EL COLEGIO DE MÉXICO

Centro de Estudios Económicos

Documentos de trabajo Número II – 2020

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Jaume Sempere
El Colegio de México

enero de 2020

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On Potential Pareto Gains from Free Trade Areas Formation.

Jaume Sempere[1]

C.E.E., El Colegio de México, Camino al Ajusco 20,

Pedregal de Santa Teresa, 10740 México D.F., México

jsempe@colmex.mx

This version: January 2019.

Abstract

This paper extends the results of Grinols and Silva (2011) to Free Trade Areas with rules of origin requiring a minimum national content. These rules include, for instance, the ones stipulated in the NAFTA (or the USMCA) agreement. In our model, producers decide whether or not to comply with rules of origin to avoid paying tariffs to export to other FTA members. However, there is a technical problem caused by the fact that, as prices change, producers can switch from production plans that satisfy rules of origin to production plans that do not. This can produce a discontinuity in the supply correspondence. We prove existence of equilibrium with Pareto gains from forming FTAs by assuming that there are a continuum of producers with an atomless distribution of characteristics.

JEL Classification: D50, D60, F13, F15.

Keywords: Gains form Trade, Free Trade Areas, Rules of origin, General Equilibrium.

[1]I am grateful to Stephen Mcknight for useful comments. A version of the paper was presented in the LAMES 2019 held in Puebla. Comments of participants are gratefully aknowledged. Financial support from CONACyT through grant No. 60734 is gratefully aknowledged.

1 Introduction

A stylized fact is that the formation of Free Trade Areas (FTA) is more common than that of Customs Unions[2]. Given the relative abundance of FTA agreements, it is surprising that there are so many theoretical results on the gains from forming Customs Unions[3] and so few results on the same issue regarding FTAs[4]. The purpose of this paper is to attempt to fill this gap in the literature.

In the formation of a FTA, signing countries liberalize trade among them but can maintain different tariffs with the rest of the world. Then there is the incentive to sell foreign goods into the free trade area through the country that keeps the lowest tariff against the rest of the world products. The way to avoid trans-shipping is through rules of origin.

Many rules of origin are used in practice. For many industries, FTAs, such as NAFTA or the recently renegotiated USMCA, impose rules implying a maximum of value added (or cost) in non originating nations in proportion of total value added (or total net cost)[5]. This type of rules are discussed, for instance, in Krishna and Krueger (2000)[6].

[2]Facchini, Silva and Willmann (2017) finds using the World Trade Organization data base (effective in May 2017) that there are eight FTAs in force for each Customs Union agreement.

[3]See Kemp and Wan (1976), Grinols (1981), and Hammond and Sempere (1995), for instance

[4]A remarkable exception is Grinols and Silva (2011).

[5]For instance chapter IV of NAFTA imposes those rules that apply for the automobile sector, among others

[6]From a legal point of view (see Krishna and Krueger, 2000), there are four types of Rules of Origin: requirements in terms of domestic content, requirements in terms of a change in tariff headings, requirements in terms of processes that have to be carried out in the free trade area, or a requirement of a substantial transformation of the commodity.

Grinols and Silva (2011) show the existence of Pareto gains from forming a FTA starting from an arbitrary status quo allocation (that would prevail in the absence of the formation of the FTA). Grinols and Silva's argument requires a particular set of rules of origin that ensure that the status quo production plan can be traded free of tariffs between different members of the FTA. Therefore, in their paper, rules like the ones imposed by NAFTA would rule out the possibility of Pareto gains from trade, as the status quo production plan does not necessarily satisfy the rules of origin.

As Panagariya and Krishna (2002) argue, the commodities not satisfying the rules of origin can be traded "presumably" at the same conditions as before the FTA agreement. The aim of this paper is to extend Grinols and Silva's contribution by assuming that tariffs applied to commodities not satisfying rules of origin are not higher than before signing the FTA agreement. Consequently, given that commodities produced in a member country not satisfying rules of origin can be traded "non duty free" to other FTA members, the profit function of exporting firms considers two possibilities. The first is complaining with the rules of origin and export duty free to the other FTA countries. The other is not complaining and exports must pay the corresponding tariffs. In any case, the status quo production plan is available for FTA members at not higher tariffs than at the status quo, and a revealed preference argument can be applied to show gains from trade.

There is however a technical problem with the above framework. A discontinuity in the production correspondence can arise due to the fact that there will be a set of prices for which producers stick to a production plan with binding rules of origin to avoid paying tariffs but, as prices change,

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Following their reasoning, in an analytical point of view, the rules can be modeled as content requirement or in terms of transformation steps needed to qualify as origin.

the producer may prefer not to comply with the rules of origin and pay tariffs, which can imply a jump in the supply correspondence. We solve this technical problem by assuming that there are a continuum of producers with an atomless distribution of characteristics. In this sense, we complement the analysis of Grinols and Silva by considering more general rules of origin but at the cost of introducing an additional assumption.

