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**ARE POTENTIAL GAINS FROM ECONOMIC INTEGRATION
POSSIBLE WITH MIGRATION?**

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Are Potential Gains from Economic Integration Possible with Migration?

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Abstract

We present a general equilibrium model with migration of consumers. Then the theorems concerning gains from trade and from market integration in customs unions are revisited. The main idea involved in showing Pareto gains is the use of *dispersed compensation*. Two kinds of compensation mechanisms are used. The first uses lump sum transfers. The second assumes that the government can freeze prices and dividends and use a poll subsidy.

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1 Introduction

Examining the gains from international migration, Johnson (1967) uses a single good, two factor model to argue that as long as there is a change in factor prices, a finite outflow of professional emigrants (the brain drain) must necessarily harm those left behind. Berry and Soligo (1969) claim that if a finite outflow of a factor causes a rise in its price, those left behind necessarily incur a deadweight loss, which is analogous to the surplus in the case of a finite inflow of a factor. Wong (1986) generalizes Johnson's result to the case of m commodities and n factors. But he also concludes that those left behind may gain if the emigrants leave behind some of their physical capital.

Apparently those left behind would lose in most cases, but Kemp (1993) provides an important insight which could improve our understanding of the subject. In his paper on the gains from international migration, labour services are considered to be the same as any other Arrow-Debreu commodity. Thus, the models used to prove Pareto gains from trade in commodities implicitly allow the analysis of gains from free trade of labour services. Each national agent could, following trade liberalization, freely offer his labour services in all the other countries involved (even in several simultaneously). Pareto gains from market integration (including free trade in labour markets) are therefore obtained. The results quoted in the paragraph above do not apply because the compensation mechanism designed for the gains from trade theorems include emigrants.

In this paper we build on Kemp's paper by explicitly modeling the decision to emigrate. Endowing individuals with the possibility to migrate is the same as giving them the chance to: (1) choose between alternative sets of non-traded goods; (2) buy traded goods at prices different from those in their original countries because of different distortionary taxation; or (3) locate in different countries by expending a given amount on travelling, removal costs, learning the language, etc. Each consumer would have a preference relation on existing commodities and, on the basis of national prices and non-traded goods, migration costs, income and preferences, would choose where to live.

In our model we are aware that in real economies it is difficult to supply labour at several different places simultaneously. We assume that labour is included in the set of a country's non-tradeable commodities. We will allow

the consumer to offer his labour supply in other countries, but this will be costly for him.

In addition to most labour services, the set of a nation's non-traded goods would hypothetically include local public good production and other non-tradeables. The literature on local public goods analyses the case in which each agent decides where to live on the basis of public goods and taxes. This would be easily adapted here to the case in which public production is included as an additional firm producing non-traded goods and commodity taxes would determine different consumer prices in each of the countries.

The theory of local public goods (see Tiebout, 1956) predicts that, without barriers to migration between communities, individuals will shift from one region to another as soon as there appear differential opportunities for labour, or the set of public goods and taxes is preferred over that of another region. The result of *voting with the feet* is an equalization of standards of living across regions. As shown by Esteban (1991), this theoretical prediction is far from being close to the empirical evidence in Europe. He argues that empirical evidence supports the fact that individuals may attach value to living in a socio-cultural environment with which identify. This fact will be considered in our model. We will assume that individuals may give value to living in a particular country and include location as a non-marketed commodity in the definition of each consumer's consumption set.

The gains from trade theorems, as first shown by Samuelson (1939 and 1962) and Kemp (1962), claim that when a group of countries frees trade among themselves, improvements in efficiency are possible and will result in a Pareto gain given adequate compensation. The latter is necessary because even though these reforms increase aggregate real income, they do not by themselves ensure a Pareto improvement. A reform can benefit those people related to firms that are competitive after trade liberalization, but it could also harm those with ties to industries that are not competitive after the reform.

Two types of compensation mechanisms that give rise to a Pareto gain could be used. The first, associated with classical welfare economics, assumes that governments have enough information available about people's characteristics to use lump-sum compensation. This is the one devised by Grandmont and McFadden (1972). The second, forming part of the new

welfare economics, takes into account the informational restrictions faced by governments and uses only incentive compatible compensation. Then two compensatory mechanisms have been used. The first, devised by Dixit and Norman (1980, 1986) and based on the Diamond and Mirrlees' (1971) justification of productive efficiency, uses movements in commodity taxes to implement the Pareto gain. The second, devised by Hammond and Sem-pere (1992), extends the previous mechanism to avoid the assumption of free disposability and reduces informational requirements. This compensation mechanism involves changes in commodity taxes and a uniform subsidy.

Brecher and Choudhri (1990) have a model of a country liberalizing trade in factors. They apply the same compensatory mechanism as Dixit and Norman and show that the only way to obtain Pareto gains from that reform is by having national consumers and emigrants consuming at internal consumer prices and immigrants consuming at international prices. So immigrants do not pay or receive national indirect taxes or subsidies. In other words, each country should apply a nationality based indirect taxation to do the compensation.

In our case we do not have the same problem. We model explicitly the decision to emigrate and consumers will only decide to do so in case it is welfare improving for them. We establish a system of union wide compensation that makes each country freeze consumer prices and distributes a union wide poll subsidy. Only when the poll subsidy is positive consumers will change their consumption decision (including where to locate).

