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Abstract

In a three country model with endogenous tariffs, this paper evaluates and contrasts the welfare effects of free trade agreements (FTAs) and customs unions (CUs) – the two most commonly occurring preferential trade agreements (PTAs). We show that if the external tariff of a PTA is not too high, it benefits both members and non-members. We also highlight the implications of a key (but commonly ignored) distinction between the two types of PTAs: while an FTA member can form an another (independent) FTA with an existing non-member, a CU member cannot. Under a pair of independent bilateral FTAs, the common member's welfare is higher than that under free trade. Furthermore, if the common member is relatively efficient compared to the other two countries, such a 'hub and spoke' pattern of FTAs can yield higher global welfare than free trade. By contrast, such an outcome is never possible under a CU.

Keywords: Free Trade Agreements, Customs Unions, External Tariffs, Welfare, Intraindustry Trade, Oligopoly.

JEL Classifications: F13, F12.

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1 Introduction

As per the World Trade Organization (WTO), over 176 preferential trade agreements (PTAs) are in force today and most countries participate in multiple PTAs. In fact, only twelve countries in the world (six of which are WTO members) do not belong to a PTA and, on average, each country belongs to six PTAs (World Bank, 2005). About 40% of world trade occurs on a preferential basis and so pervasive are PTAs today that most favored nation (MFN) treatment has begun to appear more of an exception rather than a core rule of the WTO.[1]

The spread of PTAs has always been viewed as a mixed blessing by economists and policy-makers. More than five decades ago, in a seminal paper Jacob Viner (1950) argued that the distortions created by PTAs can have adverse welfare consequences for both member and non-member countries. Since then, a large literature has emerged to shed light on various aspects of PTAs.[2] The goal of this paper is to contribute to this literature by deriving the welfare effects of PTAs when tariffs of both members and non-members are endogenously determined.[3] Abstracting from the process by which PTAs are formed, the paper focuses on the two most commonly occurring PTAs: free trade agreement (FTAs) and customs unions (CUs).[4] An important conceptual contribution of the paper is that it derives the welfare implications of a key difference between FTAs and CUs: whereas a member country of a bilateral FTA is free to form another (independent) bilateral FTA with

[1] This number is lower (around 20%) if one allows for the fact that MFN tariffs are zero (or near zero) for many products (World Bank, 2005).

[2] See Bhagwati et. al. (1999) for a collection of many of the important articles in the area.

[3] In a companion paper (Saggi and Yildiz, 2006), we endogenize the formation of FTAs but take tariffs as given.

[4] An overwhelming majority (i.e. close to 85%) of existing PTAs are free trade agreements (WTO, 2003). Only a handful of existing CUs involve major world markets – the prime examples being MERCOSUR (the Latin American CU) and several agreements of the European Community (EC) with Turkey and several Eastern European countries. Despite the widespread prevalence of FTAs, the analytical literature on PTAs has tended to focus more on CUs.

an existing non-member, a CU member *cannot* do so because CU members must impose a common external tariff on non-members. To the best of our knowledge, ours is the first paper to draw out the welfare implications of this important distinction between the two types of PTAs.

In order to tie our results with closely related existing literature (in particular Krishna, 1998, Ornelas, 2005, and Saggi, 2006), we analyze the effects of PTAs in a three country oligopoly model of trade policy.[5] In this model, when production costs of the oligopolistic good are equal across countries, PTAs of all types increase aggregate world welfare – i.e. when countries are symmetric, trade liberalization of any kind is beneficial (Proposition 1). The intuition behind this result is that, under cost symmetry, preferential trade liberalization increases the volume of global trade without causing any socially harmful trade diversion.[6] We also show that if PTA members do *not* raise their tariffs upon the formation of a PTA, a bilateral PTA necessarily benefits member countries (Proposition 2). Furthermore, even the non-member country gains from the formation of a PTA so long as the PTA's external tariff falls below a certain threshold (Proposition 3).[7]

An interesting result of the paper is that if there exist a pair of independent bilateral FTAs – i.e. if one country (say i) has an FTA with the other two (i.e. j and k) who do not have an FTA with each other – the common FTA member (i.e. country i) benefits so much from such preferential liberalization that it is better off relative to global free trade (Proposition 4). The

[5]The underlying trade model is a generalization of the reciprocal dumping framework of Brander and Krugman (1983).

[6]Incidentally, even if market structure were perfectly competitive, so long as marginal costs are constant and equal across countries, preferential trade liberalization would lead to trade creation without causing any trade diversion. However, starting at free trade, the imposition of a tariff by a country (say i) on only one of its trading partners (say j) reduces the volume of trade under oligopoly whereas it has no such consequences under perfect competition because the competitive supply from the favored country (say k) ensures that equilibrium price in country i's market still equals marginal cost. By contrast, under oligopoly, the reduction in country j's exports is typically not fully offset by an in increase country k's exports.

[7]It is worth noting that whether PTAs benefit member countries is a much debated question in the literature and in many existing models PTAs can actually harm member countries.

flip side of this result is that the other two countries (i.e. countries j and k) are necessarily worse off relative to global free trade. This result formally validates the intuition that when trade agreements create a hub and spoke type trading regime, the hub can benefit at the expense of the spokes.[8] These welfare results are important not only because of their theoretical novelty, but also because, as noted earlier, most countries belong to multiple FTAs and focusing only on bilateral FTAs is unlikely to yield a complete picture regarding their welfare effects.

Further analysis of a pair of independent bilateral FTAs under cost asymmetry yields another remarkable result: *such a regime can yield higher global welfare than free trade* (Proposition 5). Intuitively, this result obtains when the common member's cost of production is much lower than that of the other two members. Under such a scenario, preferential treatment of the common member country in its export markets improves world welfare because such treatment helps allocate a larger share of the world's output to a low cost location. Such a global reallocation of output is not possible if the low cost country belongs to a CU since as a CU member it cannot form an independent CU with the third country. Thus, even under cost asymmetry, no pattern of CUs can dominate global free trade from a welfare perspective (Proposition 6).