We will describe a general equilibrium model in the spirit of Grandmont and Mcfadden (1972), Grinols (1981), Hammond and Sempere (1995), Kemp and Wan (1972), Kemp y Wan (1976), among others, and prove existence of equilibrium with Pareto gains from the formation of FTAs.

The paper is organized as follows. Section 2 defines rules of origin. Section 3 present the model. Section 4 discusses gains from FTA formation. Section 5 concludes the paper.

2 The model

2.1 Commodities

As in Grinols and Silva (2011), it is assumed that there are 2 nations forming a FTA and a third country that represents the rest of the world. Assume that each of the nations produce N types of commodities. As in Debreu (1959), goods are differentiated by location so there are $9N = G$ goods (as there are 3 countries of possible origin and 3 of possible destination).

As goods are different depending on origin and destination, and different prices can be sustainable with different external tariffs with rules of origin, there will be $9N$ different prices. Depending on origin and on complying rules of origin some commodities will be subject to tariffs and others not.

As in Grinols and Silva (2011)[7],

$$p = \left\{ \begin{array}{l} p_{HH} \\ p_{FH} \\ p_{WH} \\ p_{HF} \\ p_{FF} \\ p_{WF} \\ p_{HW} \\ p_{FW} \\ p_{WW} \end{array} \right\}$$

Where p_{hg} is the price of a commodity with origin in h and destination g. Tariffs apply to commodities imported from the rest of the world and to commodities exported between FTA member countries that do not satisfy rules of origin. We will denote by w the world prices and by $(p - w)$ the vector of external tariffs.

Assumption: We assume from now on that if a firm belonging to a member country does not comply with rules of origin, it is charged a tariff that is not larger than the one applied before the formation of the FTA.

2.2 Consumers

We only model the consumption and production sector of H and F. In each nation $k \in K = (H, F)$ there are I_k consumers. The set of all consumers in the FTA is $I = \cup_{k \in K} I_k$. Each consumer i's net trade vector $x^i \in \Re^G$

[7]Grinols and Silva (2011) model tariffs implicitly in the price vector. We will model tariffs explicitly, therefore the vector of prices can be considered net of tariffs

is restricted to a feasible set X^i [8]. The consumer net trade vectors will be measured in terms of average per firm located in the FTA.

We make the following assumptions regarding consumers:

(A.1) Each consumer $i \in I$ has a closed and convex feasible set X^i. The set X^i has a *lower bound* $\underline{x}^i$ such that $x^i \in X^i$ implies $x^i > \underline{x}^i$, and satisfies the *free disposal of commodities* condition requiring that, whenever $x^i \in X^i$ and $\tilde{x}^i > x^i$, then $\tilde{x}^i \in X^i$.

(A.2) Each consumer i has a weak preference relation $\succsim^i$ defined on X^i that is reflexive, complete, transitive, continuous, convex, and *weakly monotonic in commodities* in the sense that, whenever $x^i \in X^i$ and $\tilde{x}^i > x^i$ then $\tilde{x}^i \succ^i x^i$.

2.3 Production

Suppose there is a continuum J of producers in the FTA indexed by j, with $\mathcal{J}$ as a σ-field of measurable subsets. Also, let ν be the appropriate measure, so that $(J, \mathcal{J}, \nu)$ is the atomless measure space of producers. Suppose that the set of producers of country $k \in K$ are denoted by J_k. The different sets J_k are assumed to be pairwise disjoint.

For simplicity of notation and without loss of generality, we consider that there are firms specialized in producing goods for export purposes, and firms specialized in production for the internal market. In fact, this is equivalent as decomposing each firm in two. One that is specialized in producing for exports and the other that is specialized in production for the local market.

[8] For simplicity of notation I do not distinguish between internationally traded and non-tradeable goods.

The rest of the paper will distinguish individual producers only by the fact that the supply of those specialized in exporting is conditioned to comply with rules of origin or to export with tariff charges. We assume

(A.3) Each producer $j \in J_k$ has a closed and convex production set $Y^j \subset \Re^G$ whose members are net output vectors, $0 \in Y^j$, and there is *free disposal of commodities* in the sense that, if $y^j \in Y^j$ and $\tilde{y}^j < y^j$ with $\tilde{y}^j \in \Re^G$, then $\tilde{y}^j \in Y^j$.

The collection $Y_k = \int_{J_k} Y^j d\nu$ $(k \in K)$ of average national production sets, whose product is $\mathbf{Y}^K := \prod_{k \in K} Y_k$, is also assumed to satisfy the requirement that:

(A.4) For each aggregate lower bound $\underline{y} \in \Re^G$, the constrained set of international production allocations defined by

$$\mathbf{Y}^K(\underline{y}) := \{ \mathbf{y}^K \in \mathbf{Y}^K \mid \int_J y^j d\nu > \underline{y} \}$$

is bounded.