In this paper we will analyze the case of forming a customs union. The additional complexity of this analysis is compounded by the need to compare the welfare effects of trade creation due to the elimination of tariffs between members, with the trade diversion effects, because the common external tariff may divert production toward higher cost producers. However we will use the idea originally of Vanek (1962) and Kemp (1964), later reformulated by Kemp and Wan (1976), and finally presented more formally by Grinols (1981). The argument relies on the union being able to maintain a common external tariff so that border prices are frozen, as is total amount of trade in each commodity which the union carries out with the rest of the world.

The methodology we will use to tackle the implied non-convexities makes use of a model with a continuum of traders as originated in the work of

Aumann (1964) and follows the methods of Hildenbrand (1974), as developed in Yamazaki (1981). These are based on the smoothing effects of aggregation when the distribution of agents' characteristics is *dispersed* in a certain way. In particular, at the time of designing the compensatory mechanism, the additional property of *dispersed compensation* will be required.

The paper is organized as follows: Section 2 sets up a general equilibrium model of an international economy with a continuum of traders. Section 3 defines our concept of potential Pareto gains. Section 4 analyzes the possibility of achieving Pareto gains from creating customs unions when migration is allowed, and when using lump-sum transfers is feasible for each government. Section 5 proves the possibility of Pareto gains under the weaker assumption that only incentive compatible compensation is feasible. Section 6 concludes the paper with some final remarks.

2 An International Economy with a Continuum of traders

There are K countries indexed by k . There is a continuum of consumers I indexed by i . I_k is the subset of consumers originally living in country k . There is also a continuum of producers J indexed by j . J_k is the subset of producers of country k . We also assume that there is a finite set of commodities, denoted by L . This set is partitioned into $L = \cup_{k \in K} N_k \cup T$, where N_k is the set of goods specific to country k and T is the set of internationally traded goods.

Let $(I \cup J, \mathfrak{F}, \nu)$ denote an atomless measure space of economic agents, where $\mathfrak{F}$ is the σ -algebra of measurable subsets and ν the distribution of agents' characteristics. A continuum economy, as defined in Aumann (1964), is a measurable mapping

$$\varepsilon : I \cup J \longmapsto \Theta$$

from the measure space into the space of agents' characteristics.

Each individual is characterized by a preference relation $\succsim_i$ which satisfies transitivity, completeness, continuity and local non-satiation. The set of preference orderings, as represented by their graphs, will be endowed with the closed convergence topology. Each individual also has a consumption set

$X^i \subset \mathbb{R}^L$ which is assumed to be closed but not necessarily convex, as will be understood from the discussion in the next paragraphs.

Denote by $t_{kk'}^i$ a minimal amount of net trades necessary to arrange migration from k to k' . Obviously, $t_{kk}^i = 0$ because consumption in i 's original country is possible without purchasing some migration services. Let $X_{kk'}^i$ be the set of feasible consumptions for consumer i when he bears the amount needed $t_{kk'}^i$ of the cost of migration from k to k' .

Obviously, if we define the consumption set as $X^i \equiv \cup_{k' \in K} X_{kk'}^i$, there could be discontinuous preferences at points on the lower boundary of some $X_{kk'}^i$. These discontinuities would be due to the fact that a migrant to k' consuming $x^i \in X_{kk'}^i$ might prefer points $\hat{x}^i \in X_{kk'}^i$ quite a bit worse than x^i to points $\hat{x}^i$ which are close to x^i , because living in k' could be valued for its own sake. To avoid this problem we will introduce consumption of location as a non-marketed good in the definition of the consumption set.

Let $\{k\}$ be the variable representing consumption of location at country k . Thus consumption of location will be introduced as a good in its own right, although not marketed. Let c^i be the consumption vector of consumer i . This includes consumption of marketed commodities x^i and consumption of location. For instance, if consumer i lives in k and consumes x^i of marketed commodities, $c^i = (k, x^i)$.

Now consumer i 's feasible set would be $X^i \equiv \cup_{k' \in K} \{k'\} \times X_{kk'}^i$, where if $l \in N_{k'}$ and $x_l^i < t_{kk'}^i$, this implies that $x_l^i = 0$ if $c^i \in X^i$ and $i \in I_k$, $k \neq k'$. Also if $x_l^i \geq t_{kk'}^i$ and $x_l^i \neq 0$ for some $l \in N_{k'}$, then $x_l^i = 0$ if $l \in N_k$ if $c^i \in X^i$ and $i \in I_k$. In other words, if the individual consumes one of the non-traded goods he/she must bear the migration costs to preserve feasibility.

We will restrict our analysis to the case in which the consumer can migrate to only one of the other countries, so that if $x_h^i \neq 0$ for some $h \in N_{k'}$ then $x_l^i = 0$ for all $l \in N_{k''}$ whenever $k' \neq k''$.

We will also assume that $X_{kk'}^i$ for $k, k' \in K$ are convex and closed sets. Clearly the latter does not imply that the sets X^i are convex. The appearance of indivisible costs of consumption of non-traded goods and the fact that $t_{kk'}$ could be considered as indivisible composite commodities imply non-convexities in consumption sets.