In a model closely related to ours, Krishna (1998) has shown that an FTA between two countries reduces their incentives to liberalize trade with respect to the third country. However, Ornelas (2005) and Saggi (2006) have argued that the exogenity of tariffs is a crucial assumption behind this result since endogenously determined FTA tariffs can be actually lower than MFN tariffs. Bagwell and Staiger (1997a and 1997b) have called this result the tariff complementarity effect of PTAs. It is of some interest to note that tariff complementarity has emerged in several different models of international

[8] In Puga and Venables (1997), the formation of a hub and spoke arrangement benefits the hub whereas it can hurt the spoke nations by making location in the hub more attractive to firms. It is noteworthy that we obtain a similar welfare result even though no agglomeration effects exist in our model. For further discussion of hub and spoke trading arrangements see Wonnacott (1996).

trade: Ornelas (2005) and Saggi (2006) utilize the oligopoly model of intra-industry trade; Kennan and Riezman (1990) and Bond et. al. (2004) consider general equilibrium Ricardian models; and Bagwell and Staiger (1997a and 1997b) and Ornelas (2006) use competitive partial equilibrium models with integrated markets. However, all of these models rely on specific assumptions regarding preferences to obtain tariff complementarity. For example, Bagwell and Staiger (1997a and 1997b), Ornelas (2005 and 2006), and Saggi (2006) assume linear demand whereas Kennan and Riezman (1990) and Bond et. al. (2004) consider Cobb-Douglas preferences. Given that the welfare effects of PTAs on non-members hinge critically on tariff complementarity, it is important to know whether this result holds under more general conditions. However, as Bond et. al. (2004) note, a comparison of equilibrium tariffs under MFN and PTAs is hindered by the fact that PTAs result in discrete tariff changes relative to MFN. It turns out that the underlying structure of our model allows us to isolate sufficiency conditions that shed light on a comparison of equilibrium tariffs under various trade policy regimes. More specifically, we argue that the sufficient condition required for a PTA's external tariff to be positive is *less likely* to be satisfied relative to the analogous sufficient condition under MFN. This result can be viewed as a weak type of tariff complementarity.

2 Model

In this section, we present an oligopoly model of international trade in which each country has a unilateral incentive to impose rent extracting tariffs on its trading partners (unless it commits not to do so via a PTA). There are three countries (denoted by i, j, k) and two goods: x and y. Preferences over the two goods are quasilinear: $U(x, y) = u(x) + y$. Good x is produced by a single firm in each country at a constant marginal cost c (in terms of the numeraire good y).

We consider a two stage game of trade policy between three countries. The problem confronting each country at the first stage of the game depends

upon the underlying world trade policy regime in place. Under the most favored nation (MFN) regime, each country imposes a non-discriminatory tariff on its trade partners to maximize its own welfare. In addition, we consider two types of PTAs: an FTA and a CU. By their very nature, both types of PTAs violate MFN since PTA members eliminate tariffs only on each other. However, while FTA members impose independently chosen tariffs on the non-member, CU members coordinate their tariff decisions and implement a common external tariff. Taking the global trade policy regime and the associated tariffs as given, firms compete in quantities (Cournot competition) and make independent decisions regarding how much to sell in each market (i.e. markets are segmented as in Brander and Krugman (1983) and Brander and Spencer (1984)).[9]

2.1 Production and trade

Due to market segmentation, it is sufficient to focus on only one country's market (say that of country i). Let x_{zi} denote country z's exports to country i where $z \neq i$; x_{ii} the sales of firm i in country i; and $x_i = x_{ii} + \sum_{z \neq i} x_{zi}$ denote total sales of good x in country i. Let c denote the marginal cost of production for good x (i.e. it is equal across countries).

If countries i and z does not belong to a PTA, country z's exports of good x to country i are subject to a specific tariff t_{zi} per unit. Let country i's tariff vector be denoted by $\mathbf{t}_i = (t_{ji},\, t_{ki})$. Using similar notation for the other two countries, the global tariff vector is denoted by $\mathbf{t} = (\mathbf{t}_i, \mathbf{t}_j, \mathbf{t}_k)$. By assumption, countries impose no taxes on local firms and the numeraire good (that may be traded internationally in order to balance trade).

Country z's effective marginal cost of exporting to country i equals $c + t_{zi}$. Without loss of generality, set $c = 0$. Country z's profit function π_{zi} for

[9] There is substantial empirical support for the assumption of market segmentation in the literature on pricing to market behavior – see Knetter (1989 and 1993) and Marston (1990).

exports to country i can be written as:

$$\pi_{zi} = [p_i(x_i) - t_{zi}]x_{zi} \tag{1}$$

First order conditions (FOCs) for profit maximization for exporters are

$$p_i + p_i' x_{zi} = t_{zi} \tag{2}$$

The above FOCs together with an analogous condition for the local firm (i.e. $p_i + p_i' x_{ii} = 0$) determine the equilibrium output levels of all firms. Summing the first order conditions for all firms in country i gives

$$3p_i + p_i' x_i = \sum_{z \neq i} t_{zi} \tag{3}$$

Following Bergstrom and Varian (1985), if the left hand side is downward sloping (i.e. $4p_i' + p_i'' x_i < 0$) then total industry output sold in country i depends only on the sum of the (tariff included) marginal costs of production of all firms. We assume that this property holds so that total sales in country i decline with either of its tariffs:

$$\frac{dx_i}{dt_{zi}} < 0 \tag{4}$$

In addition, the following comparative statics are also assumed to hold:[10]

$$\frac{dx_{zi}}{dt_{zi}} < 0 < \frac{dx_{ii}}{dt_{zi}} = \frac{dx_{\tilde{}zi}}{dt_{zi}} \tag{5}$$

In other words, an increase in t_{zi} lowers country z's exports to county i (x_{zi}) while it increases the sales of its local firm (x_{ii}) (as well as that of the rival exporter denoted by $\tilde{}z$).

As is well known, if markets are segmented and marginal costs are constant, strategic independence of trade policies obtains and own tariffs do not

[10] As is well known, assuming second order conditions for profit maximization hold, these comparative statics obtain when the Cournot Nash equilibrium is stable and output levels of firms are strategic substitutes. Since these results are well known, it is convenient to directly assume that the comparative statics in (5) hold.

affect export profits.[11] Let country i's domestic surplus $s_i(\mathbf{t}_i)$ be defined as the sum of consumer surplus, tariff revenue, and the domestic firm's local profits:

$$s_i(\mathbf{t}_i) \equiv u(x_i) - p_i x_i + \sum_{z \neq i} t_{zi} x_{zi} + \pi_{ii} \tag{6}$$

Welfare of country i can be written as the sum of its domestic surplus and total export profits:

$$w_i(\mathbf{t}) \equiv s_i(\mathbf{t}_i) + \sum_{z \neq i} \pi_{iz}(\mathbf{t}_z) \text{ where } \pi_{iz} = (p_i - t_{iz}) x_{iz} \tag{7}$$

Finally, world welfare is defined as:

$$ww(\mathbf{t}) = w_i(\mathbf{t}) + w_j(\mathbf{t}) + w_k(\mathbf{t}) \tag{8}$$

3 Optimal tariffs under different regimes

As noted earlier, an important difference between an FTA and a CU is that members of an FTA choose their external tariffs independently whereas CU members choose a common external tariff. Thus, a country can sign *independent FTAs with both its trading partners who in turn do not have a trade agreement with each other whereas such a possibility cannot arise under a CU*. We denote a bilateral FTA between countries i and j by $\langle\{ij\}\rangle$ and a pair of bilateral FTAs with i as the common member by $\langle\{ij, ik\}\rangle$. To economize notation, a CU between countries i and j is also denoted by $\langle\{ij\}\rangle$ where it is clear from the context whether we are discussing an FTA or a CU. Finally, a regime where all countries adopt their MFN tariffs is denoted by $\langle\{M\}\rangle$ whereas global free trade is denoted by $\langle\{F\}\rangle$.

