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Earl L. Grinols *
*Peri Silva***

* Hankamer School of Business, Baylor University
** University of North Dakota and LdA

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Earl L. Grinols* and Peri Silva†

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Abstract

This paper identifies the most restrictive limit that rules of origin can enforce and still continue to guarantee gains from trade for free trade area formation in general settings. Many commonly used rules of origin exceed this condition in practice. Second, free trade areas generally involve unharmonized tariffs requiring rules of origin that make standard analyses difficult or inapplicable. We incorporate the identified welfare-supporting rules of origin into standard existence of equilibrium proofs and prove the existence of a free trade area equilibrium involving only *within-FTA* transfers that is at least as satisfactory for every consumer worldwide as an arbitrary original world trade allocation. The analysis explains why hub-and-spoke extensions of free trade areas cannot guarantee gains from trade for all participants in general.

JEL classification numbers: D60, F13, F15

Keywords: Rules of origin, free trade areas, Walrasian equilibrium, welfare analysis.

*Department of Economics, Hankamer School of Business, Baylor University, One Bear Place #98003, Waco, Texas 76798

†Corresponding Author: Department of Economics, University of North Dakota, and Centro Studi Luca d'Agliano. Gamble 290 Centennial Drive, Grand Forks, ND 58202; Tel. (701)777-3351; e-mail: peri.dasilva@mail.business.und.edu. Peri Silva acknowledges financial support from CAPES-Brazil.

1 Introduction

The literature on preferential trade agreements has developed faster for the theory of customs unions than for free trade areas, partly because members of a free trade area (FTA) can apply different tariff schedules to goods traded with non-members and must apply rules of origin to prevent duty-free trans-shipment of goods originating in the rest of the world. The theory of FTAs, therefore, requires investigating the joint implementation of trade instruments and rules of origin, making analysis more difficult. This paper contributes to the theory of free trade areas by describing for the first time the most restrictive limit that rules of origin can enforce and still continue to guarantee gains from trade for free trade areas in general. Second, it employs a less restrictive framework for welfare analysis and fills a gap in the literature by proving that starting from an arbitrary world trade equilibrium there always exists a free trade area equilibrium involving only *within-FTA* transfers that provides welfare gains to FTA members and is at least as satisfactory for every consumer worldwide as the initial equilibrium.

The paper addresses rules of origin and existence as follows. First, we describe a methodology that incorporates the main distinctions between FTAs and customs unions. In particular, this methodology incorporates transportation cost considerations and allows the investigation of different rules of origin. Second, it provides a proof for the existence of Pareto-improving free trade areas. Third, it shows that only FTAs whose rules of origin for between-member trade allow value added to be unrestricted in a particular way can unambiguously guarantee gains consistent with tariffs chosen so that FTA formation is simultaneously unharmful to the rest of the world. The methodology of these results is robust to the inclusion of factors of production in the utility function—any factor may have inelastic supply or not—and to the existence of non-tradable goods. Any commodity can be used as a final or as an intermediate good.

Section 2 describes the model. Sections 3 and 4 identify the unique rules of origin that guarantee welfare gains and state the existence proposition. Section 5 comments on these results relative to the related literature. Section 6 discusses the limitations of our results and the practical significance of being able to form Pareto superior equilibria as part of the move to freer world trade.

2 Transportation and Equilibrium

Consider a free trade area formed by two countries named Home and Foreign that are denoted by H and F, respectively. The rest of the world is denoted by the letter W. Extension to an agreement formed by several countries is similar and will not be pursued here. Goods are differentiated both by their characteristics and location. It is necessary, especially in international trade, to distinguish goods by description and location of use. Feenstra (2004, pp. 192), for example, suggests applying Arrow-Debreu-based methodology to study the welfare effects of the formation of preferential agreements. According to Debreu "a good at a certain location and the same good at another location are *different* economic objects, and the specification of the location at which it will be available is essential." (Debreu, pp. 29-30, emphasis in original.) He notes that if location changes, "a *different* commodity results." (Ibid., p. 30, emphasis in original.)

Any good can be used for final consumption or as an intermediate good in production. A good produced in one country and transported to another becomes a different good. We consider economies that produce K types of goods, implying $9K$ goods in total (3 countries of origin and 3 countries of destination). Since goods are differentiated by their location and description, the prices prevailing in the preferential trade agreement are described in a $9K \times 1$ vector. Note also that trans-shipment technology is a form of production, and, therefore, a process of transforming certain inputs into specific outputs. Moving a good from one location to another transforms it and so the prices prevailing in a customs union or FTA represent the cost of transportation between locations as well as preferences and production technology.

