in country i given that the aggregate level of protection does not change in that country as indicated by (18). In this case, the direction of welfare change in country i is still described by Proposition 2, i.e., $dW_i = \rho_i dTR_i$. However, the effect on global welfare is different and is

$$dW_{WR,i} = \rho_i d\mathrm{TR}_i + \sum_{j \neq i} n_j d\pi_{i,j}(\mathbf{t}_i) = \rho_i dTR_i - \sum_{j \neq i}\left(2f_i' n_j x_{i,j} dx_{i,j} + n_j f_i'' x_{i,j}^2 dx_i\right)$$

$$= -\frac{\delta n_l n_h (t_{i,h} - t_{i,l})}{f_i'(n_l + n_h)}\left[2(\rho_i - 1)(t_{i,h} - t_{i,l}) + (\rho_i - 2)(c_h - c_l)\right] \tag{40}$$

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[24] An usual interpretation offered by the literature on public economics is that the parameter ρ_i represents the marginal willingness to pay for the public good (MWP) in country i. If we were to assume that government raises revenue in order to finance a public good, it is well-known that an optimizing government will equate the MWP to the marginal cost of public funds (MCPF), defined as the welfare lost by raising an additional dollar of revenue. When only lump sum taxes are available freely, MCPF is unity, but, this is not the case in our model as taxation is distortionary. Thus, if ρ were not greater than unity in the presence of a public good, it would be preferable to eliminate any public good provision in favor of a lump sum rebate to the consumer. This would be the case since consumer choices would not be restricted and households could consume private goods that they value more than the public good. (see, for example, Neary, 1994; Keen and Lahiri, 1993; and Maggi and Rodriguez-Clare, 2000)

From (40), the following proposition and the corollary follow

Proposition 7 *Consider a specific unilateral tariff reform in the form of (13) in country i, starting from arbitrary initial values of tariff rates. We have*

1. *When $\rho_i = 1$, the reform will increase global welfare if and only if $c_l > c_h$.*

2. *When $\rho_i > 1$, the reform will increase world welfare if and only if $t_{i,h} - t_{i,l} > (\rho_i - 2)(c_l - c_h)/(2(\rho_i - 1))$,*

Corollary 4 *Consider a specific unilateral tariff reform in the form of (13) in country i, starting from arbitrary initial values of tariff rates. We have:*

1. *When $1 < \rho_i < 2$, a sufficient condition for the reform to increase global welfare is $c_l > c_h$, and a necessary condition for the reform to reduce global welfare is $c_h > c_l$.*

2. *When $\rho_i > 2$, a sufficient condition for the reform to increase global welfare is $c_h > c_l$, and a necessary condition for the reform to reduce global welfare is $c_l > c_h$.*

Intuitively, from (40), we know that changes in welfare is a linear combination of changes in tariff revenue (which is the change in welfare for the country reforming its tariffs) and changes in the profits of firms selling to the reforming-country market. In this case, changes in tariff revenue has a larger weight than the latter two terms since $\rho_i > 1$. From corollary 2 we know that when $c_h > c_l$ the reform increases tariff revenue. However, when $c_l > c_h$, the reform increases the average efficiency in the industry by increasing the market share and profits of the more efficient firms. In this case, total profits of foreign firms increase with the reform. Therefore, when we put a very high weight on tariff revenue ($\rho_i > 2$), a sufficient condition for the reform to be global welfare improving is $c_h > c_l$, and when it is not very high ($1 < \rho_i < 2$), the profits of foreign firms become relatively more important than tariff

revenue and $c_l > c_h$ is a sufficient condition for the reform to be global welfare improving. The latter situation is also in line with results described in Proposition 3.[25]

5   Optimal Tariffs

In this section, we consider the welfare effect of specific tariff reforms when the initial tariffs are at non-cooperative optimal levels. First, we shall consider the case of unilateral tariff reforms. Then shall we turn to the investigation of the welfare effect of multilateral tariff reforms. For brevity, we disregard considerations related to unemployment and revenue constraint discussed in the previous Section.