Since a country imposes no taxes on its own firm, we only need to keep track of import tariffs. Before proceeding further, it is useful to clarify our notation with an example: in the export profit function $\pi_{ki}(t_{ki}, t_{ji})$, the first argument is the tariff faced by country k in country i's market while the

[11] Strategic independence arises in many related models: see Ornelas (2005 and 2006), Bagwell and Staiger (1997a and 1997b), and Kennan and Riezman (1988).

second argument is the tariff faced by its rival exporter (i.e. the tariff faced by one's rival is always listed second).

Finally, at the risk of slight abuse of notation, we will sometimes write profit, domestic surplus, and total welfare as a function of the policy regime itself. For example, $s_i(M)$ denotes country i's welfare under MFN where it is understood that everyone uses their optimal MFN tariffs (to which we turn next).

3.1 MFN tariffs

Under MFN, each country chooses its non-discriminatory tariff to maximize its own welfare. Strategic independence implies that country i's tariff choice problem under MFN basically entails the maximization of its domestic surplus $s_i(t_i)$ with respect to t_i:

$$\max_{t_i} s_i(t_i) \equiv u(x_i) - p_i x_i + t_i \sum_{z \neq i} x_{zi} + p_i x_{ii} \tag{9}$$

Using $u' = p_i$, the first order condition for the above problem is given by

$$\frac{ds_i(t_i)}{dt_i} = -\frac{dp_i}{dt_i} x_i + \sum_{z \neq i} x_{zi} + t_i \sum_{z \neq i} \frac{dx_{zi}}{dt_i} + \frac{dp_i}{dt_i} x_{ii} + p_i \frac{dx_{ii}}{dt_i} = 0 \tag{10}$$

where

$$\frac{dp_i}{dt_i} = p_i' \frac{dx_i}{dt_i} \tag{11}$$

and p_i' denotes the slope of the inverse demand function $p_i(x_i)$. Equation (10) can be rewritten as

$$\frac{ds_i(t_i)}{dt_i} = \left(1 - \frac{dp_i}{dt_i}\right) \sum_{z \neq i} x_{zi} + t_i \sum_{z \neq i} \frac{dx_{zi}}{dt_i} + p_i \frac{dx_{ii}}{dt_i} = 0 \tag{12}$$

Following Brander and Spencer (1984), the above equation implicitly defines country i's optimal MFN tariff t^m (due to symmetry, there is no subscript on t^m):

$$t^m = -\left[\frac{\left(1 - \frac{dp_i}{dt_i}\right) \sum_{z \neq i} x_{zi} + p_i \frac{dx_{ii}}{dt_i}}{\sum_{z \neq i} \frac{dx_{zi}}{dt_i}} \right] \tag{13}$$

Since $\frac{dx_{zi}}{dt_i} < 0$ and $\frac{dx_{ii}}{dt_i} > 0$ (see equation 5), it follows that $t^m > 0$ if

$$\frac{dp_i}{dt_i} < 1 + \frac{p_i \frac{dx_{ii}}{dt_i}}{\sum_{z \neq i} x_{zi}} \tag{14}$$

As a result, a sufficient condition for $t^m > 0$ is that $\frac{dp_i}{dt_i} < 1$ – i.e. the optimal MFN tariff is positive if a small increase in the tariff rate causes the domestic price to increase by less than the tariff. The second term on the RHS of the above condition captures the profit shifting motive for a tariff: an increase in the tariff shifts profits to the domestic firm ($\frac{dx_{ii}}{dt_i} > 0$) and this profit shifting effect implies that the optimal MFN tariff can be positive even if the pass through from the tariff to the domestic price is bigger than 1. For trade agreements to be meaningful in our model, we need $t^m > 0$ so that the sufficient condition in (14) is assumed to hold.

3.2 External tariff of an FTA

In order to see how the formation of an FTA alters the tariff equilibrium under MFN, we now consider the tariff choice problem of country i under the bilateral FTA $\{ij\}\rangle$. Before proceeding with this comparison, it is worth discussing why such a comparison is of interest. In order to protect the interests of non-members and to limit the scope for socially harmful trade diversion, WTO rules require that PTAs *not* raise their tariffs on non-member countries (i.e. their external tariffs should not exceed their MFN tariffs).[12] Clearly, to what extent FTA countries actually follow this rule depends upon how tempted they are to raise tariffs on outsiders. An interesting question in this context is whether FTA countries may *voluntarily* lower their tariffs on non-members relative to MFN.

[12] This rule is specified in Article XXIV of the General Agreement on Tariffs and Trade (GATT).

Under the FTA $\{ij\}\rangle$, country i solves:[13]

$$\max_{t_{ki}} s_i(t_{ji}, t_{ki}) \text{ where } t_{ji} = 0 \tag{15}$$

Following the derivations for t^m, the first order condition for the above problem is given by

$$\frac{ds_i(0, t_{ki})}{dt_{ki}} = -\frac{dp_i}{dt_{ki}} x_i + x_{ki} + t_{ki}\frac{dx_{ki}}{dt_{ki}} + \frac{dp_i}{dt_{ki}} x_{ii} + p_i \frac{dx_{ii}}{dt_{ki}} = 0 \tag{16}$$

which implies that country i's optimal external tariff under the FTA $\langle\{ij\}\rangle$ is implicitly defined by the following equation:

$$t^f = -\left[\frac{-\frac{dp_i}{dt_{ki}}\sum_{z\neq i} x_{zi} + x_{ki} + p_i\frac{dx_{ii}}{dt_{ki}}}{\frac{dx_{ki}}{dt_{ki}}}\right] \tag{17}$$

Since $\frac{dx_{ki}}{dt_{ki}} < 0$, it follows that $t^f > 0$ if

$$\frac{dp_i}{dt_{ki}} < \frac{x_{ki}}{\sum_{z\neq i} x_{zi}} + \frac{p_i\frac{dx_{ii}}{dt_{ki}}}{\sum_{z\neq i} x_{zi}} \tag{18}$$

The above inequality has an analogous interpretation to (14) and a comparison of the two inequalities can help shed some light on how the external tariff of an FTA t^f compares with the MFN tariff t^m. We turn to this next.