Since countries H and F form an FTA, we assume that they can implement different tariffs and that internal free trade prevails between them. Thus, goods originating in the rest of the world may have different prices in the FTA countries' markets. Producers in the FTA desire to sell their output in the member market with higher price. This may create an impediment to member countries' independent tariff setting. Potential conflict arises from the ability to import a product from the rest of the world and trans-ship it to the member market with the higher internal price. In this case, transportation would imply a relationship between the prices of goods that is potentially inconsistent with the prices implied by the different tariffs of union members. This issue must be treated in the proof of general equilibrium existence.

Let prices prevailing in the union be denoted by p. They differ from world prices p^W by tariffs t, $p = p^W + t$. Thus,

$$p \equiv \begin{pmatrix} p_{HH} \\ p_{FH} \\ \hline p_{WH} \\ \hline p_{HF} \\ p_{FF} \\ \hline p_{WF} \\ \hline p_{HW} \\ p_{FW} \\ p_{WW} \end{pmatrix} = p^W + t = p^W + \begin{pmatrix} 0 \\ 0 \\ \hline t_{WH} \\ \hline 0 \\ 0 \\ \hline t_{WF} \\ \hline t_{HW} \\ t_{FW} \\ 0 \end{pmatrix} \quad (1)$$

where $t_{ab} \in \mathcal{R}^K$ is the vector of tariffs applied to goods originating in country a and whose final location is country b. It is clear from equation (1) that country H selects tariffs t_{WH} on goods acquired from country W, which may differ from country F's tariffs on products originating in the same location, t_{WF}. The duties on products imported by one union member from the other are zero, $t_{HF} = t_{FH} = 0 \in \mathcal{R}^K$. Throughout the paper we use subscripts to describe the location of origin and the final location in the same way we did with the vector of tariffs.

What do world prices mean in this framework? Dixit (1985, pp. 317) argues that world prices "denote trading prices just outside the home country's borders." This is the definition we use in this paper as well. Dixit (1985) goes on to say that world prices for non-tradeables can be set arbitrarily. Our framework adopts the convention that the world price of non-tradeable goods (i.e., goods not traded between countries) matches the price that prevails in the FTA. This implies that zero duties on trade are applied to non-traded goods. That does not cause harm since the relation between FTA and world prices for non-tradeable commodities is irrelevant.

Assume that endowments are constant throughout the analysis. Country i's production vector is $y^i \in Y^i \subset \mathcal{R}^{9K}$, $i = H, F$. A positive component of y^i is an output and a negative element is an input. The consumption vector of country i is $x^i \in X^i \subset \mathcal{R}^{9K}$, while the consumption vector of consumer j of country i is $x^i_j \in X^i_j \subset \mathcal{R}^{9K}$. The external trade vector of country i is denoted by $z^i \in \mathcal{R}^{9K}$. A positive element of z^i is an imported good and a negative element is an exported good. Many coordinates of the vectors x^i, y^i, and z^i will be zero. For example, external trade in goods produced and consumed in the same country is zero. Firms located in country H could "produce" a good of type WFk (good of description k, physically originating in W, with end-of-period location F) by acquiring good k from W and transporting it to F. In this case, one element of y^H would be the input, $-y_{WWk}$, and another element would be the output, y_{WFk}. Whether goods are subject to tariffs depends on their origin and the degree of transformation

they have undergone while passing through the hands of the exporter before reaching their final destination.

In a free trade area, members may set different tariffs and thus may have different internal prices. As discussed above, firms located in the FTA have an incentive to transship products imported from the rest of the world by a low tariff member to a high tariff FTA partner. Rules of origin must be chosen to prevent the duty-free transshipment of goods originating in the rest of the world among FTA member countries. Next we describe tariff policy and rules of origin that jointly insure consistency between transshipment and independent member tariffs.

2.1 Tariffs

Assumption 1 (Choice of Tariffs) *Each FTA member chooses tariffs so that its trade with the rest of the world (country W) is unchanged between the initial pre-union situation 0 and the post-union-formation situation 1.*

Assumption 1 has the effect of preventing welfare losses to the rest of the world upon FTA formation by freezing external trade flows. Recording of production and trade follows the usual general equilibrium convention. For example, which country did the shipping matters in the recording of production and trade flows. Thus, assume that good WWk (good of type k originating in W and entering into commerce there) is placed on W's ship and transported to country H. The description of production in W would reflect this transportation activity and would record $-y^W_{WWk}$ as an input and y^W_{WHk} as an output. Aggregate production, of course, would involve netting out commodity flows. The superscript W indicates that country W did the producing of good y_{WHk}. Country H would receive y^W_{WHk} and record this quantity in its import vector as z^H_{WHk}.