This means that bounded aggregate global inputs only allow bounded outputs in each separate country, as well as in the international economy as a whole.

As Hildenbrand (1974) does for consumers, we assume:

(A.5) The *producer characteristic space* Θ of feasible production sets Y, is endowed with the topology of closed convergence and the associated Borel σ-field $\mathcal{B}$. Moreover, the mapping $j \mapsto \Gamma^j$ from J to $\Re^G \times \Re^G$ is measurable w.r.t. the respective σ-fields $\mathcal{J}$ and $\mathcal{B}$.

2.4 Feasible Allocations and the Status Quo

An *allocation* is a collection $(\mathbf{x}^I, \mathbf{y}^J, m)$ consisting of consumption plans for each of consumers, net imports m from the rest of the world, and a measurable function $j \mapsto y^j \in \Re^G$ specifying each firm production plan. The allocation is *feasible* if $(\mathbf{x}^I, \mathbf{y}^J)$ together satisfy:

- $x^i \in X^i$ for $i \in I$
- $y^j \in Y^j$ for all $j \in J_k$ and $k \in K$;
- $\sum_I x^i = \int_J y^j d\nu + m$.

Note that (iii) requires that the aggregate net demand vector of consumers per head of FTA population of producers should equal the average net output of producers plus the net imports from the rest of the world.

The gains from forming the FTA will arise from an allocation that is Pareto superior to a pre-specified status quo feasible allocation. The status quo consists of a feasible allocation $(\bar{\mathbf{x}}^I, \bar{\mathbf{y}}^J, \bar{m})$.

Interiority Assumption: We assume that $\bar{x}^i \in IntX^i$ for every $i \in I$.[9] The interiority assumption will imply the existence of a cheaper point that allows the application of the cheaper point lemma that implies that a compensated demand is a Walrasian demand[10].

[9]This will allow us to avoid the Arrow's exceptional case first noticed in Arrow (1951). This assumption could be avoided following the concepts discussed in Hammond (1993) (also applied by Corchon, Hammond and Sempere, 2014, to an economy with public goods), but at the cost of complicating unecessarily the model.

[10]see, for instance, Hammond and Sempere (2009) p. .

3 Competitive equilibrium in a FTA

3.1 Profit maximization and Supply

Rules of origin in this paper will be defined by a correspondence $ROO^j(p, \alpha^j)$. This can include the type of rules discussed by Panagariya y Krishna (2001) and Grinols and Silva (2011), and also others. In the particular case of rules requiring content for a firm j belonging to country H, exporting to F, and importing components from W (the analysis of firms in country F exporting to H is symmetric).

$$ROO^j(p, \alpha^j) = \{y^j \in Y^j \parallel \frac{p_{WH} y^j_{WH}}{p_{WH} y^j_{WH} + p_{HF} y^j_{HF} + p_{HH} y^j_{HH}} \leq \alpha^j\}$$

This restriction implies that, for an exporting firm j, the value of the product originated in the rest of the world is less than α^j% of the total value produced by the firm. We use the super-index of the firm for α because the rules of origin depend on the particular composition of the export vector.

LEMMA: *The $ROO^j(p, \alpha^j)$ is a continuous correspondence.*

The proof is formally equivalent to showing continuity of the budget constraint correspondence (see Debreu, 1959, chapter 4), so it will be omitted.

If an exporting firm complies with rules of origin, country F does not charge tariffs to its exports. Therefore the profit to be maximized is $p_{WH} y^j_{WH} + p_{HF} y^j_{HF} + p_{HH} y^j_{HH}$. If, instead, it does not comply, the profit to be maximized is $p_{WH} y^j_{WH} + (p_{HF} - t_{HF}) y^j_{HF} + p_{HH} y^j_{HH}$.

In fact, the supply correspondence could be written as:

$$\eta^j(p, \alpha^j) = \arg \max_{y^j \in Y^j} \begin{cases} \max_{y^j \in Y^j} \{p_{WH} y^j_{WH} + p_{HF} y^j_{HF} + p_{HH} y^j_{HH} \parallel y^j \in ROO^j(p, \alpha^j)\} \\ \max_{y^j \in Y^j} p_{WH} y^j_{WH} + (p_{HF} - t_{HF}) y^j_{HF} + p_{HH} y^j_{HH} \end{cases}$$

The corresponding profit function will be

$$\pi^j(p,\alpha^j) = \max_{y^j \in Y^j} \begin{cases} \max_{y^j \in Y^j}\{p_{WH}y^j_{WH} + p_{HF}y^j_{HF} + p_{HH}y^j_{HH} \parallel y^j \in ROO^j(p,\alpha^j)\} \\ \max_{y^j \in Y^j} p_{WH}y^j_{WH} + (p_{HF} - t_{HF})y^j_{HF} + p_{HH}y^j_{HH} \end{cases}$$

It is clear that the profits of the firm are larger if it does not pay tariffs so, as far as the $RRO^j(p,\alpha^j)$ does not bind, the firm would prefer not to pay tariffs. However, if the $RRO^j(p,\alpha^j)$ binds the firm may prefer to pay tariffs. Then the profit will change its functional form. This can produce a jump in the supply function, as, for some prices, the firm may prefer to stick to the binding production plan but eventually, as prices change, it can switch to the profit maximizing production plan in presence of tariffs. Therefore, the supply correspondence of an exporting firm j is non necessarily upper hemi-continuous.