3.3 Tariff complementarity

Under linear demand, Ornelas (2005) and Saggi (2006) have shown that $t^f < t^m$. As noted earlier, the property that countries lower their external tariffs upon forming an FTA has been called the tariff complementarity effect

[13] Note that due to strategic independence, the tariff choice problem of the non-member country remains the same as that under MFN and in equilibrium it implements the optimal MFN tariff. The problem confronting the other member (i.e. country j) is exactly analogous to that confronting country i.

by Bagwell and Staiger (1997a and 1997b).[14] As might be expected, without making further assumptions about the utility function, one cannot explicitly compare t^f and t^m. Given this, one potential way of addressing the issue of tariff complementarity is to ask whether a *stronger sufficient* condition is needed for the external tariff of an FTA to be positive relative to MFN (i.e. whether inequality (18) is harder to satisfy than inequality (14)).[15] If the answer to this question turns out to be affirmative, we can then argue that an FTA is *less likely* to impose a positive tariff on the non-member country relative to that under MFN.

To make further progress, consider conditions (14) and (18) at $t_i = t_{ki} = 0$. Under this scenario, all firms produce equal amounts so that $\sum_{z \neq i} x_{zi} = 2x_{ki}$ (and domestic price in country i under MFN and the FTA $\{ij\}\rangle$ is the same). At $t_{ki} = 0$, condition (18) can be rewritten as

$$\left.\frac{dp_i}{dt_{ki}}\right|_{t_{ki}=0} < \frac{1}{2} + \frac{p_i \frac{dx_{ii}}{dt_{ki}}}{\sum_{z \neq i} x_{zi}} \tag{19}$$

It turns out that even at $t_i = t_{ki} = 0$, the comparison of (19) and (14) is not entirely straightforward because both the LHS and the RHS terms of the two inequalities are different. First consider a comparison of the LHS terms. Since $p_i' < 0$, a comparison of prices under the two regimes is equivalent to a comparison of total output levels (x_i) under the two regimes. We know that

$$\left|\frac{dx_i}{dt_i}\right|_{t_i=0} > \left|\frac{dx_i}{dt_{ki}}\right|_{t_{ki}=0} \tag{20}$$

i.e. starting at zero tariffs, a given increase in country i's MFN tariff reduces the total output sold in country i by a greater amount than an equivalent tariff increase in its external tariff as a member of the FTA $\{ij\}\rangle$.[16] This is

[14] See also Bond et. al. (2004) and Ornelas (2006).

[15] Note that this approach allows us to accommodate discrete tariff reductions (i.e. from MFN tariffs to zero tariffs) among FTA members.

[16] Starting at zero tariffs ensures that the market equilibrium under MFN and the FTA $\{ij\}\rangle$ is identical.

because a country's MFN tariff applies to *both* its trading partners whereas the FTA tariff applies *only* to the non-member country. This implies that

$$\left.\frac{dp_i}{dt_{ki}}\right|_{t_{ki}=0} < \left.\frac{dp_i}{dt_i}\right|_{t_i=0} \tag{21}$$

i.e. the LHS of (19) is smaller than the LHS of (14).

Now consider the RHS terms of the two inequalities. We observe that if $\frac{dx_{ii}}{dt_{ki}}$ under an FTA is smaller than $\frac{dx_{ii}}{dt_i}$ under MFN, the RHS of inequality (19) is relatively smaller. We argue that this indeed is the case: an increase in the MFN tariff raises costs of both foreign rivals of the domestic firm as opposed to only one of them (which is the case under the FTA $\{ij\}\rangle$) implying that the domestic firm's output increase in response to a given increase in the domestic tariff must be larger under MFN than under the FTA $\{ij\}\rangle$. Thus, starting at zero tariffs (which ensures that domestic price and total imports are the same under the two regimes), country i's domestic firm benefits relatively more from an increase in the MFN tariff compared to an increase in its external tariff a member of an FTA (or a CU).

The above analysis has established that *both* the LHS and the RHS of inequality (19) are smaller than that of inequality (14). This implies that we *cannot* unambiguously state that one sufficient condition is more restrictive than the other implying that tariff complementarity may not always obtain. However, such a conclusion is possible when the price response to a tariff increase under MFN is roughly twice as large as the price response under an FTA because then the effect on domestic profits becomes the sole determinant of which sufficient condition is more binding. In other words, when

$$\left.\frac{dp_i}{dt_{ki}}\right|_{t_{ki}=0} \leq \frac{1}{2}\left.\frac{dp_i}{dt_i}\right|_{t_i=0} \tag{22}$$

we can safely conclude that country i is *less likely* to impose a positive tariff on the non-member relative to that under MFN.

At this point it is useful to consider the illustrate the case of linear demand. Suppose $p_i = \alpha - x_i$. Then

$$\frac{dx_{ii}}{dt_i} = \frac{1}{2} \text{ whereas } \frac{dx_{ii}}{dt_{ki}} = \frac{1}{4} \tag{23}$$

i.e. the effect of a small tariff increase on the domestic firm's local profits under MFN is exactly twice as large relative to the FTA $\{ij\}\rangle$ and

$$\frac{dp_i}{dt_{ki}} = \frac{1}{4} \text{ whereas } \frac{dp_i}{dt_i} = \frac{1}{2} \tag{24}$$

i.e. inequality (22) *exactly binds* under linear demand. Inequalities (23) and (24) imply that tariff complementarity holds under linear demand. In fact we can show directly that

$$t^f = \frac{\alpha}{7} < t^m = \frac{3\alpha}{10} \tag{25}$$

As Ornelas (2005) and Saggi (2006) have noted, the intuition for this result is that the benefits to the local firm of a tariff increase are diluted by the formation of an FTA since the exporter from the partner country captures some of the profit increase that results from the imposition of a tariff.

It is worth noting that, while somewhat surprising, tariff complementarity is rather well supported empirically. In a detailed micro level study, Chang and Winters (2002) found that tariffs on non-members actually declined after the formation of MERCOSUR (the major Latin American customs union). Similar evidence is cited in Bohara et. al. (2004) who argue that their results support Richardson's (1993) political economy model of endogenous protection. We now derive the optimal external tariff of a CU and then examine how it compares to optimal tariffs under MFN and an FTA.

3.4 External tariff of a Customs Union

If countries i and j form a customs union (CU), they impose zero tariffs on each other and a common tariff on country k (i.e. $t_{ki} = t_{kj} = t_{ku}$). As members of the CU $\langle\{ij\}\rangle$, country i and j solve

$$\max_{t_{ku}} w_i(0, t_{ku}) + w_j(0, t_{ku}) \tag{26}$$

Note that this problem is equivalent to countries i and j solving

$$\max_{t_{ku}} s_i(0, t_{ku}) + \pi_{ji}(0, t_{ku}) + \ s_j(0, t_{ku}) + \pi_{ij}(0, t_{ku}) \tag{27}$$

because each member country's welfare is affected by the partner country's tariff only through its export profits in its partner's market. In other words, the major difference between a CU and an FTA is that a CU takes into account the effect of its tariff on the export profits that members earn in each other's markets. Given strategic independence and symmetry, it is sufficient to focus on the maximization of country i's welfare as a CU member. Following the derivations for the FTA case, the first order condition for this problem is given by