2.2 Rules of Origin

Trans-shipment allows a producer to import a product from location a and re-export it to location b. Rules of origin that prevent trans-shipment distinguish between transformations that change a commodity's description k and not merely the good's location.

Assumption 2 (Rules of Origin) *A good or service may enter duty free to one FTA country from the other only if it contains strictly positive value added of the sending FTA country. If the good is "new" (neither produced nor consumed at the initial pre-FTA situation 0), it may pass*

duty free to one FTA country from the other only if it contains 100 percent value added of the sending FTA country.

Notice that Assumption 2 does not impose any minimum fraction of value that must be added by the sending FTA partner to grant the commodity duty-free access. A good is deemed to contain strictly positive value added of the producing (or trans-shipping) country only if its type (not merely its final location) is different from the description of each of its inputs. If good WHk is an input, for example, *any* transformation to some other good HFk_0 where $k \neq k_0$ suffices.[1] Notationally, a good produced in country W of type k that is re-exported by H to country F ($WWk \rightarrow WHk \rightarrow WFk$) ultimately becomes good WFk (a different *economic* product than WWk or WHk to be sure), but is not allowed to pass duty free by FTA partner F because it is still a good of the original type "k " and retains the same description as one of its inputs. The 100% rule for new goods prevents evasion. If an H importer, for example, sought to avoid the positive value added (change-of-product-type) requirement for duty free access by importing a good WHk, trivially repackaging it, and claiming it to be a "new" good HHk_1 where k_1 is a never-before-seen product type, then it would fall under the 100% local content rule and be prevented from duty free access.

Assumption 2 rules are the weakest ("most generous") that prevent trans-shipment of pre-existent commodities. We show in Section 4 that more restrictive rules are inconsistent with Pareto improvement.

3 FTA Equilibrium

We are now ready for our first result. An existence proof verifies for an FTA that a chosen combination of external tariffs and rules of origin support the implementation of a Pareto superior allocation. General existence proofs have been available for customs union theory[2] but not for free trade areas.[3] In general, we show that for an arbitrary initial trade equilibrium, a free trade area Pareto superior equilibrium exists that is consistent with the simultaneous and possibly price-dependent assignment of purchasing power so that no one is worse off. This solves the problem

[1] What if country H produces a good that uses many intermediate inputs from different origins? If the good's final description k_0 differs from each of the comparable input descriptions, the good contains value-added of country H and is deemed to originate (be produced) in location H.

[2] See Kemp and Wan, 1976.

[3] Examples can be constructed showing that the set of results for FTAs is not empty. For example, Feenstra, 2004, writes "While Krishna and Panagariya [2002] do not provide a general existence result, we can certainly construct examples where [the described conditions hold]" (p. 195).

that knowing that an equilibrium that has features A (related to rules of origin and tariffs) will also have features B (everyone's welfare rises) shows that features B can be attained only if existence of the original equilibrium A is proved.

Thus, let countries H and F form an FTA that satisfies Assumptions 1 and 2 and apply the Gale and Mas-Colell Theorem (see appendix for details) to establish the following proposition. Gale and Mas-Colell (1975) apply the same standard as this paper, defining goods by characteristic and location. Their proof is very general and maintains the treatment of goods initiated by Debreu.

Proposition 1 *Let Assumptions 1 and 2 hold, then a welfare-enhancing FTA equilibrium involving H and F exists where consumers in countries H, F, and W are not worse off post-agreement.*

The proof follows a similar strategy to that used by Kemp and Wan (1976), Grinols (1981), and Hammond and Sempere (1995) for welfare-enhancing customs unions. The difference is incorporating rules of origin.

An example highlights the way the theorem works. Consider that the world is partitioned into the US, Mexico, and the rest of the world. Suppose that the US and Mexico form an FTA that satisfies Assumptions 1 and 2, and assume that the price of textiles in the US is higher than in Mexico. Suppose that in FTA equilibrium Mexico exports textiles to the US but both countries imported textiles from the rest of the world before the FTA was formed. Would that trigger an increase in the amount of textile exports from Mexico to the US large enough to make independent tariff setting inconsistent?