Denote by q_k the vector of consumer prices of country k , which could be different from producer prices p because of commodity taxation. Let

$q = \{q_k\}_{k \in K}$. Also denote by m_k^i the net transfers consumer i gets from production profits and government transfers if he lives in k . Let $m^i = \{m_k^i\}_{k \in K}$. For each consumer we can define the budget set correspondence if he lives in country k ,

$$B_k^i(q_k, m_k^i) = \{c^i \in X^i \mid q_k x^i \leq m_k^i\}$$

where m_k^i is the net transfer received if i lives in k . The budget set correspondence if he can migrate to any $k \in K$ is given by

$$B^i(q, m^i) = \cup_{k \in K} B_k^i(q_k, m_k^i)$$

The compensated demand correspondence is

$$\xi_c^i(q, m^i) = \{c^i \in B^i(q, m^i) \mid \hat{c}^i \succsim_i c^i \implies \forall k : q_k \hat{x}^i \geq m_k^i\}$$

and the Walrasian demand correspondence,

$$\xi_w^i(q, m^i) = \{c^i \in B^i(q, m^i) \mid \hat{c}^i \succ_i c^i \implies \forall k : q_k \hat{x}^i > m_k^i\}$$

These compensated demands will be non-empty if the budget correspondences are non-empty and will have a closed graph. Walrasian demands will be non-empty for (q, m^i) such that the budget correspondence is non-empty and the correspondence will be upper-hemicontinuous wherever there is a cheaper point $(k, \tilde{x}^i) \in X^i$ with $q_k \tilde{x}^i < m_k^i$ in the corresponding “local” consumption set (conditioned to the decision of location).

With our definitions of demands, we have given each consumer the possibility of choosing among the different budget sets that he would face in each different country. Given that we have incorporated location and the migration costs in the consumption sets, his choice represents a choice of country. Compensated demands are those that minimize cost when the individual can choose the country where he consumes or supplies. In a similar way we can define Walrasian demands as those which maximize utility subject to a budget constraint that could be different for different countries where the consumer can choose between different sets of non-traded goods and different commodity taxes. This definition generalizes the one used in Bewley (1981) in the context of local public goods theory.

Each producer j is characterized by a production set $Y^j \subset \mathbb{R}^L$ which satisfies $0 \in Y^j$. Each production set is assumed to be closed and convex. It

is also assumed that if l does not belong to $N_k \cup T$, then $y_l^j = 0$ whenever $j \in J_k$ and $y^j \in Y^j$. This assumption implies that even though owners of the firms can migrate and offer labour in other countries, they cannot transport their production activities with them. Each producer chooses a vector of production y^j . The average production set of the agents of country k is $\int_{J_k} Y^j d\nu := Y_k$ (denoted Y_k from now on so its elements will be written as y_k). They are also assumed to satisfy the requirement that for each aggregate lower bound $\underline{y}$ the constrained set of international production allocations

$$Y^K(\underline{y}) = \{y^K \in Y^K = \prod_{k \in K} Y_k \mid \sum_{k \in K} y_k \geq \underline{y}\}$$

is bounded. This means that in the international economy, bounded inputs only allow bounded outputs in each separate country.

We want to find an allocation that is Pareto superior to a prespecified status quo allocation in the countries that would form the customs union. $(\bar{c}, \bar{y})$ are the lists of all consumers' initial net consumption vectors and all producers' initial net output vector. In an intertemporal economy some commodities could be consumed or produced after the date of the reform. Therefore $\bar{c}^i$ refers to what consumer i 's net consumption vector would have been in the absence of the reform being considered.

In this paper we assume that the pre-reform allocation satisfies a balance of trade constraint, which could be expressed in terms of averages $w\bar{z}_k = \bar{b}_k$ for each country k , where w is the world price vector for traded goods, $\bar{b}_k$ is a maximum allowable average deficit, and $\bar{z}_k$ is the net mean import vector which could be defined by

$$\bar{z}_k = \int_{I_k} \bar{x}^i d\nu - \int_{J_k} \bar{y}^j d\nu = \bar{x}_k - \bar{y}_k$$

In order to leave the rest of the world unchanged when the customs union is formed, we assume, following most of the literature on the gains from customs union formation, that an external tariff can be set so that both world prices w and the average amount of trade per head

$$\bar{z} = \int_I \bar{x}^i d\nu - \int_J \bar{y}^j d\nu = \bar{x} - \bar{y}$$

that the union carries out with the rest of the world remain constant. This means that, even though the amount traded by any particular country could be different after the reform, this difference is compensated by other offsetting changes so that the total is the same. It is important to realize that after the change, tariffs among the members disappear and therefore there will be a common vector of producer prices p for traded goods. Thus, in our model, the vector of external tariffs $p - w$ and producer prices p will be endogenous, adjusting to clear commodity markets across the union while keeping $\bar{z}$ and w constant.

We assume that producers maximize profits. For every $p \neq 0$, we define producer j 's supply correspondence by

$$\eta^j(p) = \arg \max \{py^j \mid y^j \in Y^j\}$$

which will be non-empty and have a closed graph for prices at which profits are bounded. We also can define the profit function as

$$\pi^j(p) = \max \{py^j \mid y^j \in Y^j\}$$

Country k 's average supply function $\eta_k(p) := \int_{J_k} \eta_j(p) d\nu$ and country k 's average profit function, $\pi_k(p) := \int_{J_k} \pi_j(p) d\nu$ are defined in a similar fashion.