We define $R(p,\alpha,t_H,t_F)$ as the average FTA internal tariff revenue obtained from firms not satisfying rules of origin in the two countries. To avoid unecessary complications in the model we assume that this is given back to the firms as a lump sum transfer[11].

We denote by $\pi(p,\alpha) = \int_J \pi^j(p,\alpha^j)d\nu$ the mean profit function in the FTA. We denote by $\hat{\pi}(p,\alpha) = \pi(p,\alpha) + R(p,\alpha,t_H,t_F)$ the total average income coming from firms that can be distributed to consumers.

3.2 A graphical example

Assume that a firm j belonging to H produces a single commodity to be exported to F using as input a single commodity imported from W. We

[11]We could assume instead that the tariff revenue is given directly to consumers. This would not change the esence of the results as profits of the firms will be distributed to consumers

do not use the subindex of commodity to simplify notation. The Rules of origin defined above can be written as

$$ROO^j(p,\alpha^j) = \{y^j \in Y^j \parallel \frac{p_{WH}y^j_{WH}}{p_{WH}y^j_{WH} + p_{HF}y^j_{HF}} \leq \alpha^j\}$$

That can be written as $\{y^j \in Y^j \parallel (1-\alpha^j)p_{WH}y^j_{WH} = \alpha^j p_{HF}y^j_{HF}\}$. This is represented in the figure 1 as the line with positive slope $\frac{(1-\alpha^j)}{\alpha^j}\frac{p_{WH}}{p_{HF}}$ starting in the origin. We call it $ROO(p,\alpha^j)$. We assume for the example that $\alpha^j \leq 0.5$. This implies that the rule of origin requires that at least 50% of the value has to be generated in the exporting country.

The concave function represents the technology (a production function) and the area below this function is the production set.

The isoprofit lines for production plans satisfying the rules of origin have slope $\frac{p_{WH}}{p_{HF}}$ and a higher line means higher profit. Therefore the solution to the profit maximization problem is a tangent solution with the production set (we call this $Isoprofit(p)$ in figure 1, where we only represent the isoprofit line corresponding to the firm's optimizing solution). If rules of origin are very requiring (i.e. $\alpha^j \leq 0.5$), the slope of isoprofit lines is smaller than the slope of the rules of origin relation. This is the case represented in figure 1.

The isoprofit lines for production plans when the firm's production is subject to tariffs have slope $\frac{p_{WH}}{p_{HF}-t_{HF}}$. This implies that the slope is larger than the corresponding to the duty free isoprofit lines and it is larger for larger tariffs. We call $Isoprofit(p,t)$ the one giving a tangency solution with the production set.

Figure 1 shows the solution of the profit maximization problem when ROO constraint is not binding. The optimal point is highlighted with a bullet point.