5.1   Unilateral Tariff Reforms

Here we consider the case in which the initial tariffs are at the non-cooperative optimal levels and investigate the welfare effect of unilateral tariff reforms. Notice that both (19) and (22) remain valid for describing the welfare effects of tariff reform. Similarly, (13) still describes the tariff reform. We shall now characterize the optimal tariffs and check whether or not those tariffs satisfy the conditions of welfare improvements in Propositions 2 and 3.

Optimal tariffs in country i are chosen by setting $\partial h_i / \partial t_{i,j} = 0$, giving rise to[26]

$$\frac{(2n_i x_{i,i} - x_i)f_i' + n_i(x_{i,i})^2 f_i''}{\Delta_i} - \frac{1}{f_i'\Delta_i} \cdot \left[\sum_k n_k t_{i,k}(f_i' + x_{i,k}f_i'') \right] + \frac{(t_{i,j} + f_i' x_{i,j})}{f_i'} = 0. \quad (41)$$

Notice that expressions (19) and (22) depend on the difference between the tariffs involved in the tariff reform, $t_{i,h} - t_{i,l}$. We can subtract the first order conditions related to the choice

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[25]It is worth noting that the level of consumption taxation does not affect the results described in Proposition 7. This happens for two main reasons. First, we assume that the reform includes only tariff changes, while the tax on consumption remains constant. Second, we assume a specific tariff reform where expression (18) indicates that the level of protection, and, consequently, the total sales, are constant. The combination of these two reasons implies that the revenue raised with the consumption tax remains constant.

[26]This expression can be obtained directly from expression (15). Note that the number of firms in country n_j affects all the terms proportionally and hence cancel out.

of these two tariffs, and simplify it by using equation (4), to obtain:

$$t_{i,h} - t_{i,l} = (c_l - c_h)/2, \tag{42}$$

which implies that a higher tariff is imposed on firms with lower marginal cost (see, Saggi (2004)). By putting more restrictions on imports from more efficient firms, the country can better protect its social welfare interests (profits and tariff revenue). Notice that the differences in optimal initial tariffs do not depend on the choice of parameter λ, a fact that is used in the appendix to explore the robustness of our results.[27]

Since the initial tariffs are at the optimal levels, from the envelope property it follows that the reform will have no effect on the welfare level of country i, i.e., $dW_i = 0$. As for global welfare, it is easy to verify that optimal tariffs satisfying (42) also satisfy the condition of welfare improvement in Proposition 3. In fact, from equation (22) we find

$$dW_{WR,i} = -\delta n_l n_h \left(c_l - c_h\right)^2 / (2f_i' \left(n_l + n_h\right)) > 0. \tag{43}$$

Formally,

Proposition 8 *Starting from non-cooperative optimal initial values of tariffs, a specific unilateral tariff reform in the form of (13) in country i unambiguously increases global welfare.*

From (42) we know that the country with more efficient firms faces a higher tariff from country i. This is due to the non-cooperative nature of optimal tariffs. For global efficiency, more efficient firms should have a bigger market share than those at the Nash optimal levels. Since our reform reduces tariffs imposed on the more efficient country and increases that of the more inefficient one, it improves global efficiency and hence increases global welfare. In the analysis above we have taken the weight λ to be equal to $n_l/(n_l + n_h)$. In the appendix, we have carried out the same analysis as in this sub-section when the weight is the ratio

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[27]In the appendix, this fact is used to explore the robustness of our results to import-weighted tariff reforms. It is also worthy noting that including the issues related to unemployment, revenue constraint, as well as the level of the consumption tax, make no difference to the result described by expression (42). This is because the employment effect and the effect on total sales of the two tariffs are the same in magnitude.

of imports from country l to total imports from countries l and h. It is shown there that Proposition 8 continues to hold under this new value of λ.

5.2 Multilateral Tariff Reforms

We shall now consider simultaneous reforms in all the countries. In other words, we consider multilateral reforms where all the countries reform their tariffs according to the rule given in equations (11)-(13). For expositional clarity and simplicity, we shall assume that each country reduces its maximum tariff and increases the minimum. We continue to assume that the initial levels of the tariffs are at their non-cooperative optimal levels.