$$\frac{d(s_i(0,t_{ku})+\pi_{ji}(0,t_{ku}))}{dt_{ku}} = -\frac{dp_i}{dt_{ku}}x_i + x_{ki} + t_{ku}\frac{dx_{ki}}{dt_{ku}} + \frac{dp_i}{dt_{ku}}(x_{ii}+x_{ji}) + p_i\left[\frac{dx_{ii}}{dt_{ku}}+\frac{dx_{ji}}{dt_{ku}}\right] = 0 \tag{28}$$

which can be rewritten as

$$-\frac{dp_i}{dt_{ku}}x_{ki} + x_{ki} + t_{ku}\frac{dx_{ki}}{dt_{ku}} + p_i\left[\frac{dx_{ii}}{dt_{ku}}+\frac{dx_{ji}}{dt_{ku}}\right] = 0 \tag{29}$$

which implies that the optimal external tariff of a CU (denoted by t^u) is implicitly defined by the following equation:

$$t^u = -\left[\frac{(1-\frac{dp_i}{dt_{ku}})x_{ki} + p_i\left[\frac{dx_{ii}}{dt_{ku}}+\frac{dx_{ji}}{dt_{ku}}\right]}{\frac{dx_{ki}}{dt_{ku}}}\right] \tag{30}$$

Thus, a sufficient condition for the external tariff of a CU to be positive is (i.e. $t^u > 0$)

$$\frac{dp_i}{dt_{ku}} < 1 + \frac{p_i\left[\frac{dx_{ii}}{dt_{ku}}+\frac{dx_{ji}}{dt_{ku}}\right]}{x_{ki}} \tag{31}$$

The interpretation of the above inequality is analogous to (17). The only difference between an FTA and a CU is that the CU internalizes the *positive externality* that members impose on each other by raising each other's export profits due to their tariffs on the non-member country.

Given that the two types of PTAs are similar in that only the non-member faces a tariff, a direct comparison of the two sufficient conditions is feasible. Evaluating the FOC for the optimal CU tariff (i.e. equation 28) at the

optimal FTA tariff t^f gives

$$\left.\frac{d(s_i(0,t_{ku})+\pi_{ji}(0,t_{ku}))}{dt_{ku}}\right|_{t_{ku}=t^f} = -\frac{dp_i}{dt_{ku}}x_{ki} + x_{ki} + t_{ku}\frac{dx_{ki}}{dt_{ku}} + p_i\left[\frac{dx_{ii}}{dt_{ku}} + \frac{dx_{ji}}{dt_{ku}}\right] \tag{32}$$

$$+ \frac{dp_i}{dt_{ku}}(x_{ki}+x_{ji}) - x_{ki} - p_i\frac{dx_{ii}}{dt_{ku}}$$

which implies that

$$\left.\frac{d(s_i(0,t_{ku})+\pi_{ji}(0,t_{ku}))}{dt_{ku}}\right|_{t_{ku}=t^f} = \frac{dp_i}{dt_{ku}}x_{ji} + p_i\frac{dx_{ji}}{dt_{ku}} > 0 \tag{33}$$

i.e. *a CU charges a higher tariff than an FTA.* The intuition for this result is clear – each CU member internalizes the benefit its tariff protection confers on the other member and therefore charges a higher tariff.

Does tariff complementarity hold under a CU? Just like an FTA, a CU's external tariff applies *only* to the excluded country. As before, further insight into the tariff complementarity effect can be obtained by comparing the sufficient condition (31) under a CU with that under MFN (i.e. inequality (14)) at $t_{ku} = t_i = 0$. Once again, to make progress, we have to separately consider the LHS and the RHS of the two inequalities and as was the case for the comparison of an FTA and MFN, the LHS of (31) is smaller than LHS of (14).

Now consider the RHS terms of these inequalities. At $t = 0$, $\sum_{z\neq i} x_{zi} = 2x_{ki}$. Thus, the RHS of (31) is *larger* than the RHS of (14) iff

$$\frac{dx_{ii}}{dt_i} \leq 2\left[\frac{dx_{ii}}{dt_{ku}} + \frac{dx_{ji}}{dt_{ku}}\right] \tag{34}$$

In other words, if the marginal increase in the profit of the domestic firm due to a given increase in the MFN tariff is less than twice the sum of the marginal increases in the profits of a CU member firms due to an increase in the CU tariff then tariff complementarity is likely to hold under a CU. When (34) holds, the LHS of (31) is then smaller than that of (14) while the RHS is larger implying that the sufficient condition for the CU tariff

to be positive is weaker (i.e. a *CU is less likely to charge a positive tariff relative to an individual country under MFN*). In fact, under linear demand and symmetry, we can show that

$$\frac{dx_{ii}}{dt_i} = \frac{1}{2} \text{ and } \frac{dx_{ii}}{dt_{ku}} = \frac{dx_{ji}}{dt_{ku}} = \frac{1}{4} \tag{35}$$

so that inequality (34) binds under linear demand:

$$\frac{dx_{ii}}{dt_i} = \frac{dx_{ii}}{dt_{ku}} + \frac{dx_{ji}}{dt_{ku}} \tag{36}$$

implying that tariff complementarity holds under linear demand for a CU as well.[17] In general, it is clear from the above analysis that tariff complementarity is likely to hold under the oligopoly model of intraindustry trade under fairly general circumstances regardless of whether the PTA is an FTA or a CU.

4 Trade liberalization and welfare

Given the above discussion of tariff complementarity and the fact that WTO rules forbid member countries of PTAs from raising tariffs on non-member countries, for the remainder of the paper unless otherwise noted, we restrict attention to the case where tariff complementarity holds under a CU: $t^u \leq t^m$ (which automatically implies that it holds under an FTA as well since $t^f < t^u$). To derive the effects of PTAs on global welfare, we first show that unilateral trade liberalization of any kind is desirable in our model:

Proposition 1: *A reduction in any country's tariff(s) (whether on a preferential or a non-discriminatory basis) increases aggregate world welfare.*

Differentiating world welfare with respect to t_{ji} gives:

$$\frac{dww}{dt_{ji}} = \frac{ds_i}{dt_{ji}} + \sum_i \frac{d\pi_{zi}}{dt_{ji}} \text{ where } z \neq i. \tag{37}$$

[17] In fact, under linear demand,

$$t^U = \frac{5\alpha}{19} < t^M = \frac{3\alpha}{10}$$

Using $u' = p_i$ and $x_i = x_{ii} + \sum_{z \neq i} x_{zi}$, we have

$$\frac{ds_i}{dt_{ji}} = \frac{dp_i}{dt_{ji}} \frac{dx_i}{dt_{ji}} [x_i - x_{ii}] + p_i \frac{dx_{ii}}{dt_{ji}} + x_{ji} + t_{ji} \frac{dx_{ji}}{dt_{ji}} + t_{ki} \frac{dx_{ki}}{dt_{ji}} \tag{38}$$