Let's verify what Mexican textile exporters could do in this case. One option would be to import textile products and re-export them to the US. In this case, Mexican exporters would pay duties based on Assumption 2, making prices in the two countries consistent. Another option would be to import larger quantities of inputs (yarn, fabric and etc.), add value to them, and export the textile products to the US. But this is not possible since Mexico applies external tariffs to freeze trade of all inputs with the rest of the world at the pre-FTA levels. The combination of the choice of external tariffs (Assumption 1) and the setting of rules of origin (Assumption 2) guarantees price consistency of welfare-enhancing FTAs.

4 Rules of Origin and Welfare

The main types of rules of origin applied in practice require that at least one of the following criteria be fulfilled to grant duty-free access to member countries' markets: (i) minimum regional

content[4]; (ii) a pre-specific change in tariff heading; (iii) a specific phase of the production process performed within the preferential agreement; (iv) substantial transformation of name and characteristics. Thus, the rules of origin implemented in practice may severely constrain the profit maximization choices of firms. The production choices available to an economy with the less restrictive Assumption 2 rules of origin imposed are equivalent to the original production set with pre-FTA opportunities preserved. More restrictive rules, such as those that require more than a specified fraction of value to be added by the exporting country, fail to preserve initial opportunities and may reduce the effective production set.

Let superscripts 0 and 1 describe the pre- and post-FTA situations, respectively. Assume that each household j of country i has preferences that can be represented by a utility function u_j^i. Consistent with the proof of existence of equilibrium, the income of consumers can be any continuous function of prices. Here we assume that a particular *fair sharing distribution rule* is used, meaning that it provides consumers with enough income to purchase their pre-agreement consumption bundle at post agreement prices, plus a non-negative supplement:

$$e_j^i[p^{i,1}, u_j^{i,1}] \equiv p^1 \cdot x_j^{i,0} + \theta_j^i \left((p^1 \cdot \left(y^{i,1} + z^{i,1}\right) - p^1 \cdot \left(y^{i,0} + z^{i,0}\right)\right)$$

where $e_j^i[p^{i,1}, u_j^{i,1}]$ is the consumer's expenditure function, $\theta_j^i \geqslant 0$, and $\sum_j \theta_j^i = 1$.[5] A *fair sharing distribution rule* was used in Grinols (1981), for example, and Grandmont and McFadden (1972) to prove the existence of competitive equilibrium of Kemp-Wan customs unions and of Pareto-improving free trade allocations, respectively.

Proposition 2 *The fair sharing distribution rule is viable in equilibrium under Assumptions 1 and 2 with transfers across member countries.*

Proof. Write the change in welfare for consumer j of member country $i = \{H, F\}$ under the distribution rule as $\Delta W_j^i \equiv e_j^i[p^1, u_j^{i,1}] - e_j^i[p^1, u_j^{i,0}]$, where $u_j^{i,0}$ and $u_j^{i,1}$ represent pre- and post-FTA utility levels. Then

$$\begin{aligned}
\sum_i \sum_j \Delta W_j^i \;=\; & \sum_i \left(\sum_j \left(p^1 \cdot x_j^{i,0} - e_j^i(p^1, u_j^{i,0}) \right) \right) && \text{Term 1} \\
& + \sum_i \left(\sum_j \theta_j^i \quad p^1 \cdot \left(y^{i,1} - y^{i,0}\right) \right) && \text{Term 2} \\
& + \sum_i \left(\sum_j \theta_j^i \quad p^1 \cdot \left(z^{i,1} - z^{i,0}\right) \right) && \text{Term 3} \qquad (2)
\end{aligned}$$

[4] Krueger (1997).

[5] The sum over j of the right hand side of (2) adds to country i income, $p^1 \cdot (y^{i,1} + \omega + z^{i,1})$.

where we used the identity $x^{i,t} = y^{i,t} + \omega^{i,t} + z^{i,t}$ for situations $t = \{0, 1\}$. Term 1 describes substitution in consumption effects; Term 2 represents the production efficiency effects due to prices and technology; and Term 3 summarizes tariff revenue and terms of trade effects.[6]

Term 1 ≥ 0 because consumers minimize the cost of achieving a given level of utility subject to their budget constraints. Term 2 ≥ 0 by the Assumption of perfect competition which implies producer efficiency under constant production choices (firms maximize the value of aggregate output). Term 3 $= 0$ because the trade of a good produced and consumed in the same country is zero; the export of one member country corresponds to the import of the other for goods traded between FTA members; and trade between country W and an FTA member is frozen. ■