Since the highest and lowest tariffs in various countries can correspond to imports from different countries, we need to introduce new notations for subscripts. The highest and the lowest tariffs imposed by country i are denoted by $t_{i,h(i)}$ and $t_{i,l(i)}$ respectively. Similarly, the notations $x_{i,h(i)}$, $x_{i,l(i)}$, $c_{h(i)}$, $c_{l(i)}$, $n_{h(i)}$ and $n_{l(i)}$ are defined. Using these notations, we can appropriately re-write equations (4) and (13) recognizing that since the rank order of tariffs can be different across countries, the weight λ can also vary from country to country.

Turning to world welfare and denoting it by dW_{WR}, and considering the same specific tariff reform as in (13) with λ equal to $n_{l(i)}/(n_{l(i)}+n_{h(i)})$, we can conclude that the change in global welfare is computed as the sum of each country's contribution to the change in world welfare as given by equation (43), i.e.,[28]

$$dW_{WR} = \sum_i dW_{WR,i} = -\sum_i \frac{\delta n_{l(i)} n_{h(i)} \left(c_{l(i)} - c_{h(i)}\right)^2}{2 f_i' \left(n_{l(i)} + n_{h(i)}\right)} > 0. \tag{44}$$

The reason for this global welfare improvement is the same as discussed after Proposition 8. In this case however, not all countries will gain, as we shall show now.

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[28]The expression below is derived when $\lambda_i = n_{l(i)}/(n_{l(i)}+n_{h(i)})$. The same global welfare-improving result can be obtained when the weight is the ratio of imports from country l to total imports from country l and h, as we do in the appendix.

Equation (15) describes the welfare effects of tariff reform for country i. Since the initial tariffs are at non-cooperative optimal levels, the terms that appear in the first and in the second lines of that equation disappear due to the envelope property. So, in a multilateral tariff reform, a country is affected only by changes in the tariffs imposed by other countries, as captured by the terms in the third line of Equation (15). This says that we can have three situations that a country may face and we shall now describe them one by one.

First, the firms in country i may have the highest marginal costs among firms from all countries. This implies that under the tariff reform, these firms would face tariff increases in selling to other countries, and this will reduce the profits of these firms. Thus, welfare in country i necessarily decreases according to (15). Second, firms located in country i may be the most efficient firms (lowest marginal costs) in the world. This implies that these firms will face lower tariffs selling in other countries' markets raising welfare in country i.

The last case corresponds to the situation where firms from a particular country i are neither the most nor the least efficient in the world. In this case, with tariff reform, tariffs employed on imports from country i do not change, $dt_{j,i} = 0$ for any country j. The welfare effect on country i is derived by substituting the reform rule (13) in equation (15) to obtain:

$$dW_i = \sum_{j \neq i} \left[\frac{n_i}{\Delta_j} \left(2x_{j,i} f_j' + x_{j,i}^2 f_j'' \right) \left(t_{j,h(j)} - t_{j,l(j)} \right) \left(n_{l(j)} \left(1 - \lambda_j \right) - n_{h(j)} \lambda_j \right) \right] \quad (45)$$

Notice that, according to (45), country i benefits from an increase in $t_{j,l(j)}$ but loses from a decrease in $t_{j,h(j)}$. From (45) we can derive two results. First, when the weights are given by $\lambda_j = n_{l(j)}/(n_{l(j)} + n_{h(j)})$, there will be no change in welfare for country i in this case, i.e., $dW_i = 0$. This is so since the tariff reform based on the relative number of firms keeps the aggregate level of protection constant, which implies that equilibrium price and total sales in country j remain constant. Consequently, sales by countries not directly affected by changes in tariffs are left untouched, a fact also suggested by (7) and (8). Second, if the weights are

as in the appendix, i.e., $\lambda_j = n_{l(j)}x_{i,l(j)}/(n_{l(j)}x_{j,l(j)} + n_{h(j)}x_{j,h(j)})$ then (45) becomes

$$dW_i = \sum_{j \neq i} \left(-\frac{\delta n_{l(j)}n_{h(j)}n_i \left(c_{l(j)} - c_h \right)^2 \left(2x_{j,i}f'_j + x^2_{j,i}f''_j \right)}{4\Delta_j f'_j \left(n_{l(j)}x_{j,l(j)} + n_{h(j)}x_{j,h(j)} \right)} \right) > 0. \tag{46}$$

