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ABSTRACT: We develop a Heckscher-Ohlin-Ramsey model, combining dual techniques with classic geometric techniques from trade theory. This framework is used to explore the long-run general equilibrium effects of regional integration (preferential trade agreements). Emphasis is placed on positive mechanics related to adjustment in the capital stock, long-run changes in the pattern in trade, and the implications for changes in long-run (steady-state) national income. The importance of relative country size and the dynamic implications for third countries are also addressed.

Key words: regionalism; trade and investment; preferential trade arrangements; Heckscher Ohlin Ramsey model; trade and growth

JEL classification: F15, F41, F1

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1. Introduction

Since the end of the Second World War, there have been two major waves of regional integration. The first of these, in the 1950s and 1960s, included not only a nascent European Union, but also regional initiatives centered on trade between developing countries. With the exception of the European experiment (which was driven by politics rather than economics), this first wave left little in the way of operational agreements. By the early eighties, multilateral tariff cutting by developed countries and unilateral trade liberalization by developing countries substantially weakened the case for regional integration. Yet, paradoxically, this apparent weakening of the economic case for integration has been followed by a second wave of preferential trade arrangements (PTAs), as well as a deepening and widening of existing agreements. By 1994, all but three (Japan, Hong Kong, and South Korea) of the 135 members of the World Trade Organization (WTO), were signatories to at least one such agreement. This second wave, beginning in the early 1980s, has included the North American Free Trade Agreement (NAFTA), as well as continued expansion of the European project. As in the first wave, it has also included initiatives focused on trade between developing countries (like MERCOSUR in Latin America.)

An important difference between the first and second wave has been a set of agreements linking industrial countries with smaller often less developed regional partners (like the NAFTA and the EU-South Africa trade agreement). The NAFTA has locked Mexico and the United States into such an agreement, while Southern European countries -- Spain, Portugal and Greece -- entered the European Union. The motivation behind these "North-South" agreements has been a mix of politics and economics. (See Schiff and Winters 1998; Baldwin et al 1997). On the economic side of the argument, the proponents of regional agreements seem convinced that their projects offer important potential dynamic effects related to growth and investment. (Baldwin 1989; Francois 1997; Fernandez and Portes 1998).

This paper is concerned with linkages between long-run capital stocks and regional integration schemes. While this issue has been highlighted in the recent literature on regional and multilateral liberalization, the basic approach largely has been computational. The theoretical treatment of the issue has been limited to a notional efficiency shock to GDP. This approach (a notional shock to GDP) has been motivated by appeals to the possible impact of a regional agreement, but without explicit development of the relevant trade-theoretic underpinnings. In contrast with the current literature, our goal here is to start instead from a well known and understood trade-theoretic general equilibrium model, the Hecksher-Ohlin model, and develop analytical results relating the long-run effects of regional integration to underlying fundamentals like relative country size and initial patterns of specialization.

The paper is organized as follows. Section 2 develops the basic analytical framework. This includes the development of the steady-state trading equilibrium for a Heckscher-Ohlin economy. Because of convenient properties of the steadystate, we are then able to draw on the well-developed geometric literature on regionalism to examine the basic, non-local long-run mechanics of PTAs. This is done in Section 3. We then turn in Section 4 to data on investment patterns surrounding recent PTA episodes, relating this to the theory developed. We summarize our results in Section 5.

2. The Model

The literature on capital accumulation and international trade dates back at least as far as Ricardo (1815). More recent literature includes Inada (1968), Johnson (1971), and Ethier (1979). In this section we draw together two streams of this literature. The first involves geometric representation along the lines of Atsumi (1971), while the second is the dual representation of steady-state equilibria along the lines of Manning and Markusen (1991). The standard 2x2 model is made dynamic by introducing both endogenous capital accumulation and inter-temporal optimization. The focus of this chapter is the long-run, steadystate structure of a trading economy. The dual approach makes clear the relationship of our framework to macroeconmic growth models, while the geometric approach facilitates explicit discussion of discrete (i.e. non-local) policy shocks.