Also note that

$$\sum_{z \neq i} \frac{d\pi_{zi}}{dt_{ji}} = \frac{dp_i}{dt_{ji}} \frac{dx_i}{dt_{ji}} [x_i - x_{ii}] - x_{ji} + [p_i - t_{ji}] \frac{dx_{ji}}{dt_{ji}} + [p_i - t_{ji}] \frac{dx_{ki}}{dt_{ji}} \tag{39}$$

where we have made use of the first order conditions for profit maximization for each firm. From equations (37) through (39) we have:

$$\frac{dww}{dt_{ji}} = p_i \frac{dx_{ii}}{dt_{ji}} + p_i \sum_{z \neq i} \frac{dx_{zi}}{dt_{ji}} \tag{40}$$

Using $x_i = x_{ii} + \sum_{z \neq i} x_{zi}$, the following is immediate:

$$\frac{dww}{dt_{ji}} = p_i \frac{dx_i}{dt_{ji}} < 0 \text{ since } \frac{dx_i}{dt_{ji}} < 0 \tag{41}$$

i.e. the lowering of any tariff improves world welfare. Analogous arguments establish that (i) the lowering of its tariff on an MFN basis must also improve world welfare and that (ii) it is socially optimal to set an FTA's external tariff to zero. *As a result, under symmetry, free trade yields higher world welfare than any other policy regime.*

Corollary 1:

$$ww(F) > ww(ij, ik) > ww(ij) > ww(M)$$

The intuition for this is simple: when all countries have the same cost of production, the allocation of output across countries is immaterial and any trade restrictions (whether preferential or multilateral) simply lower aggregate world output and therefore welfare. Since any tariff creates a deadweight loss (i.e. rent extraction by an importing country is more than offset by the loss in profits of exporters) free trade maximizes world welfare.

5 Welfare effects of a bilateral PTA

Perhaps the most basic question about PTAs is how they affect the welfare of member countries. Let t^p denote a PTA's external tariff of a PTA $\langle\{ij\}\rangle$, where t^p represents t^f when the PTA in question is an FTA and t^u when it is a CU.

5.1 Effect on members

Note that if $t^u \leq t^m$, both types of PTAs increase the global volume of trade. Furthermore, under symmetry, PTAs do not cause any trade diversion. Using these arguments we can show the following:

Proposition 2: *If $t^p \leq 2t^m$, a bilateral PTA makes member countries better off relative to MFN.*

To see the logic behind this result first suppose that $t^p \leq t^m$ (i.e. tariff complementarity holds). Proposition 1 implies that as long as $t^p \leq t^m$ the formation of an PTA *cannot* make both members and the non-member worse off relative to MFN (since world welfare must increase due to trade liberalization). Furthermore, given symmetry, there are only three possibilities (i) all countries are better off under a PTA relative to MFN; (ii) members are better off while the non-member is worse off; and (iii) members are worse off while the non-member is better off. To prove proposition 2, we only need to rule out statement (iii). To see why statement (iii) is false, suppose countries i and j form an FTA and consider their individual welfare at $t_{ki} = t_{kj} = t^m$. Since only country k faces the tariff t^m, it must be that its export profits as a non-member are lower than those under MFN in both export markets:

$$\pi_{ki}(t^m, 0) = \pi_{kj}(t^m, 0) < \pi_{ki}(t^m, t^m) = \pi_{kj}(t^m, t^m) \tag{42}$$

Due to market segmentation and strategic independence of tariffs, the domestic surplus of country k is unaffected by the formation of an FTA between countries i and j since country k continues to impose its optimal MFN tariff on countries i and j. The decline in its export profits implies that country k is necessarily worse off relative to MFN if FTA members set their external

tariffs equal to their MFN tariffs (i.e. $t_{ki} = t_{kj} = t^m$). Since all countries cannot be worse off due to the FTA (Proposition 1), member countries must be better off when their external tariffs equal their MFN tariffs ($t_{ki} = t_{kj} = t^m$). However, by the definition of t^f, each FTA member is better off using t^f than it is using t^m:

$$w_i(0, t^f) = w_j(0, t^f) > w_i(0, t^m) = w_j(0, t^m) \tag{43}$$

Thus, FTA members must surely be better off relative to MFN. Exactly the same argument holds for the case of a CU except that its optimal external tariff is t^u.

But what if tariff complementarity fails to hold? Can a PTA make member countries worse off? We claim that as long as the external tariff of a PTA is no larger than twice the MFN tariff (i.e. $t^p \leq 2t^m$), PTA members (and world as a whole) must gain from their mutual liberalization. To see why, note that if $t^p \leq 2t^m$, the total tariff protection of each member country (defined as the sum of its tariffs) declines relative to MFN since the PTA tariff applies only to the non-member country. Given that total imports of a country depend only its total tariff protection (see equation (3)), it follows that total output sold in a country increases if it forms a PTA as long as $t^p \leq 2t^m$. Due to strategic independence, the non-member's optimal tariff does not respond to an PTA and world welfare must increase due to the trade liberalization undertaken by PTA members so long as respective total protection levels are lower relative to MFN. Thus, trade liberalization is more important than tariff complementarity for ensuring proposition 2 holds. Finally, it is worth noting that members can be better off under a PTA even when they do not lower their total tariff protection but the world as a whole must surely lose if $t^p > 2t^m$.

An immediate implication of Proposition 2 is that the move from a bilateral PTA to multilateral free trade yields a smaller welfare gain for a member country than a move from MFN tariffs to global free trade. Let

$$\Delta w_i(M) \equiv w_i(M) - w_i(F) \text{ and } \Delta w_i(ij) \equiv w_i(ij) - w_i(F)$$

Corollary 2

$$\Delta w_i(ij) < \Delta w_i(M)$$

In other words, the formation of a bilateral PTA makes multilateral free trade less desirable to member countries. This result is reminiscent of the findings of Krishna (1998) who focused on the case where the local government cares only about the local firm's profits. Our analysis shows that his insight extends to the case of welfare-maximizing governments.

5.2 Effect on the non-member

Note that the formation of a PTA does not alter the non-member's domestic surplus:

$$s_k(ij) \equiv s_k(M) \tag{44}$$

Thus, the non-member is affected by the PTA $\langle\{ij\}\rangle$ only via its export profits. Let $\Delta\pi_k(ij)$ denote the difference between its export profits under PTA $\langle\{ij\}\rangle$ and MFN:

$$\Delta\pi_k(ij) \equiv \pi_{ki}(t^p, 0) + \pi_{kj}(t^p, 0) - \pi_{ki}(t^m, t^m) - \pi_{kj}(t^m, t^m). \tag{45}$$

It follows then that whether the non-member's fate depends upon how the PTA's external tariff compares to the MFN tariff. If $t^p \simeq t^m$, the non-member is surely worse under the PTA relative to MFN because $\pi_{ki}(t^m, 0) < \pi_{ki}(t^m, t^m)$. However if $t^p \simeq 0$, it is better off under the PTA relative to MFN because $\pi_{ki}(0, 0) > \pi_{ki}(t^m, t^m)$. Intuitively, the PTA lowers the cost of its rival exporter and the non-member can benefit from its formation only if its own cost also declines substantially.