Figure 2 shows the case in which the ROO constraint is binding. In

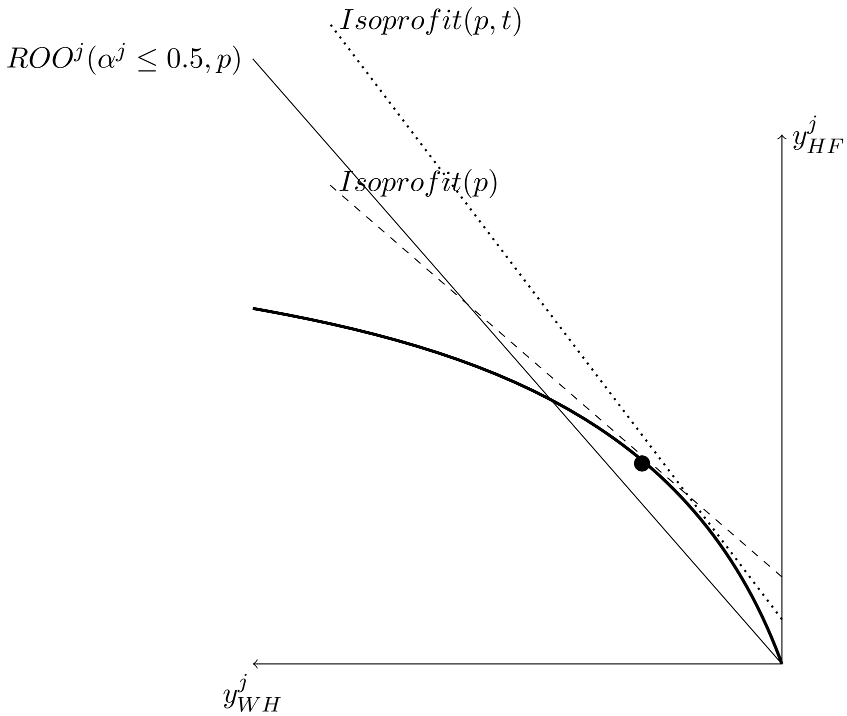

Figure 1: Firm's decision for a non binding ROO

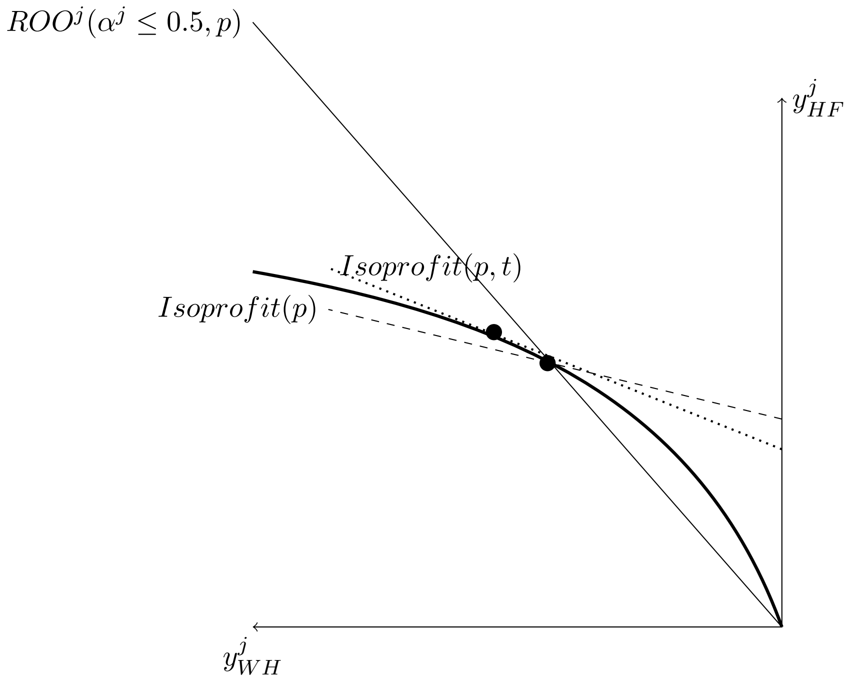

Figure 2: Firm's decision for a binding ROO

this case the firm would evaluate the profits of exporting without tariffs at the binding production plan, and the profits of exporting with tariffs the production plan obtained at the tangency point of $Isoprofit(p,t)$ with the production set. The two tangency points are highlighted with bullet points.

In this case there can be a discontinuity in the supply decision as there can be several prices at which the ROO is binding but the firm still prefers to stick to the binding production plan and avoid paying the tariffs. However, as the relative price changes, the firm would eventually change to the maximizing production plan with tariffs. This would imply a jump in the supply correspondence for some price vector. This discontinuity would depend on the size of tariffs to be paid and on the shape of the production set.

3.3 Demand

Given any price $p \in \Re^G$, any consumer $i \in I$ and any wealth level $w^i \in \Re$, the consumer's *budget constraint* is the inequality

$$p\, x^i \leq w \tag{1}$$

Consumer's i's *budget set* is then the set

$$B^i(p, w^i) := \{x^i \in X^i \mid p\, x^i \leq w^i\} \tag{2}$$

of individually feasible consumer vectors satisfying the Budget constraint.

A budget balanced wealth distribution rule $w^I(p) \in \Re^I$ satisfies $\sum_{i \in I} w^i(p) = \hat{\pi}(p, \alpha) + (p - w)m$. That is, the average revenue to be distributed in the union is equal to the average distributable profits plus the external tariff revenue.

Given any price system $p \in \Re^G$, any private agent $i \in I$, and any wealth level $w^i \in \Re$:

1. the *demand set* is defined as

$$\xi^i(p, w^i) := \{(\hat{x}^i) \in B^i(p, w^i) \mid (x^i) \succ \hat{x}^i \Longrightarrow p\, x^i > w^i\}$$

2. the *compensated demand set* is defined as

$$\xi^i_c(p, w^i) := \{\hat{x}^i \in B^i(p, w^i) \mid x^i \succsim \hat{x}^i \Longrightarrow p\, x^i \geq w^i\}$$

3.4 Competitive Equilibrium

A feasible allocation $(\hat{x}^I, \hat{y}^J, \hat{m})$, together with a a price vector p and a set of rules of origin α, is a competitive equilibrium if

- $\hat{x}^i \in \xi^i(p, w^i)$ for $i \in I$
- $y^j \in \eta^j(p, \alpha^j)$ for all $j \in J_k$ and $k \in K$;

A compensated equilibrium substitutes $\hat{x}^i(p, w^i)$ by $\hat{x}^i_c(p, w^i)$.