2.1 Basic structure

We assume two goods, *X1* and *X2*, produced with the aid of two homogeneous factors, capital and labour. The population of the economy is fixed and consists of many identical families. The labour force is scaled by the population, with labour supplied inelastically. Hence, the total labour supply, L, is fixed. The economywide capital stock, *K*, is endogenously accumulated. In the spirit of the static Heckscher-Ohlin-Samuelson (HOS) model, we assume that both factors are perfectly mobile between sectors and both product and factor markets are perfectly competitive.[1] Furthermore, consumers and producers in a country face domestic prices that deviate from world prices due to trade taxes. (When we adopt the small country assumption world prices are taken as given.) We assume real specific taxes only on imports, which are directly transferred to households. We also impose current account clearing on the model in steadystate. The balance-of-payments constraint then requires that the value of expenditure on consumption and investment should equal the value of production plus the net revenue from trade taxes. (Note that we omit time subscripts whenever no ambiguity results.)

Formally, on the production side of the economy, we have:

(1) $$X1 = f^{1}(K1, L1)$$

(2) $$X2 = f^{2}(K2, L2)$$

(3) $$L = L1 + L2$$

(4) $$K = K1 + K2$$

We will also assume that goods *X1* and *X2* are combined into a composite good that is then either consumed or invested. This macroeconomic composite is defined as follows:

(5) $$Y = f^{Y}(X1, X2)$$

Note that f^{i} has the usual convexity properties. In the single country case developed in this section (and expanded to the multi-country case in the next), *Y* serves as the numeraire and is a measure of national income. Hence, all prices, wage rates, rental rates, and so forth can be expressed in units of *Y*. Furthermore, *Y* must be created at home (`assembled on site') so that

[1] However, since our focus is primarily on long-run, steady state equilibrium, it is possible to weaken this assumption of perfect capital mobility across both sectors. As also mentioned by Baxter (1992), as

only *X1* and *X2* are traded. The final good can be either consumed as *C*, or invested as *I* (i.e. added to the capital stock). This gives us the standard equation of motion of the capital stock:

(6) $$\dot{K} = I - dK$$

where a dot over a variable, such as over *K*, denotes differentiation with respect to time. We assume that capital depreciates at the constant rate δ. First order conditions for firms' profit maximization under perfect competition imply that

(7) $$r = P^{X1} \cdot f_K^1 - d = P^{X2} \cdot f_K^2 - d$$

(8) $$w = P^{X1} \cdot f_L^1 = P^{X2} \cdot f_L^2$$

where *r* is the real interest rate, *w* is the real wage rate, and P^{Xi} denotes the real price of *Xi*,and subscripts denote partial derivatives.

The consumption side of this model follows from the economic behavior of the families. The family is assumed to one in which individuals live forever (not very realistic) or a dynasty in which generations are continuously linked (more realistic). Each household maximizes the standard separable inter-temporal utility function

(9) $$V = \int_0^\infty e^{-q \cdot t} \cdot u(c_t) \cdot dt \qquad u' > 0, u'' < 0$$

where θ>0 is the rate of time preference and *u* is a strictly concave instantaneous utility function. Families hold assets in the form of capital and internal loans. The budget constraint for the family is given by

(10) $$\dot{a} = r \cdot a + w + t - c$$

where *a* is assets per family and *t* is the lump-sum transfer of tariff income. (We also impose the no-Ponzi game assumption.) The first-order conditions for maximization give the growth rate of consumption (i.e. the Euler equation).

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long as capital can be moved in the long-run (e.g. for example, by letting old capital equipment depreciate and placing new investment in a different location) the same steady state results are obtained

(11) $$\frac{\dot{c}}{c} = s \cdot (r - q)$$

where σ is the inverse of the negative of the elasticity of substitution. (For convenience we will assume a log-utility function, so that σ is equal to one.)

By combining the consumption side with the production side as outlined above, the model can be solved for a competitive market equilibrium.[2] The aggregate of each variable is denoted by its capital letter. As the only form of asset holding is capital, we have that *A*=*K*. The state variables are *K* and *C*, and their time paths are determined by equation (6), the aggregate version of (11), and a transversality condition. In the long run (defined as where the steadystate conditions hold) consumption remains constant and total savings equals the depreciation of the capital stock.