The rule in equation (2) describes necessary and sufficient transfers to spread the gains from the formation of FTAs satisfying Assumptions 1 and 2 in the following sense. Terms 1 and 2 can be as little as equal to zero if economic agents maintain their pre-FTA choices under the new vector of prices that prevails in the FTA. In this case, the *fair sharing distribution rule* is necessary to guarantee that every household is not worse-off after the FTA is formed. If each member country is responsible for the application of the *fair sharing distribution rule* on its households, then cross country transfers are required to implement this income distribution arrangement. The reason is that external-trade-freezing tariffs keep constant the terms of trade between each member country and the rest of the world but do not keep constant the terms of trade between member countries. Grinols and Silva (2007) discuss at length the necessary and sufficient cross-country transfers to spread the welfare gains from FTA formation.

The key term for rules of origin is Term 2. If Assumptions 1-2 are satisfied then quantities of goods which were imported indirectly through the partner country in the pre-FTA situation can continue to be imported indirectly as long as the tariffs levied on goods originating in the rest of the world continue to be paid. Goods that contain strictly positive value added of the sending member country in the pre-FTA situation are traded among member countries without restrictions. Thus, producers located within the FTA have the production choice $y^{i,0}$ available in the pre- and post-FTA situations.

More restrictive rules of origin than Assumption 2 can reduce social welfare in conjunction with the formation of FTAs based on Assumption 1 because they diminish the range of production choices of firms located within the union with respect to their pre-FTA levels, $Y^{i,0} \supset Y^{i,1}$. In this case, Term 2 can be negative ($y^{i,0}$ may no longer be available) and assurance of a Pareto superior FTA allocation fails. An example may clarify why this is true. Suppose that a firm in country

[6] See Grinols and Wong (1991).

H imports fabric from country W and uses it to produce textile products that are exported to country F in the pre-FTA equilibrium. Suppose that rules of origin differ from Assumption 2 and require the use of fabric produced by FTA members in order to be granted duty free access to member countries' markets after an FTA formed by H and F that satisfies Assumption 1 is created.[7] This constrains the production decision of country H's firm relative to the pre-FTA equilibrium.[8] We therefore have:

Proposition 3 *Assumption 2 is the most restrictive rule of origin that remains consistent with a fair sharing distribution of income and choice of tariffs such that FTA member country trade with the rest of the world is unchanged between the initial pre-union situation* 0 *and the post-union-formation situation* 1.

The intuition can be given in terms of the theory of the second best. If each FTA member freezes its trade flows with the rest of the world at pre-FTA levels, setting tariffs to zero on trade among members eliminates a distortion that is present in the economy described by the FTA. However, rules of origin consistent with independent tariff setting introduce distortions into the economy if they do not satisfy Assumption 2. Of course, the welfare gains in Proposition 2 can be even greater if the necessity for rules of origin is eliminated. This explains the static efficiency superiority of customs unions relative to free trade areas.[9] In customs union formation, the trade with the rest of the world of the entire union needs to be frozen at situation 0 levels so that the preferential trade agreement collapses to a customs union. The rules of origin defined in Assumption 2 are the only ones that eliminate the possibility of welfare losses due to the formation of FTAs where each member freezes its trade flows with the rest of the world at pre-formation levels.

5 Comments on the Literature

The concern of this paper is guaranteeing and spreading gains from improved trade. The study of preferential trading agreements covers a body of results involving external tariffs, cross-

[7] Note that the example is close to NAFTA's rules of origin on textile products which require a "triple transformation" to grant duty free access to member countries' markets.

[8] In practice, custom agents may find it difficult to distinguish a claimed new final product from its inputs, inviting evasion of rules of origin by claiming a product new. Assumption 2 rules of origin require that new goods have their entire value added in the FTA. This analytically-based rule, therefore, has the practical benefit that it discourages exporters from trying to fool custom agents.

[9] See Grinols and Silva (2007) for a proof of general superiority of customs unions over free trade areas.

country transfers, and, in the case of free trade areas, rules of origin. Countries may experience welfare decline if there is failure to appropriately control one or more factors (tariffs, transfers, rules of origin).