4 Gains from trade

The gains from forming the FTA will arise in comparation with a pre-specified feasible status quo allocation $(\bar{\mathbf{x}}^I, \bar{\mathbf{y}}^J, \bar{m})$. First assume, as Grinols and Silva (2011), that the countries establish tariffs with the rest of the world so that the aggregate net trade from the rest of the world remains at the status quo level $\bar{m}$. This will ensure that nobody from the rest of the world is damaged by the formation of the FTA. Second we have to prove the existence of competitive equilibrium in the FTA so that each consumer is better off than in the status quo.

Notice that, as $\bar{y}^j \in Y^j$, the status quo production plan for each of the firms in the FTA is still feasible, and therefore, at any price arising in the FTA, aggregate distributable profits are at least the same as in the status quo. This will imply that $\hat{\pi}(p, \alpha) \geq \int_J p\bar{y}^j d\nu$.

Grandmont–McFadden (1972) define sagacious wealth distributions as a useful concept to demonstrate the existence of gains from trade and we will follow a similar argument.

Define consumer i's *compensated expenditure* relative to the status quo as

$$\bar{e}^i(p) := \min_{x^i}\{p\,x^i \mid x^i \in X^i,\, x^i \succsim^i \bar{x}^i\}. \tag{3}$$

This is the minimum expenditure allowing a consumer to achieve the status quo consumption vector.

The budget feasible wealth distribution rule $w^I(p) \in \Re^I$ is said to be sagacious (Grandmont and McFadden, 1972[12]) if, for all $p > 0$, one has:

- $w^i(p) \geq \bar{e}^i(p)$ for all $i \in I$.
- whenever $\sum_{i\in I} \bar{e}^i(p) < \hat{\pi}(p,\alpha) + (p-w)\bar{m}$, then $w^i(p) > \bar{e}^i(p)$ for every $i \in I$.

By construction, a sagacious wealth distribution rule generates lump-sum transfers allowing each consumer to afford at least the status quo standard of living. Expenditure minimization implies that $\bar{e}^i(p) \leq p\bar{x}^i$ for every $i \in I$, and profit maximization implies that $\hat{\pi}^j(p,\alpha) \geq p\bar{y}^j$ for every $j \in J$. This, and the feasibility of the status quo allocation would imply that the first part is always feasible[13].

Note that in a sagacious wealth distribution

$$\hat{\pi}(p,\alpha) + (p-w)\bar{m} \geq \int_J p\bar{y}^j d\nu + (p-w)\bar{m} = \sum_{i\in I} p\,\bar{x}^i \geq \sum_{i\in I} \bar{e}^i(p). \qquad (4)$$

The next proposition shows that an equilibrium relative to a sagacious distribution rule implies a Pareto gain with respect to the status quo, unless the status quo is an equilibrium in the FTA.

PROPOSITION 1: *Unless the status quo is a Compensated equilibrium, any Equilibrium relative to a sagacious wealth distribution rule $w^I(p)$ is strictly Pareto superior to the status quo.*

PROOF:

Case 1. If $\hat{\pi}(p,\alpha) + (p-w)\bar{m} > \sum_{i\in I} \bar{e}^i(p)$ then $w^i(p) > \bar{e}^i(p)$ for all i, so $\hat{x}^i \succsim^i \bar{x}^i$ for $i \in I$, and it is strictly preferred if preferences are locally non

[12] see also Hammond and Sempere (2006), and Corchon, Hammond and Sempere (2014) for more discussion

[13] An obvious example, extension of Grandmont and McFadden (1972), would be $w^i(p) = \bar{e}^i(p) + \theta^i[\hat{\pi}(p,\alpha) + (p-w)\bar{m} - \sum_{i\in I} \bar{e}^i(p)]$ for $\theta^i > 0$ for all $i \in I$ and $\sum_{i\in I} \theta^i = 1$.

satiated.

Case 2. $\hat{\pi}(p,\alpha) + (p - w)\bar{m} = \sum_{i \in I} \bar{e}^i(p)$ then $w^i(p) = \bar{e}^i(p)$ for all i and it follows that $(\bar{x}^I, \bar{y}^J, \bar{m}, p, \alpha)$ is a compensated equilibrium. □

Finally, we present our main result.

PROPOSITION 2: *There exists a competitive equilibrium* $(\hat{x}^I, \hat{y}^J, \bar{m}, p, \alpha)$ *in an FTA which is Pareto superior to the status quo.*

PROOF: See the appendix.

5 Concluding remarks

We have shown the existence of a competitive equilibrium with potential Pareto gains from forming a FTA with rules of origin implying content. Each firm has the possibility of exporting to other FTA member countries either duty free, complaining with rules of origin, or paying tariffs without the need of complaining with rules of origin. Therefore, the status quo production plan vector is still in the post-FTA production possibility set. However, this causes a technical difficulty due to a possible discontinuity in individual supply correspondences. We solve this problem by assuming a continuum of firms distributed with an atomless measure.