Now we assume that the reform improves production efficiency in the sense that for the aggregate set of countries forming the customs union, the productive sector as a whole makes more profits, on average, by adjusting its plans than by staying where it is, so $\pi(p) > p\bar{y}$. What is required here is that the pre-customs union allocation belongs to the interior of the aggregate production set of the union as a whole. We only need that the normals to the hyperplanes supporting the pre-reform production vectors be different for different countries before forming the customs union (as would happen with the existence of distorting tariffs).

A stronger assumption that would ensure aggregate productive gains for each member country is that pre-reform production prices be different for different countries and also that optimal aggregate production plans for each country be different from pre-reform plans for any production price vector that would arise once the union is formed. Then improvements in production efficiency are possible for each country. This would imply $\pi_k(p) > p\bar{y}_k$ for all k instead of $\pi_k(p) \geq p\bar{y}_k$ for all k as would be implied by profit maximization. However, we are not going to use this assumption unless specified.

3 Potential Pareto Gains

Supply-side policies that improve production efficiency, even though they increase aggregate real income, do not in themselves assure a Pareto improvement. A reform can make people better off (for instance, those owners of firms which benefit from the reform) and some others worse off (like those with ties to industries that are not competitive after the reform). The consequences of a reform could force people to migrate under disadvantageous conditions.

Thus, obtaining a Pareto gain requires the design of an appropriate redistribution mechanism. We will show two different kinds of mechanisms which both depend upon informational assumptions about the government. For both types we will specify some general assumptions. Let $m^i(p)$ be the unearned income of consumer i —that is, income coming from public sector transfers and corporate dividends. Let $q_k(p)$ be consumer prices in country k , their dependence on producer prices due to commodity taxation. We assume that these functions are continuous and homogeneous of degree one in p . Later on, we will also make some important assumptions about the measure distribution of the transfers.

Formally, finding a Pareto gain requires finding $\{p, [m^i(p)]_{i \in I}, [q_k(p)]_{k \in K}\}$ such that:

- (i) $\hat{y}^j \in \eta^j(p) \quad \forall j \in J \quad \nu\text{-a.e.}$
- (ii) $\hat{c}^i \in \xi_w^i(q(p), m^i(p)) \quad \forall i \in I \quad \nu\text{-a.e.}$
- (iii) $\int_I \hat{x}^i d\nu - \int_J \hat{y}^j d\nu = \bar{z}$ and
- (iv) $\hat{c}^i \succ_i \bar{c}^i \quad \forall i \in I \quad \nu\text{-a.e.}$

4 Gains with Migration: Lump Sum Compensation

Here, the government has enough information available about people's characteristics to use lump sum transfers. Commodity taxation is not used so

$q_k(p) = p$. Thus, the choice of country only depends upon non-internationally-traded goods, such as job opportunities and housing, and location, and not on different consumer prices for tradeables.

Each country joining the union has to reform its tariff system. This will have positive effects in terms of tariff revenue for some countries, but it could also have negative effects for some others. These tariff revenue effects could impede the implementation of the Pareto gain. To avoid this possibility, we follow the literature (see Grinols, 1981) and postulate intergovernmental transfers that compensate for the loss of tariff revenue. We assume that the union-wide revenue from the common external tariff forms a community fund. This is divided among the member countries following the pre-reform pattern of trade. Specifically, when producer prices are p , each member country gets a transfer of $(p - w)\bar{z}_k$ even if its net import vector differs from $\bar{z}_k$.

We also assume that the amount each country is allowed to distribute, on average, does not exceed its national mean income plus mean external borrowing and mean transfers derived from the external tariff, so

$$\int_{I_k} m^i(p) d\nu \leq \bar{b}_k + (p - w)\bar{z}_k + \pi_k(p) = p\bar{z}_k + \pi_k(p)$$

The transfers must be constructed to assure each consumer more than enough income to purchase his pre-reform allocation of marketed commodities at the new prices, so that $m^i(p) > p\bar{x}^i$. With our assumption of increased production efficiency for the set of countries forming the union as a whole, this would be obviously feasible on average. But the use of international lump sum transfers could be necessary. A sufficient condition to avoid such transfers is the assumption of increased production efficiency within each member country. We assume that this happens for the rest of the section. Then

$$\int_{I_k} m^i(p) d\nu = p\bar{z}_k + \pi_k(p) > p\bar{z}_k + p\bar{y}_k$$

for each $k \in K$.

Under the assumptions of section 2, there exists a compensated equilibrium $\{p, [\hat{c}^i]_{i \in I}, [\hat{y}^j]_{j \in J}\}$ in which:

- (i) $\hat{y}^j \in \eta^j(p) \quad \forall j \in J \quad \nu\text{-a.e.}$

$$(ii) \quad \hat{c}^i \in \xi_c^i(p, m^i(p)) \quad \forall i \in I_k \text{ and } k \in K \quad \nu\text{-a.e.}$$

$$(iii) \quad \int_I \hat{x}^i d\nu - \int_J \hat{y}^j d\nu = \bar{z}$$

By construction, the transfers give each consumer more than enough income to buy his pre-reform allocation. This ensures the existence of a cheaper point in each consumers consumption set, avoiding Arrow's (1951) exceptional case. In a model with convex consumption sets, compensated demand would coincide with Walrasian demand and our equilibrium would be a competitive one. In a model with non-convexities this would not be true.