To place the discussion of rules of origin in context, recall that the modern theory of Pareto superior preferential trading arrangements dates to the work of Kemp and Wan (1976) who showed that any group of countries is capable of forming a welfare-enhancing customs union if the common external tariff is chosen to freeze trade with the rest of the world and appropriate intra-union transfers are used. Their result depended on showing that a Pareto-improving equilibrium existed and has been extended in a number of important directions. The Kemp and Wan strategy for the creation of customs unions did not provide a description of how to find the compensations that support the welfare enhancement of the union households. Grinols (1981) identified the self-financing necessary and sufficient transfers in the sense that they summed to union tariff revenues and under certain circumstances were the only ones feasible to achieve a Pareto superior allocation in a Kemp-Wan customs union. Hammond and Sempere (1995) proved the existence of equilibrium in Kemp and Wan customs unions using commodity taxation to spread the gains from freer trade. Kowalczyk and Sjostrom (2000), and Konishi, Kowalczyk and Sjostrom (2003) showed that Kemp-Wan customs unions with the specified compensations bring global free trade into the core and have other desirable properties.

Similar concerns apply to supporting welfare-enhancing free trade areas. With respect to rules of origin—not an issue in free trade or customs union theory—the analysis shows that Assumption 2 rules are sufficient for welfare gains, and are also necessary in the sense that they are the most restrictive that can be applied and still guarantee welfare-enhancement in any circumstance. This extends a number of earlier results. For example, Panagariya and Krishna (2002) show that an FTA equilibrium using Assumption 2 rules of origin will generate enough FTA income that every household could be given enough that no one would be worse off. This extends Kemp and Wan in the direction of free trade areas, but, as previously noted (Feenstra, 2004, p. 195), did not prove that the described equilibrium exists.[10] The fair sharing distribution rule, referenced in Section 4, describes the necessary and sufficient compensations for welfare enhancement of union countries, consistent with the existence of the equilibrium proved.

The conclusions regarding the results in this paper and those that precede it depend on one's

[10] Ohyama (2002) also describes the implementation of an FTA where members would jointly enjoy greater welfare levels, but does not address rules of origin. The lack of rules of origin in the equilibrium described could prevent the existence of the assumed vector of prices and prevent the formation of a welfare-enhancing FTA in the first place. Neither Ohyama nor Panagariya and Krishna described how to find the compensations that are needed to support the gains of union households.

perspective regarding the move to freer world trade. To gauge whether or not global free trade can be achieved through the formation of FTAs, one needs to understand whether FTAs serve as "building blocks" or "stumbling blocks" of global free trade. Kemp and Wan can be interpreted as proving the existence of a path of Pareto-improving customs unions which could be used in principle to implement global free trade. Likewise, our results imply that there exists a sequence of enlarging FTAs which are Pareto-improving, and that could be used to implement global free trade, provided that one is willing to implement restrictions on the aggregate trade flows between all FTA members and their partners not involved in the new FTA. See the conclusion of this paper for details.

A considerable number of papers have investigated the building-block stumbling-block question, some of which we touch on here. For example, Yi (2000) applies a n-country coalition formation game where welfare-concerned governments decide whether or not to form FTAs. He shows under two different FTA formation rules ("open regionalism" and "unanimous regionalism") that the possibility of implementing global free trade by forming FTAs may not materialize due to free-riding problems if the number of countries is sufficiently large. Then, we can conclude that Yi (2000) indicates that FTAs serve as "stumbling blocks" to free trade. On the contrary, Furusawa and Hideo (2007) and Goyal and Joshi (2006) use a n -country strategic network[11] model to examine the incentives of countries to form FTAs. Both papers conclude that global free trade emerges as a stable outcome in the case of symmetric models where governments maximize welfare.[12] In this case, FTAs serve as building blocks to global free trade.[13]

6 Conclusion

This paper develops a methodology to study welfare-enhancement in the presence of free trade areas. The methodology is general and is able to identify the corresponding bound for restrictiveness of the rules of origin compatible with welfare gains. We also apply the methodology

[11] Strategic network equilibria allow for FTAs where member countries can be part of more than one preferential agreement. In this sense, it is more realistic than coalition formation games that do not allow these cases in equilibrium.

[12] In Furusawa and Hideo (2007), the symmetric model means that countries have the same level of industrialization (i.e., same measure of consumers and same measure of firms). Goyal and Joshi define symmetric economies based on market size and costs of production.

[13] Several papers on the political economy of trade have also investigated this question. Krishna (1998) and Ornelas (2005) conclude that FTAs are stumbling blocks to free trade for different reasons. The former finds that member countries would lose interest in multilateral openness after forming an FTA, and the latter finds that member countries' external tariff reductions would decrease the interest of non-members in global free trade.

to prove the existence of welfare-enhancing free trade areas. Starting from an arbitrary initial world trade equilibrium involving countries $H, F,$ and W there exists an alternative Pareto improving free trade area equilibrium characterized by free trade between countries H and F, rules of origin specified in Assumption 2, and external tariffs of H and F selected to freeze pre-existing trade flows of each country with W.