Proposition 3: *There exists a critical threshold tariff* $\underline{t}$ *such that a PTA between countries* i *and* j *makes country* k *(i.e. the non-member) better off relative to MFN iff* $t^p \leq \underline{t}$ where $\pi_{ki}(\underline{t}, 0) = \pi_{ki}(t^m, t^m)$ and $\underline{t} \leq t^m$.[18]

[18] In fact, the tariff $\underline{t}$ is equivalent to the Kemp-Wan (1976) tariff in the context of a CU. Panagariya and Krishna (2002) show how the Kemp-Wan result regarding the welfare effects of CUs can be extended to FTAs.

By now it is clear that how the formation of a PTA affects the desirability of global free trade from a non-member's perspective once again depends crucially on the external tariff of a PTA: if such a tariff is low (i.e. less than $\underline{t}$), the PTA actually benefits the non-member who then gains less from a move to global free trade relative to that under MFN. In fact, sufficiently low PTA tariffs can *completely eliminate* the incentive of a non-member to pursue multilateral trade liberalization. To see this, note that if the external tariff of a PTA is close to zero, the non-member would never favor a move to global free trade since such a move would require it to give up its own optimal MFN tariff without receiving any benefit in foreign markets.

6 A pair of bilateral FTAs

How do individual countries fare under a pair of independent bilateral FTAs? We argue below that a pair of bilateral FTAs makes the common member better off and the other two members *worse off* relative to global free trade. To see why, first note that starting at free trade, if countries j and k were to switch to *independent* bilateral FTAs with only country i, export profits of country i would *increase* in both its export markets because in each of its export markets, country i's rival exporter would face the tariff t^f whereas it itself would not:

$$\Delta\pi_i(ij,ik) \equiv \sum_{z\neq i}\pi_{iz}(0,t^f) - \sum_{z\neq i}\pi_{iz}(0,0) > 0 \tag{46}$$

Furthermore, the domestic surplus of country i under $\langle\{ij,ik\}\rangle$ is the same as that under free trade since it has a bilateral FTA with both its trading partners and must therefore practise free trade

$$\Delta s_i(ij,ik) \equiv s_i(0,0) - s_i(0,0) = 0 \tag{47}$$

As a result, country i's welfare under $\langle\{ij,ik\}\rangle$ is necessarily *higher* than that under free trade:

$$\Delta w_i(ij,ik) \equiv w_i(ij,ik) - w_i(F) > 0 \tag{48}$$

From Corollary 1 we know that world welfare is lower under $\langle\{ij, ik\}\rangle$ relative to free trade: $ww(ij, ik) < ww(F)$. Thus it must be that the sum of countries k and j's welfare under $\langle\{ij, ik\}\rangle$ is lower than that under free trade:

$$\Delta w_j(ij, ik) + \Delta w_k(ij, ik) < 0 \text{ where } \Delta w_z(ij, ik) \equiv w_z(ij, ik) - w_k(F) \text{ and } z \neq i. \tag{49}$$

But since countries j and k both have an independent FTA with country i, the welfare of each under $\langle\{ij, ik\}\rangle$ is the same: $w_j(ij, ik) = w_k(ij, ik)$. It follows immediately that both must be worse off under $\langle\{ij, ik\}\rangle$ relative to free trade $\langle\{F\}\rangle$:

$$\Delta w_j(ij, ik) = \Delta w_k(ij, ik) < 0 \tag{50}$$

In other words, we have shown the following result:

Proposition 4: *Under the pair of independent bilateral FTAs $\langle\{ij, ik\}\rangle$, the common member (i.e. country i) is better off relative to free trade (and therefore relative to MFN) whereas the other two countries (i.e. j and k) are worse off relative to free trade.*[19]

Proposition 4 also sheds light on how the formation of a pair of independent FTAs affects incentives for multilateral trade liberalization. Note that under $\langle\{ij, ik\}\rangle$, country i is already practising free trade whereas the other countries are imposing tariffs only on each other. But since their welfare under $\langle\{ij, ik\}\rangle$ is lower than that under free trade, they would surely gain from a move to global free trade.

Corollary 1 implies that the formation of a pair of bilateral FTAs necessarily increases aggregate world welfare when countries are symmetric. But what if the cost of production of good x differs across countries? Rather than provide an exhaustive (and repetitive) analysis, we focus on an interesting new possibility that arises only under cost asymmetry. Let c_z denote country z's marginal cost of good x where $c_k \geq c_j \geq c_i = 0$. Since cost asymmetry

[19] Following proposition 3, we can show that if the external tariff of an FTA falls below a critical threshold then the countries that have only a single FTA are better off relative to MFN.

affects optimal tariffs, we use τ (with an appropriate superscript) to denote optimal tariffs under cost asymmetry.

Proposition 5: *Suppose $c_k = c_j = c > c_i = 0$. Then, the pair of bilateral FTAs $\langle\{ij, ik\}\rangle$ can yield higher world welfare than global free trade.*

Suppose countries j and k form individual FTAs with country i and let $c_k = c_j = c > c_i = 0$. Under such a situation, countries j and k impose zero tariffs on country i and the tariff τ^F on each other where τ^F solves

$$\tau^F = \arg\max \ s_j(0,\tau) = \arg\max \ s_k(0,\tau) \tag{51}$$

so that

$$\left.\frac{ds_j(0,\tau)}{d\tau}\right|_{\tau=\tau^F} = \left.\frac{ds_k(0,\tau)}{d\tau}\right|_{\tau=\tau^F} = 0 \tag{52}$$

Now consider the impact of FTA's external tariff under the trade regime $\langle\{ij, ik\}\rangle$ on world welfare . Using $\frac{ds_i(0,0)}{d\tau} = 0$ and equation (52) we can write

$$\left.\frac{dww(0,\tau)}{d\tau}\right|_{\tau=\tau^F} = \sum_{z\neq i}\frac{d\pi_{iz}(0,\tau)}{d\tau} + \frac{d\pi_{jk}(\tau,0)}{d\tau} + \frac{d\pi_{kj}(\tau,0)}{d\tau} \tag{53}$$

In other words, *when FTA tariffs are optimally chosen by member countries, a further increase in the external tariffs of the FTA countries increases world welfare iff they increase the total export profits in the world economy.*

Note that

$$\frac{d\pi_{iz}(0,\tau)}{d\tau} = p'\frac{dx_z}{d\tau}x_{iz} + p\frac{dx_{iz}}{d\tau} = p'\left(\frac{d(x_{jz}+x_{kz})}{d\tau}\right)x_{iz} > 0 \text{ where } z \neq i \tag{54}$$

i.e. an increase in the tariff on its rival exporter increases country i's export profits in both of its export markets**.**

Similarly,

$$\frac{d\pi_{jk}(\tau,0)}{d\tau} = \left[p'\left(\frac{d(x_{ik}+x_{kk})}{d\tau}\right) - 1\right]x_{jk} < 0 \tag{55}$$

i.e. an increase in the tariff faced by country j lowers its export profits in country k's market**.**

Also,

$$\frac{d\pi_{ij}(0,\tau)}{d\tau} = \frac{d\pi_{ik}(0,\tau)}{d\tau} \tag{56}$$

i.e. from country i's perspective, a small increase in the tariff faced by one of its exporting rivals is the same as an equivalent increase in the tariff faced by the other rival exporter.