In our case, this is not enough to prevent the existence of a non-null set of individuals from country k who can more than afford their pre-reform consumption, but who have now migrated and are stuck at the lower boundary of one of the sets $X_{kk'}^i$ ($k \in K$). This would happen when migration is clearly better, even though the migrant is at a cheapest point of his conditionally feasible set, given the decision to migrate. This difficulty could prevent the existence of competitive equilibrium.

To avoid this problem we need an additional assumption, which is motivated by Yamazaki's (1981) *dispersed endowments* and Coles and Hammond's (1991) *dispersed needs* assumption. To state this assumption formally, define first the sets, for $i \in I_k$ and $k \in K$,

$$P^i = \{p \mid \exists k'; \exists \hat{c}^i \in \xi_c^i(p, m^i(p)) \cap \{k'\} \times X_{kk'}^i :$$

$$\forall \tilde{x}^i \in X_{kk'}^i : p\tilde{x}^i \geq m^i(p)\}$$

and,

$$I(p) = \{i \in I \mid p \in P^i\}$$

Now assume:

DISPERSED COMPENSATION: *The lump-sum transfers satisfy $\nu(I(p)) = 0 \quad \forall p \neq 0$.*

It is necessary that the measure distribution of the transfers conditioned to the consumption set is atomless at the points of difficulty. In other words, it gives null measure to the set of agents receiving the same transfer and having the same feasible set, for those agents who would decide to migrate and their consumption allocation would be a cheapest point of the conditionally

consumption set given their decision as to which country to live in. Then the possible discontinuities of individual demand are dispersed so mean demand preserves continuity. A very simple example of a transfer system satisfying our conditions is the following:

EXAMPLE: Assuming that all consumers in country k have the same consumption set and pre-reform allocation, the transfer system will give each $i \in I_k$, for each k , the amount

$$m^i(p) = p\bar{x}^i + \theta_k^i[\pi_k(p) - p\bar{y}_k]$$

where θ_k^i is uniformly distributed on $(0, \bar{\theta})$, where $\bar{\theta}$ is fixed in order to satisfy $\int_{I_k} \theta_k^i d\nu = 1$

As shown below, this is sufficient to have a cheaper point in the local feasible set for almost every consumer and so to make our compensated equilibrium a competitive one.

LEMMA: Assuming that the transfers satisfy "Dispersed compensation," $c^i \succ_i \hat{c}^i \implies px^i > p\hat{x}^i$ ν -a.e. at the compensated equilibrium.

PROOF: There are two possible cases to consider. The first happens when the individual does not migrate. In this case, because of the construction of the transfers and budget exhaustion, $p\hat{x}^i = m^i > p\bar{x}^i$. The pre-reform allocation trivially provides a cheaper point. If, at the compensated equilibrium the consumer has migrated to country k' ($\hat{x}^i \in X_{kk'}$ or $\hat{c}^i = (k', \hat{x}^i) \in X^i$), suppose $p\hat{x}^i = px^i$ and $c^i \succ_i \hat{c}^i$. Then, by our assumption, for $I \setminus I(p)$, there exists $\tilde{x}^i \in X_{kk'}$ such that $p\tilde{x}^i > p\hat{x}^i$. By convexity of $X_{kk'}^i$ and continuity of preferences, $x^i(\epsilon) = (1 - \epsilon)x^i + \epsilon\tilde{x}^i \in X_{kk'}^i$ and $(k', x^i(\epsilon)) \succ_i \hat{c}^i$ for small $\epsilon > 0$, while $px^i(\epsilon) < p\hat{x}^i$. This contradicts the hypothesis that $\hat{c}^i$ was a compensated demand. $\square$

From the lemma and the discussion above we conclude:

Proposition 1 *With the assumptions of section 2 and assuming "dispersed compensation," there exists a competitive equilibrium ν -a.e. In this equilibrium, every consumer is better off than at the pre-reform allocation.*

This transfer system depends on what each individual would have consumed in the absence of reform. In an Arrow-Debreu economy this consists of a

stream of consumption starting at the moment the reform is implemented. For example, to compensate everyone the government would need to know the detailed career plans of each worker. These are a function of consumers' preferences and incomes which are generally private information. Therefore the transfer system, following Hammond (1979), is generally not incentive compatible. If a revelation mechanism were instituted to discover each consumer's $\bar{x}^i$ asking them to report what they would have consumed if the economy had remained unreformed, then there would be incentives to claim more compensation than really needed. This difficulty will be sorted out in the next section, where we use an incentive compatible mechanism.

A different problem concerning the economy with migration analysed in this section is that achieving the Pareto gain also requires the government of each k to be able to compensate all the individuals in I_k , even though the set of consumers currently living in k could be different. That is, each government has to compensate all consumers who were living in its country before the reform, independently of where they are currently living. This happens because, even though each national production sector has profited from the reform, it does not mean that each country can afford the pre-reform consumption allocation of all its inhabitants (including immigrants) at new union prices. What is required is a system of international transfers among governments to make them able to compensate also the immigrants. This would be feasible because the aggregate improvement in productive efficiency in the customs union.