Our equilibrium existence proof applies the Gale and Mas-Colell Theorem to the formation of FTAs. Their theorem is very flexible since it proves equilibrium for an economy where agents' income can be described by any continuous function of prices $\alpha[p]$ and the economy can produce a bounded amount of output from zero input. The income function $\alpha[p]$ can represent any arbitrary transfer of income among households. In particular, it can represent the income transfers represented in this paper by the *fair sharing distribution rule*. Consumers in countries H and F have the ability to purchase their original consumption bundle or a strictly superior bundle. Conditions in W are unchanged. The rules of origin in Assumption 2 are needed to generate the stated results. More restrictive rules of the type often applied in practice are equivalent to imposing a reduced production set, for which the existence of Pareto improving equilibria cannot be guaranteed in general.

Free trade is often opposed by individuals, regions, sectors and/or industries that lose in the move to freer trade. The need to internationally coordinate common tariffs constitutes an additional impediment. The existence of a free trade area equilibrium for countries H and F that is Pareto superior to an arbitrary initial trade equilibrium and does not require coordination of countries' tariffs addresses these points. This may partly explain the popularity of free trade areas compared to other forms of preferential trading arrangements. The analysis also explains why more restrictive rules of origin that are encountered in practice are often insufficient for gains, and provides arguments against more restrictive forms.

Free trade areas represents a viable and general strategy with which to extract gains from freer trade, with limitations. Choosing external tariffs to freeze trade with the rest of the world may be difficult given the amount of information needed, for example. The analysis also explains why "hub-and-spoke" expansions of free trade areas cannot in general guarantee welfare gains to all parties. Thus, assume a world of countries H, F, and W. Let H form an FTA with F. Consider next that H decides to form an FTA with W, but countries F and W apply tariffs on products traded between them. In this case, country H becomes what is known in the literature as a "hub" and countries F and W become the "spokes". Forming such an FTA is not necessarily welfare-enhancing since H can not apply tariffs on W to hold $H-W$ trade flows fixed. Except by

chance, Assumption 1will be violated.[14] Thus, our framework shows that the sequential enlarging of free trade areas through implementation of hub-and-spoke free trade agreements fails to satisfy the requirements for stepwise Pareto improvement.

Whether free trade areas ultimately constitute an aid to continuing freer trade, or, after initial gains add to regional complacency of countries that view their trade to be free enough, may hinge on other issues yet to be explored.

Appendix

Economics has expanded considerably in its ability to prove the existence of general equilibrium under much more general conditions.[15] Following Gale and Mas-Colell (1975), write the following conditions for an economy:

E.1– The net production set Y is closed, convex, contains the negative orthant, and has a bounded intersection with the positive orthant.

E.2– The consumption set for individual j, X_j, is closed, convex, non-empty and bounded below.

E.3– The preference mappings P_j are irreflexive (that is, $x_j \notin P_j(x_j)$), have an open graph in X_j x X_j, and their values are non-empty, convex sets.

E.4– The functions $\alpha_j(p)$ are continuous and satisfy $\alpha_j(p) > p \cdot x_j^0 > \inf\ p \cdot X_j$ for all p where x_j^0 is consumer j's initial consumption bundle and $\alpha_j(p)$ is the individual's income.

Then the following proposition is immediate from Gale and Mas-Colell.

Proposition: There exists a competitive equilibrium for the economy. ■

[14] Deltas, Desmet, and Facchini (2007) present a thorough investigation of the effects of Hub-and-Spoke FTAs on trade flows and welfare.

[15] Gale and Mas-Colell (1975), Shafer and Sonnenschein (1975), McKenzie (1981) and others, for example, prove that competitive equilibria exist in economies with non-transitive, interdependent and price-dependent preferences. Competitive equilibria also exist in the presence of production technologies where a finite amount of output can be generated by zero input, and even in more abstract circumstances where the income of every consumer is represented by any continuous function of prices. Hartwick, Variya, and Schweizer (1976) expand existence results to the assumption that goods can be fixed (consumed in only one location) or mobile (transported to all locations). Transportation technology is explicitly described by a linear function. The concern in their paper is that certain fixed goods (e.g. housing) can not be consumed in more than one place and consumers need to choose where to consume them (e.g. where to live). Then, they decided to divide goods into the two categories as already described. In our paper, consumers that live in one country do not have the choice of where to live, which is intuitive, and descreases the complexity of the model.