In this case, $dW_i > 0$ since $\Delta_j < 0$, $f'_j < 0$ and $f'_j(x_j) + f''_j(x_j)\left(x^2_{j,i}/2x_{j,i}\right) < 0$ according to assumption 1 since $x_j = \sum_k x_{j,k} > \left(x^2_{j,i}/2x_{j,i}\right)$. Formally,

Proposition 9 *Starting from non-cooperative optimal initial values of tariffs, a multilateral reform of tariffs as given by the rule (13) gives rise to the following:*

1. *The country with the most efficient firms gain,*

2. *The country with the least efficient firms lose,*

3. *If $\lambda_j = n_{l(j)}/(n_{l(j)} + n_{h(j)})$, there is no change in welfare in all other countries,*

4. *If $\lambda_j = n_{l(j)}x_{i,l(j)}/(n_{l(j)}x_{i,l(j)} + n_{h(j)}x_{i,h(j)})$, all other countries gain, and*

5. *If either $\lambda_j = n_{l(j)}/(n_{l(j)} + n_{h(j)})$ or $\lambda_j = n_{l(j)}x_{i,l(j)}/(n_{l(j)}x_{i,l(j)} + n_{h(j)}x_{i,h(j)})$, global welfare increases.*

Countries other that h and l benefit (lose) because of a higher (lower) tariff on least (most) efficient country. When $\lambda_j = n_{l(j)}/(n_{l(j)} + n_{h(j)})$ the two effects cancel each other out since the average level of protection, and, consequently, the equilibrium price remains the same. However, when $\lambda_j = n_{l(j)}x_{i,l(j)}/(n_{l(j)}x_{i,l(j)} + n_{h(j)}x_{i,h(j)})$, the beneficial effect dominate since the average level of protection, as well as the average tariff faced by competitors, rise while the tariff imposed on these countries do not change.[29]

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[29]See expression (8) for details. Notice also that the presence of a revenue constraint, or even the presence of consumption taxes, does not alter the results described in Proposition 9.

6 Conclusion

In practice there exists quite a bit of discrimination in tariff policies: countries apply different tariff rates on imports of the same good from different countries. This happens in spite of the agreed principle of Most Favored Nation (MFN) in international economic transactions and the MFN clause of the World Trade Organization (WTO). This is so since there are various exceptions included in the WTO charter, the non-inclusion of some countries, and the non-binding nature of bound tariff commitments within WTO agreements.

Given the existence of such discrimination, in this paper we examine piecemeal tariff reforms that harmonize any pair of tariffs employed by a reforming country. Tariff reforms may be represented by moving two of the tariffs towards an weighted average of the two, or may involve either a marginal decrease or a marginal increase of a particular tariff. We do so under an asymmetric oligopolistic framework in segmented markets for an arbitrary number of countries with different market structures (number of firms and marginal costs). We consider a general demand structure and investigate extensions of our basic framework to allow for the presence of revenue constraints and of unemployment.

First of all we consider general and specific unilateral reform of tariffs in a country when the initial tariff rates are arbitrary and not necessarily optimal. We derive necessary and sufficient conditions for the reform to increase the welfare of the reforming country and also a necessary and sufficient condition for the global welfare to increase. This analysis enables us to consider the welfare effects of efficiency-enhancing tariff reforms. In the case of arbitrary initial tariffs, the results suggest that efficiency-enhancing specific tariff reforms may be opposed by welfare-minded tariff-reforming governments. Moreover, the results suggest that the presence of reciprocal behavior, as well as considerations related to the global welfare effect of a tariff reform, may increase the viability of efficiency-enhancing tariff reforms.

The extensions of our framework to include the presence of revenue constraints and of unemployment generate interesting insights about the welfare effects of unilateral tariff

reforms. We find that the more important the revenue constraints the less likely an efficiency-enhancing tariff reform is sufficient to guarantee an increase in global welfare. The presence of unemployment tends to reduce the global welfare benefits provided by the implementation of an efficiency-enhancing unilateral reform. In this case, efficiency-enhancing tariff reforms increase the aggregate profits of foreign firms by decreasing tariffs on more efficient firms while increasing tariffs on less efficient firms. However, with unemployment, this gain in efficiency is countered by a deterioration in the unemployment level in other countries: tariff reform mitigates one distortion (tariff discrimination) but exacerbates another (unemployment). This seems to resonate well with the reality in many developing countries.