5 Gains with Migration: Incentive Compatible Compensation

In this section, we use an incentive compatible mechanism to distribute the potential gains. Dixit and Norman (1980) devised an incentive compatible mechanism based on movements in commodity taxes. They assumed that the government had enough tax instruments to freeze consumer prices and that firms did not have positive profits. Then they assumed the existence of a positive direction of reform in commodity taxes — for example the existence of a commodity either purchased or sold by every consumer (for other cases, see Weimark, 1979). By movements in the price of this commodity they

could obtain a Pareto gain. In order to achieve an equilibrium, they needed the government to buy the excess supply and to be able to dispose of it freely.

Brecher and Choudhri (1990) have a model of a country liberalizing trade in factors. They apply the same compensatory mechanism as Dixit and Norman and show that the only way to obtain Pareto gains from that reform is by having national consumers and emigrants consuming at internal consumer prices and immigrants consuming at international prices. So each country should apply a nationality based indirect taxation to do the compensation. We will not have the same problem.

The mechanism we will use is the one designed by Hammond and Sempere (1992). They extended Dixit and Norman's (1980) mechanism, assuming explicitly that the government could freeze consumer prices and dividends and use a poll subsidy to distribute the gains, without requiring the knowledge of a positive direction of commodity tax reform. They showed the existence of a competitive equilibrium without assuming any sort of free disposal.

Now we require the original consumers' allocation $\bar{c}^i$ to be an equilibrium for the consumers at prices $\bar{q} = \{\bar{q}_k\}_{k \in K}$ and unearned incomes $\bar{m}^i$ so that, for each consumer $i \in I_k$ and each k ,

$$\bar{c}^i \in \xi_w^i(\bar{q}, \bar{m}^i)$$

We also assume that this set is single-valued at incomes $\bar{m}^i$ and prices $\bar{q}$ and that $\bar{c}^i$ and $\bar{m}^i$ are integrable in I .

In order to avoid any consumer being harmed by a change in commodity prices or unearned income, assume that each country k uses indirect taxes to freeze consumer prices and income taxes to freeze any sort of unearned income. Given that across the union there is a unique producer price vector after the reform, that means that each country is separately fixing its own vector of commodity taxes. Assume also that if these policies create imbalances in each national public sector budget, these are passed on to the consumers in the form of a unionwide poll subsidy s .

From these assumptions, the budget constraint for i if he lives in k' after the reform is

$$B_{k'}^i(s) = \{c^i \in X^i \mid \bar{q}_{k'} x^i \leq \bar{m}_{k'}^i + s\}$$

so the budget constraint faced by consumer $i \in I$ is

$$B^i(s) = \cup_{k' \in K} B_{k'}^i(s)$$

In order to show the possibility of Pareto gains we have to prove existence of equilibrium with frozen consumer prices and dividends, with free producer prices and a poll subsidy distributing the potential gains. We show this proof in two steps. First we show the existence of compensated equilibrium. Then we establish conditions that make the compensated equilibrium a competitive one.

We prove the existence of a compensated equilibrium in the appendix. In that equilibrium, if $s^* = 0$, then the definition of the poll subsidy implies that

$$0 = \bar{m} - \sum_{k \in K} \bar{q}_k \bar{x}_k = p^* \bar{z} + p^* \hat{y} - p^* \bar{x}$$

Given that pre-reform demand was single valued and that the pre-reform allocation was balanced, this implies that the pre-reform aggregate production plan is still efficient for the customs union economy, contradicting the assumption of aggregate productive efficiency gains. In those cases, demand would coincide with pre-reform demand. For the rest of the cases, the poll subsidy is positive.

Despite the above, as discussed in section 3, a non-null set of consumers could migrate from one of the countries to another, and even after receiving a poll subsidy still be on the lower boundary of the conditional consumption set. This could imply the existence of some points of discontinuity in prices in mean Walrasian demand. The difference is that now we only need mean Walrasian demand to be upper hemicontinuous in income. Walrasian demand is upper hemicontinuous in income even at cheaper points of the consumption set, so we avoid the problem discussed in section 3, and the equilibrium whose existence we proved is indeed a competitive one.

To conclude this section, we remark that the compensatory mechanism is incentive compatible. In this case it is also necessary to design a system of international transfers to distribute the poll subsidy among all consumers in the customs union. However we do not need a nationality based indirect taxation system. We model explicitly the decision to emigrate and consumers only decide to do so in case it is welfare improving for them. Each country

freezes consumer prices and only when the poll subsidy is positive consumers will change their consumption decision (including where to locate).

6 Final Remarks

In this paper we have presented a way to model migration in general equilibrium models. People decide where to live on the basis of non tradeables, prices of tradeables, and the costs of migration. An important feature in the model is the inclusion of location as a non marketed commodity. This helps to explain differences in living standards across countries and less individual mobility than models of local public goods would predict.

In this model we have provided conditions to achieve Pareto gains from market integration in customs unions when individuals are allowed to migrate from one country to another of the union. Given that the formation of the union could have made some people better off but harmed others, it was necessary to find a mechanism of redistribution to convert the gains in productive efficiency into effective Pareto gains. The main assumption, different from those used in standard general equilibrium analysis, was that the type of compensation had to be *dispersed*.