At $\tau = \tau^F$, the first order condition for world welfare maximization in (53) can be written as

$$\begin{aligned}\frac{1}{2}\left.\frac{dww(0,\tau)}{d\tau}\right|_{\tau=\tau^F} &= \underbrace{p' x_{ij}\left[\frac{d(x_{jj}+x_{kj})}{d\tau}\right]_{\tau=\tau^F}}_{>0} \\ &+ \underbrace{x_{jk}\left[p'\left(\frac{d(x_{ik}+x_{kk})}{d\tau}\right)-1\right]_{\tau=\tau^F}}_{<0}\end{aligned} \tag{57}$$

which is of ambiguous sign if countries are asymmetric.[20]

Under linear demand, the above simplifies to

$$\frac{1}{2}\left.\frac{dww(0,\tau)}{d\tau}\right|_{\tau=\tau^F} = \frac{x_{ij}-3x_{jk}}{2} \geq 0 \text{ iff } x_{ij} \geq 3x_{jk}. \tag{58}$$

so that under linear demand FTA tariffs under the regime $\langle\{ij, ik\}\rangle$ *are optimal from the viewpoint of global welfare maximization* iff $x_{ij} = 3x_{jk}$.[21]

Proposition 5 is a striking result and deserves further discussion. The first point to note is that the assumption that firms compete in quantities plays a crucial role in delivering this result. As is well known, under quantity competition firms with different production costs can remain active in production so long as demand is big enough. But from a world welfare perspective, this involves an inefficiency: holding constant the level of output,

[20] Under symmetry, it is clear that

$$\left.\frac{dww(0,\tau)}{d\tau}\right|_{\tau=\tau^F} = -2x_{jk} < 0$$

[21] If country k were to impose zero tariffs, a bilateral FTA between i and j can also give higher welfare than free trade if country k is inefficient.

any reallocation of production towards the low cost producer (i.e. country k) increases world welfare. Thus, the external tariffs of the two FTAs $\langle\{ij, ik\}\rangle$ have two conflicting effects on world welfare. On the one hand, such tariffs tend to lower world welfare relative to free trade since they adversely effect the exports of countries j and k (both of which are higher cost than country i). On other hand, FTA tariffs shift production in favor of country i and this improves *allocative efficiency*. What proposition 5 argues is that it is quite possible for the latter effect to dominate the former. It is easy to show that under linear demand if the (common) production cost of the two high cost countries exceeds a certain threshold, then the pair of FTAs $\langle\{ij, ik\}\rangle$ yield higher global welfare than free trade.

Given this result, it is natural to ask whether a CU can deliver higher global welfare than free trade. The answer to this question turns out to be a definite no. To see this, suppose countries i and j form a CU with each other. Then we know that their optimal external tariff solves

$$\tau^u = \arg\max s_i(0,\tau) + \pi_{ji}(0,\tau) = \arg\max s_j(0,\tau) + \pi_{ij}(0,\tau) \tag{59}$$

which implies that

$$\left.\frac{ds_i(0,\tau)}{d\tau}\right|_{\tau=\tau^u} + \left.\frac{d\pi_{ji}(0,\tau)}{d\tau}\right|_{\tau=\tau^u} = \left.\frac{ds_j(0,\tau)}{d\tau}\right|_{\tau=\tau^u} + \left.\frac{d\pi_{ij}(0,\tau)}{d\tau}\right|_{\tau=\tau^u} = 0 \tag{60}$$

Given this, at the optimal external CU tariff, the impact of a small change in this tariff on world welfare is given by

$$\left.\frac{dww(0,\tau)}{d\tau}\right|_{\tau=\tau^u} = \frac{d\pi_{jk}(\tau,0)}{d\tau} + \frac{d\pi_{kj}(\tau,0)}{d\tau} < 0 \tag{61}$$

Thus, at the optimal CU tariff, world welfare declines with a further increase in the tariff rate. In other words, the CU's tariff is too high and the formation of a CU always lowers world welfare.

Proposition 6: *Unlike an FTA, a customs union between two countries always yields lower world welfare than global free trade.*

Intuitively, since a CU already takes into account the export profits of member countries in each other's markets, any further increase in its tariff simply lowers export profits of the non-member thereby lowering world

welfare. It is worth emphasizing that this result obtains because each FTA member fails to account for export profits of the other member and under cost asymmetry this can imply that the external tariff of an FTA is *too low* from a global welfare perspective. By contrast, a CU ignores the (negative) impact of its tariff on the non-member country and therefore always charges an external tariff that is too high from a global perspective, regardless of the nature of underlying cost asymmetry across countries.

7 Concluding remarks

One of most important changes in the global trade policy landscape in the last two decades or so has been the rapid emergence of PTAs. So endemic are PTAs today that almost all countries participate in multiple PTAs. Even though PTAs have received significant attention in the literature, two key aspects of PTAs have not been adequately analyzed. First, either much of the literature has tended to take PTA tariffs as exogenously given or endogenized tariffs under rather specific assumptions about preferences. Given that the very purpose of PTAs is to alter the global structure of trade protection in a discriminatory fashion, it is important to examine PTAs in an environment where tariffs are endogenously determined. Second, the fact that most countries participate in multiple PTAs has been basically ignored in the analytical literature. Given the realties of the multilateral trading system, it is worth knowing whether membership in multiple PTAs differs in any significant manner from participation in a single PTA. This paper contributes to the existing literature on PTAs along both these dimensions.

Our analysis yields several new results. First, it shows that the tariff complementarity effect of PTAs is likely to hold even in the absence of linearity. Second, it argues that when the (endogenously chosen) external tariff of a PTA is not too high, a PTA benefits both member and non-member countries. Third, it analyzes the welfare implications of a pair of independent bilateral FTAs (that result in a 'hub and spoke' type trading arrangement) and shows that such an arrangement increases the hub's welfare even beyond

what it can obtain under global free trade. Fourth, when countries are asymmetric, such an arrangement can be welfare-preferred to global free trade if the hub country is relatively low cost compared to the spoke countries since the trade diversion inherent to such a regime enhances the efficiency of global production. By contrast, such an outcome is never possible under a CU.

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