As in Hammond and Sempere (1995), we talk about "potential" Pareto gains and not about "actual" Pareto gains. This is due to the fact that we are assuming an economy without market failures and with informed governments that can use freely lump sum transfers to distribute the gains from trade. In real economies this is not really possible. On the other hand, in the paper we are assuming that all types of tariff revenue obtained by FTA members are distributed through international transfers within the FTA. This assumption is also needed to demonstrate gains from forming

Customs Unions.

6 References

Arrow, K. (1951), “An extension of the basic theorems of classical welfare economics,” in Proceedings of the Second Berkeley Symposium on Mathematical Statistics and Probability (ed. J. Neyman), p. 507-32. Berkeley: University of California Press.

Berge, C. (1959), Espaces Topologiques et fonctions multivoques, Paris, Dunod.

Coles, J.L. and P.J. Hammond (1991), “Walrasian Equilibrium without Survival: Existence, Efficiency, and Remedial Policy,” in K. Basu, P.K. Pattanaik, and K. Suzumura (eds.) Choice, Welfare and Development: A Festschrift in Honour of Amartya K. Sen (Oxford: Oxford University Press), ch. 3, pp. 32–64.

Corchón, L., Hammond, P., and Sempere, J. (2014), “Compensated Lindahl Equilibrium: Efficiency Theorems and Gains from Trade with Individual Production and Public Goods,” Available at SSRN: https://ssrn.com/abstract=2497385 or http://dx.doi.org/10.2139/ssrn.2497385.

Facchini, G., Silva, P. and G. Willmann (2017), “The political economy of preferential trade agreements: An empirical investigation,” Kiel Working Papers 2096, Kiel Institute for the World Economy.

Grandmont, J.-M. and McFadden, D. (1972), “A technical note on classical gains from trade” Journal of International Economics 2, 109-125.

Grinols, E. (1981), “An extension of the Kemp-Wan theorem on the formation of customs unions” Journal of International Economics 2, 259-266.

Grinols, E. and P. Silva (2011), “Rules of Origin and Gains From Trade”, Economic Theory 47, 159-173.

Hammond, P. and J. Sempere (1995), “Limits to the Potential Gains from Economic Integration and other Supply-Side Policies” Economic Journal 105, 1180-1204.

Hammond, P. and J. Sempere (2006), “Gains from Trade versus Gains from Migration: what Makes Them so Different?,” Journal of Public Economic Theory 8, 145-170.

Hammond, P.J. and Sempere (2009), ‘Migration with local public goods and the gains from changing places,” Economic Theory 41, 359-377.

Hammond, P. J. (1993) “Irreducibility, Resource Relatedness, and Survival in Equilibrium with Individual Non-Convexities,” in R. Becker, M. Boldrin, R. Jones, and W. Thomson (eds.) *General Equilibrium, Growth, and Trade II: The Legacy of Lionel W. McKenzie* (San Diego: Academic Press), ch. 4, pp. 73–115.

Hildenbrand, W. (1974) Core and equilibria of a large economy. Princeton University Press, Princeton (1974)

Khan, M.A. and A. Yamazaki (1981), “On the Cores of Economies with Indivisible Commodities and a Continuum of Traders,” Journal of Economic Theory 24, 218–225.

Kemp, M. C. and Wan, H. Y. (1972), “The gains from free trade”, International Economic Review 13, pp. 509-522.

Kemp, M. and Wan, H. (1976), “An elementary proposition concerning the formation of customs unions”, Journal of International Economics 6, 95-97.

Krishna K. and A. Krueger, 1995, “Implementing free trade areas: Rules of origin and hidden protection”, NBER Working Papers 4983, National Bureau of Economic Research, Inc.

Mas-Colell, A. (1977), “Indivisible Commodities and General Equilibrium Theory,” Journal of Economic Theory 16, 443–456.

Panagariya, A. and P. Krishna (2002), “On necessarily welfare-enhancing free trade areas”, Journal of International Economics 57, 353-367.

Yamazaki A. (1981), “Diversified Consumption Characteristics and Conditionally Dispersed Endowment Distribution: Regularizing Effect and Existence of Equilibria,” Econometrica 49, 639–645.

7 Appendix: Proof of Proposition 2

The proof follows the steps of Lemma 2 in Hammond and Sempere (2006) to prove existence of compensated equilibrium[14]. Given the interiority assumption, a compensated equilibrium is also a competitive equilibrium. We only point out to the main differences. Their model is similar to ours with the difference that they consider a continuum of consumers that also take migration decisions, and a finite number of producers. Given that the demand correspondences will depend on wealth and we assume a sagacious wealth distribution that depends on p we do not use w^i as argument. Also, given that rules of origin will be taken as given we do not use them in the argument of the supply correspondences. On the other hand, given our interiority assumption, the compensated equilibrium will also be a competitive equilibrium.