Given the barriers set to deter migration in most countries, one would think that migration is harmful for the host country. Instead, most of the results in economic theory indicate that migration damages those left behind in the country of origin. The results of this paper agree with those of Kemp (1993) in that if adequate compensation is feasible then no country will lose out on migration.

When people are allowed to migrate, in addition to the important informational and institutional requirements needed to compensate the losers (knowledge of the evolution of prices, to be able to freeze prices and dividends, etc...), a system of international transfers had to be established to allow each government to compensate all its inhabitants (including immigrants). Obviously these transfers could be abused by governments claiming that they had received more migrants than they actually did. However any other system aiming at the Pareto gain would be subject to the same criticism.

The assumptions needed to arrange the compensation scheme to achieve a Pareto gain are too strong. The actual possibilities of compensation of losers offered by the economic system should be established. And then, given the practical impossibility of obtaining a Pareto gain, it will be necessary to make interpersonal comparisons of utilities in order to evaluate the reforms analyzed in this paper. If the uncompensated losers carry important weights in the economy's welfare function, a barrier to trade or migration could be justified.

Also, if there is enough uncertainty about who the losers are going to be, and about the actual possibilities of compensation, there could be an important group of people voting against a government carrying out these policies. Even without that uncertainty, as discussed in Hammond (1994), reforms of the type analysed here, without any accompanying schemes to compensate losers, could lack credibility. Consequently, barriers to trade and migration would appear.

Appendix

LEMMA: *With our assumptions, there exists a compensated equilibrium.*

PROOF: We will apply a fixed point argument to a correspondence suitably constructed based on the one used in Hammond and Sempere (1992).

Consider first the mean compensated demand correspondence for individuals who originated in country k , which is

$$\xi_c^k(s) = \int_{I_k} \xi_c^i(s) d\nu$$

Each $\xi_c^i(s)$ has a closed and thus measurable graph in the domain of characteristics of the measurable economy. Trivially, if we define $\bar{q} = \inf_{l \in L} \{\bar{q}^l\}$, each feasible consumption set is bounded above by the vector $[(s + \bar{m}^i)/\bar{q}] \bar{1}$ where $\bar{1}$ is the vector $(1, 1, \dots, 1) \in \mathbb{R}^L$. For any given s in a bounded set and any $\bar{q} \gg 0$, the function $\xi_c^i(s)$ is integrable in I_k . From the discussion of Yamazaki (1981), we conclude that mean demand is non-empty valued and has a closed graph. Given that ν is non-atomic, mean demand is also convex valued. Consumption sets are not bounded. Given that the restricted set of possible mean international productions for the customs union is bounded (write y^* for an upper bound) any feasible mean consumption must satisfy

$$x \leq y^* + \bar{z} - \int_I \underline{x}^i d\nu$$

We define the truncated mean consumption sets

$$X_h = \{c \in \int_I X^i d\nu \mid x \leq y^* + \bar{z} - \int_I \underline{x}^i d\nu + h \bar{1}\}$$

for each consumer. Here h is a strictly positive natural number and $\bar{1}$ is a vector of ones. The truncated mean consumption sets X_h are obviously compact and convex sets.

Each aggregate supply correspondence is non-empty valued, defined on a suitable compact set $\bar{Y}$. As shown by Debreu (1959), an equilibrium relative to these sets will also be an equilibrium relative to the original Y , given that the constrained set of international productions is compact and that

Y is convex (see also Hammond and Sempere, 1992). It will have a closed graph. Similarly, the mean national supply correspondence $\eta_k(p)$ will have non-empty, compact and convex values, a closed graph and will take values in a compact, convex set.

Define $c_k \in \xi_c^k(s)$ as a compensated national average demand. From each x_k we obtain union average consumption of marketed commodities $x = \int_I x^i d\nu$. Write $y_k \in \eta_k(p)$ for each national average production. Write also z for $x - y - \bar{z}$.

As the price adjustment correspondence, we use

$$P(z) = \begin{cases} z/\|z\| & \text{if } \|z\| > 0 \\ B & \text{if } \|z\| = 0 \end{cases}$$

where $B = \{p \in \mathbb{R}^L \mid \|p\| \leq 1\}$. It consists of a single point on the boundary of B unless $x - y - \bar{z} = 0$, in which case it consists of the whole of B . This correspondence will have non-empty, compact and convex values in a compact and convex set and also a closed graph, given that the value of the mean excess demand has a closed graph.

Write $\bar{m}$ for $\int_{i \in I} \bar{m}^i d\nu$. We also define the poll subsidy adjustment correspondence,

$$\sigma(x, y, p) = \max \{0, p(\bar{z} + y - x) + \sum_{k \in K} \bar{q}_k x_k - \bar{m} + 1 - \|p\|\}$$

The idea of including the term $1 - \|p\|$ is due to Bergstrom (1976). This correspondence will have non-empty and convex values. Its range S is convex and compact (because it is u.h.c. in a compact domain). We can now apply Kakutani's fixed point theorem to the product of the correspondences

$$\prod_{k \in K} [\xi_c^k(s) \times \eta_k(p)] \times \sigma(x, y, p) \times P(x, y)$$

Thus there are infinite sequences of fixed points $\{[\hat{c}_{kh}, \hat{y}_{kh}]_{k \in K}, \hat{s}_h, p_h\}$ and of integrably bounded measurable mappings $\{\hat{c}_h^i, \hat{y}_h^j\}$ such that: $\hat{c}_h^i \in \xi_c^i(s_h)$ a.e. in I_k ; $\hat{c}_{kh} = \int_{I_k} \hat{c}_h^i(d\nu)$ and $\hat{y}_h^j \in \eta^j(p_h)$ a.e. in J_k ; $\hat{y}_{kh} = \int_{J_k} \hat{y}_h^j(d\nu)$. The following lemma shows that for each h , $\|p_h\| = 1$ and $\|\hat{x}_h - \hat{y}_h - \bar{z}\| = \|z_h\| = 0$.