We then characterize optimal non-cooperative tariffs and show that global welfare unambiguously increases because of the specific tariff reform. This result seems robust to alternative ways in which tariff reform is implemented. We also consider multilateral reform of tariffs when the initial tariffs are optimal. In this case, we find that not all countries will gain from such reforms; there will be some losers. In particular, while the country with most efficient firms will gain, the country with the most inefficient firms will lose. The other countries will either be unaffected or gain depending on the weights chosen to calculate the average target tariff. Global welfare will increase unambiguously.

Thus, we describe several circumstances under which a reduction of discrimination is very likely to be potentially Pareto improving. We conclude that efficiency-enhancing reforms may be viable on welfare grounds as long as unemployment is not important to reforming-countries, and appropriate lump-sum transfers between countries are available. In this case the direction of transfers ought to be from more advanced nations (the ones with efficient firms) to less advanced or emerging nations (the ones with less efficient firms). Moreover, the presence of reciprocal/retaliatory behavior may also play an important role in promoting the implementation of efficiency-enhancing tariff reforms.

Appendix

In section 5, we have shown that, starting with non-cooperative optimal tariffs, a unilateral tariff reform in country i increases global welfare under full employment when the weight λ in the reform rule (11)-(13) is given by $\lambda = n_l/(n_l + n_h)$. In this appendix we show that this result also goes through when $\lambda = n_l x_{i,l}/(n_l x_{i,l} + n_h x_{i,h})$.

Equation (13) can be expressed in the following way by replacing $dx_{i,j}$ and dx_i with assistance of expressions (8) and (7):

$$dW_{WR,i} = -\sum_{j \neq i} \left[2n_j x_{i,j} \left\{ dt_{i,j} - \frac{\left(f_i'' x_{i,j} + f_i'\right) \sum_k n_k dt_{i,k}}{\Delta_i} \right\} + \frac{n_j f_i'' x_{i,j}^2 \sum_k n_k dt_{i,k}}{\Delta_i} \right], \quad (A.1)$$

where we used the fact that the welfare level in country i is not affected due to the envelope property. Expression (A.1) can be simplified as

$$dW_{WR,i} = \sum_{j \neq i} \left[\frac{n_j x_{i,j} \left(f_i'' x_{i,j} + 2f_i'\right) \sum_k n_k dt_{i,k}}{\Delta_i} \right]$$

$$= \frac{1}{\Delta_i} \left[2f_i' \sum_{j \neq i} n_j x_{i,j} + f_i'' \sum_{j \neq i} n_j x_{i,j}^2 \right] \left(n_l dt_{i,l} + n_h dt_{i,h}\right),$$

where we used that $\sum_{j \neq i} n_j x_{i,j} dt_{i,j} = 0$ given that we assume an import-weighted average, $n_l x_{i,l}/(n_l x_{i,l} + n_h x_{i,h})$, as λ.

Replacing $dt_{i,l}$ and $dt_{i,h}$ using (13), applying the weight $\lambda = n_l x_{i,l}/(n_l x_{i,l} + n_h x_{i,h})$, and using (42) to replace the difference between optimal tariffs $t_{i,l}$ and $t_{i,h}$, allows us to conclude after manipulations that:

$$dW_{WR,i} = -\frac{n_l n_h \delta \left(c_l - c_h\right)^2}{4f_i' \Delta_i \left(n_l x_{i,l} + n_h x_{i,h}\right)} \left[2f_i' \sum_{j \neq i} n_j x_{i,j} + f_i'' \sum_{j \neq i} n_j x_{i,j}^2 \right], \quad (A.2)$$

Note that $x_i = \sum_j n_j x_{i,j} > \left(\sum_{j \neq i} n_j x_{i,j}^2 / (2 \sum_{j \neq i} n_j x_{i,j}) \right)$. Thus, using assumption 1, we can say that the term inside the square bracket in (A.2) is negative. Also since $f_i' < 0$ and $\Delta_i < 0$, from (A.2) we can conclude that $dW_{WR,i} > 0$.

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