We apply this theorem to Proposition 1 as follows: Assume that $i = H, F$ are two economies engaged in world trade where (i) the production set of each economy is closed, convex, contains the negative orthant, and is such that positive output requires at least one positive input (impossibility of free production), (ii) the consumption set of each individual is closed, convex, non-empty and bounded below, (iii) the preference mappings of each individual satisfy E.3, and (iv) the income of each individual satisfies E.4. Assume that the two economies form a free trade area satisfying Assumptions 1 and 2.

To prove that equilibrium exists for the free trade area, follow the Kemp-Wan strategy of creating an artificial autarkic economy by adding the pre-union external trade vector of each member to the member country's endowment. In addition, because we are considering a free trade area, impose the operation of rules of origin (Kemp and Wan did not need this step). Then show that assumptions E.1-E.4 hold for the artificial economy consisting of the H, F pair, hence it has an equilibrium. The final step is to observe that the equilibrium for the artificial economy is an equilibrium for the original H, F free trade area.

By (i) and standard results, the autarkic economy satisfies E.1.[16] Firms in H are free to select $y \varepsilon Y^H$to maximize profits subject to prices p in (1). No inconsistency arises between the independence of prices in (1) except possibly for goods of type y^H_{WFk} because firms could trans-ship to F such goods imported from W. This potential conflict is prevented, however, because the production/trans-shipment of imported goods between H and F is proscribed. Such a good would bear the same description k as one of its inputs and be prohibited from duty free re-export to F. A similar observation applies to y^F production.

The key is how rules of origin affect trans-shipment and re-labeling. From country H's perspective, consider the process of re-labeling a good imported from the rest of the world, WHk, as domestic production, HHk (one unit of WHk becomes one unit of HHk with no physical alteration). Re-labeling is characterized by input of $-y^H_{WHk}$ units of input (e.g. 5 Persian rugs imported from the rest of the world) and output of y^H_{HHk} of numerically equal size (5 units of identical Persian rugs labeled as if they were a product of country H). By definition, the re-labeled good is a perfect substitute with its original form. Thus, the presence or absence of re-labeling affects nothing real and is inconsequential from the point of view of prices, consumption, or market clearing.

Rules of origin prevent re-labeling and trans-shipment from becoming consequential in the post-FTA equilibrium. Since what they limit was originally non-binding or inessential, however, they do not have production consequences with respect to the FTA. In particular, when the

[16] Arrow and Hahn (1975), pp. 62-65, Debreu (1959), p. 41.

FTA is formed, import of a re-labeled good by F is counted as if it were an import of good WFk, returning it to its true designation, both from the perspective of freezing world trade and applying tariffs to imports.

Let $\widehat{y^H_{HH}}$ and $\widehat{y^F_{FF}}$ denote the production "output" (quantity) of goods that were relabeled in the pre-FTA equilibrium by countries H and F, respectively. Enlarge the universe of goods designations to $\mathcal{R}^{11K}$ by creating a place for relabeled goods at the end of the goods vector. Define the closed convex set $A^i_k = \{y \,\epsilon\, Y^i \,|\, \widehat{y^H_{HHk}} = 0\} \cap \{y \,\epsilon\, Y^i \,|\, \widehat{y^F_{FFk}} = 0\}$. Being in set A^i_k implies no re-labeling. The following applies: The production set $\widehat{Y^i}$ formed as the intersection $\bigcap_k A^i_k$ satisfies E.1 and supports the same FTA equilibrium. $\widehat{Y^i}$, as an expository device, makes more explicit the role of Assumption 2 rules of origin by preventing an initial inessential activity from "coming on line" to become essential in the post FTA equilibrium.

The autarkic economy satisfies E.2 and E.3 by (ii) and (iii). Last, provide consumer j of country i with income $\alpha^i_j[p]$ given by the *fair sharing distribution rule* used in Section 4. This rule satisfies E.4, as would more general forms. Thus, the fictitious autarkic economy formed by H and F with no trans-shipment and where the fictitious endowment of each country consists of its usual endowments plus its pre-union external trade vector has an equilibrium $\mathcal{E}$. $\mathcal{E}$ is consistent with Assumption 2 where firms maximize profits but are not allowed by rules of origin to choose activities that involve duty-free trans-shipment of imported goods and where the pre-FTA external trade of each country has been frozen by choice of external tariff. Thus, there exists an equilibrium for the free trade area satisfying Assumptions 1, 2 as was to be shown, where every household, whether a member of the union or not, is not worse off than before the creation of the trade area. This proves Proposition 1.

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