LEMMA: *At the fixed point for each h one has $\|p_h\| = 1$ and $\|\hat{x}_h - \hat{y}_h - \bar{z}\| =$*

$$\|z_h\| = 0.$$

PROOF: Suppose instead that $\|\hat{x}_h - \hat{y}_h - \bar{z}\| > 0$. From the definition of $P(z)$, $p_h = z_h/\|z_h\|$ so

$$\|z_h\|[p_h z_h] = \|z_h\| \frac{z_h}{\|z_h\|} z_h = \|z_h\|^2 > 0$$

This implies that $p_h z_h > 0$ of σ , it follows that

$$\hat{s}_h = \max\{0, p_h(\bar{z} + \hat{y}_h - \hat{x}_h) + \sum_{k \in K} \bar{q}_k \hat{x}_{kh} - \bar{m} + 1 - \|p_h\|\}$$

If $\hat{s}_h = 0$, given the assumption that the pre-reform individual demands were single valued, it follows that $\bar{c}_k = \int_I \xi^i(0) d\nu$. By definition of maximum,

$$0 < p_h(\bar{x} - \hat{y}_h - \bar{z}_k) \leq \sum_{k \in K} \bar{q}_k \bar{x}_k - \bar{m} + 1 - \|p_h\|$$

We also assumed that at the pre-reform allocation consumers were satisfying their budget sets, so $\bar{q}_k \bar{x}^i = \bar{m}^i$ and hence $\bar{q}_k \bar{x}_k = \bar{m}_k$ and $\sum_{k \in K} \bar{q}_k \bar{x}_k = \bar{m}$. This implies that $\|p_h\| < 1$ since $p_h \hat{z}_h > 0$.

If $\hat{s}_h > 0$ then the fixed point satisfies

$$p_h(\hat{x}_h - \hat{y}_h - \bar{z}) = \sum_{k \in K} \bar{q}_k \hat{x}_{kh} - \bar{m} - s_h + 1 - \|p_h\|$$

Consumer budget balance implies that also $\|p_h\| < 1$ if $p_h \hat{z}_h > 0$. From the above discussion, we conclude that $p_h \hat{z}_h > 0$ implies $\|p_h\| < 1$. By definition of $P(z)$, $\|\hat{z}_h\| > 0$ means that $\|p_h\| = \| [z_h/\|z_h\|] \| = 1$. This contradiction implies that $\|p_h\| = 1$ and $\|z_h\| = 0$. $\square$

Given these results, the sequence of fixed points takes values satisfying

$$\begin{aligned} \hat{x}_h &\in \{x_h \in \mathbb{R}^L \mid \int_I \bar{x}^i(d\nu) \leq x_h = y_h + \bar{z} \leq y^* + \bar{z}\} \\ \hat{s}_h &\in \{s_h \in \mathbb{R} \mid 0 \leq s_h \leq p_h(\bar{z} + y_h - x_h) + \sum_{k \in K} \bar{q}_k x_{kh} - \bar{m}\} \end{aligned}$$

and $p_h \in \bar{B} = \{p_h \in \mathbb{R}^L \mid \|p_h\| = 1\}$. The lower bound of the poll subsidy ¹ gives obvious lower bounds for mean demands and upper bounds on mean supplies. The upper bound of the restricted production set gives upper bounds for mean demand and the poll subsidy. These sets are compact. Thus there must be some subsequence which converges to a limit point which will be denoted by $[(c_k^*, y_k^*)_{k \in K}, s^*, p^*]$. Given that all the $\hat{c}_h^i, \hat{y}_h^j$ are integrable, we can apply Fatou's Lemma in many dimensions to show that there are subsequences $h(m)$ ($m = 1, 2, \dots$) of $h = 1, 2, \dots$ with some $p \in \bar{B}$ and s in the set defined above, and measurable functions x^{i*} such that: (i) $\int_I c^{i*} d\nu \leq c^*$; and, as $m \rightarrow \infty$, so: (ii) $p_{h(m)} \rightarrow p^*$; (iii) $s_{h(m)} \rightarrow s^*$; (iv) $\hat{c}_{kh(m)} \rightarrow c_k^*$; (v) $\hat{c}_{h(m)}^i \rightarrow c^{i*}$ a.e. in I .

By the properties of the fixed point and given that compensated demands and supply correspondences have closed graphs, $c^{i*} \in \xi_c^i(s^*)$ and $x^* - \bar{z} = \hat{y} \in \eta^I(p^*)$. From the discussion above $\bar{z} = x^* - \hat{y}$. This defines a compensated equilibrium. $\square$

¹Remember that mean demand was assumed to be single-valued at $s = 0$.

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