Given the unit simplex Δ, define the closed domain $\Delta_n := \{p \in \Delta \mid p \geq (1/n)1^G\}$ for each integer $n \geq \#G$.

Because of (A.5), it is easy to see that, for each $p \gg 0$, the correspondence $j \mapsto \eta^j(p)$ has a measurable graph in $J \times \Re^G$. It follows that $\int_I \eta^j(p) d\nu$, the mean of this correspondence, is well defined.

The correspondence

$$\arg \max_{y^j \in Y^j} \{p_{WH} y^j\_WH + p_{HF} y^j_{HF} + p_{HH} y^j_{HH} \, if \;\, y^j \in ROO^j(p, \alpha^j)\}$$

is upper hemi-continuous by the maximum theorem (Berge, 1959, chapter 6), as it is consists in the maximizers of a continuous function in a continuous correspondence. The maximizers of $p_{WH} y^j_{WH} + (p_{HF} - t_{HF}) y^j_{HF} + p_{HH} y^j_{HH}$

[14]Which follows the similar existence proofs in Mas-Colell (1977, p. 451), Yamazaki (1981, pp. 648–52), Khan and Yamazaki (1981, pp. 223–4) or Coles and Hammond (1991, pp.52–3).

in Y^j are also an upper hemi-continuous correspondence, by the same argument.

Consider the mean excess demand correspondence $\zeta_n : \Delta_n \mapsto \Re^G$ defined by $\zeta_n(p) = \sum_{i \in I} \xi^i(p) - \int_J \eta^j(p) d\nu - \bar{m}$. Note that each set Y_k is compact by A.4 (when restricted as discussed in Section 2.4. of Hammond and Sempere, 2006). Because the measure ν is non-atomic, standard arguments show that, for each integer $n \geq \#G$, the correspondence ζ_n has non-empty convex values and a compact graph.

Next, for each $n \geq \#G$, consider the domain Z_n equal to the convex hull of the compact set $\zeta_n(\Delta_n)$. Because $Z_n \subset \Re^G$ and $\#G$ is finite, Z_n is compact. Then define the correspondence $P_n(z) := \arg\max_p \{ p\, z \mid p \in \Delta_n \}$ for all $z \in Z_n$. Of course, $P_n(.)$ also has non-empty convex values and a compact graph in $Z_n \times \Delta_n$.

It follows that each correspondence $(p, z) \mapsto P_n(z) \times \zeta_n(p)$ $(n \geq \#G)$ maps the compact convex set $\Delta_n \times Z_n$ into itself. It also has non-empty convex values and a compact graph. By Kakutani's theorem, there exists a sequence of fixed points with $(p_n, z_n) \in P_n(z_n) \times \zeta_n(p_n)$ and $p\, z_n \leq p_n\, z_n$ for all $p \in \Delta_n$. $z_n \in \zeta_n(p_n)$ implies $p_n\, z_n = 0$, so $p\, z_n \leq 0$ for all $p \in \Delta_n$. In addition, there must exist sequences $x_n^i \in \xi^i(p_n)$ for all $i \in I$ and $y_n^j \in \eta^j(p)$ a.e. in J such that $z_n = \sum_{i \in I} x_n^i - \int_I y_n^j d\nu - \bar{m}$ for all $n \geq \#G$.

Following straightforwardly the arguments in Hammond and Sempere (2006) (proof of lemma 2[15]) we can show existence of a subsequence n_r $(r = 1, 2, \ldots)$ of $n = \#G, \#G + 1, \#G + 2, \ldots$ together with measurable functions $\hat{y} : J \to \Re^G$, and a profile of net consumption vectors $\hat{\mathbf{x}}^i$ such

[15] They follow the same arguments as Mas-Colell (1977), Yamazaki (1981), Khan and Yamazaki (1981) or Coles and Hammond (1991), based on Fatou's Lemma in many dimensions.

that as $r \to \infty$, $y^j_{n_r} \to \hat{y}^j$ a.e. in J, while $x^i_{n_r} \to \hat{x}^i$ for all $i \in I$ and also $\sum_I \hat{x}^i - \int_J \hat{y}^j d\nu - \bar{m} \leq z$. Because the sets X^i and Y^j are all closed, it follows that $\hat{x}^i \in X^i$ for $i \in I$, and that $\hat{y}^j \in Y^j$ a.e. in J. Finally, following the arguments of Hammond and Sempere, it can be shown that $(\hat{x}^I, \hat{y}^J, \bar{m}, p)$ satisfies all the requirements of feasibility, and preference and profit maximization, to be a compensated equilibrium for given α. This part of the proof will be omitted.

Then, provided our assumption $\bar{x}^i \in Int X^i$ for every $i \in I$, the status quo allocation is a cheaper point $p\hat{x}^i \geq p\bar{x}^i$ for every $i \in I$. Then Arrow (1951)'s exceptional case can be avoided and the compensated equilibrium is actually a competitive equilibrium. □