2.2 A dual representation

To consolidate our basic framework for use in multi-country steadystate analysis, we use the dual general equilibrium approach popularized by Dixit and Norman (1980). (Though actually, our work here is closer to that of Woodland 1982). This approach has the advantage of reducing a multi-country model to a relatively simple set of reduced form equations. Under this approach, the single country equilibrium can be summarized as follows:

(12) $$e(P^d, Y) = g(P^d, v) + t \cdot m$$

(13) $$m = e_{P^d} - g_{P^d}$$

(14) $$g_k = (q + d)P^Y$$

(15) $$P^d = P^* + t$$

The scalar *e(.)* is the minimum expenditure required to a achieve a specified level of national income *Y,*[3] while the revenue function *g(.)* represents the maximized value of outputs, given the same set of prices and the vector of factor supplies *v*. In the long run the capital stock will adjust so that equation (11) holds. In equation (12), *t* is the vector of import tariffs and *m* is the vector of net imports of the two tradable goods. Thus, the inner product $t \cdot m$ is the total

[2] In the Heckscher-Ohlin case, these equilibria are unique except for one set of prices that involves several steady-state production equilibria but unique factor prices. In more general terms, in multi-sector economies the rate of time preference must be sufficiently low to allow for existence of a steady-state. See the discussion by Manning and Markusen (1991) on this point.

[3] Hence, expenditure is a macroeconomic concept including both consumption and investment. In static trade models, this is normally the minimum expenditure needed to achieve a specified level of utility. The present setup with two components and one composite good allows us to use the expenditure function as a macro indicator.

tariff income on international trade. Import demand is the result, by using the envelope properties, of the excess demand functions. The term P^d is the vector of internal prices, while P^* denotes world prices. Equation (14) follows from the well-known envelope property of the revenue function, which states that g_{vi} is the price of factor v_i. Equations (12)-(15) describe the basic system, where the standard static representation has been modified by the addition of a rule for the steady-state capital stock. Given this system and in particular equation (14), the implicit function theorem is applied in order to get the long-run response of capital to price changes in equation (16).

(16) $$\frac{dK}{P^d} = -\frac{g_{KP^d}}{g_{KK}}$$

2.3 Imposing a Heckscher-Ohlin structure

In the context of a Heckscher-Ohlin model, there will exist only a single price ratio that is compatible with diversified production. This is because, from the Stolper-Samuelson theorem, real factor returns will be determined by relative goods prices. This is the left side of equation (14). At the same time, the Euler equation on the right side of equation (14) equates the net return to capital to the rate of time discount. Hence, only the set of goods prices consistent with a return to capital that meets the condition of equation (11) can support a diversified equilibrium in the steady-state. At any other set of prices, capital will adjust (increasing or decreasing) to escape the Heckscher-Ohlin straight-jacket through specialization. Hence, the manner in which capital accumulates essentially reduces the economy to a Ricardian model in the long-run. (See Atsumi 1971 and Baxter 1992 on this point). Therefore, with constant returns, we have the Ricardian property of a single price ratio that supports diversification, with a country specializing according to its comparative advantage. The region of the flat on the resulting Hechscker-Ohlin-Ramsey offer curve (discussed below) corresponds to the region of the production surface where the term g_{KK} is undefined.

With factor prices fixed in diversified production the long-run production possibility frontier (PPF) is also linear. However, in a diversified equilibrium the price line is not tangent to this PPF. In particular, the relative price of *X1* will be higher than this frontier if *X1* is the capital intensive good. In the region of a diversified long-run equilibrium, the long-run PPF is the Rybszynski line.

2.4 Trade policy in the single-country Heckscher-Ohlin case

To examine trade policy and terms of trade in our analytical framework, we will first look at the long-run offer function as given by equation (13). This is shown for the H-O-R model as

OO in Figure 1[4]. The dotted curve represents the tariff-ridden offer curve, which determines trade levels given the international price at which the country trades. The internal relative price can be obtained by deducting the relevant trade taxes. The linear section is due to the linear part of the long-run PPF (the Rybczynski line), and is the region where g_{kk} in equation (16) is undefined. Apart from the standard static reallocation (in production and consumption), a price change also causes an additional adjustment in the capital stock from equation (15). As a result, every particular relative price outside the flat region corresponds to a particular steady state capital stock and consumption level.

The effect of a change in the international terms of trade or trade policy can be analyzed by totally differentiating equations (12)-(15). This yields the following:

(17) $$dY = \left(g_P \cdot dP^d - e_{P^d} \cdot dP^d + g_K \cdot dK + t \cdot dm + m \cdot dt\right)$$

(16) $$\frac{dK}{P^d} = -\frac{g_{KP^d}}{g_{KK}}$$

(18) $$dm = e_{P^d P^d} \cdot dP^d + e_{P^D Y} \cdot dY - g_{P^d P^d} \cdot dP^d - g_{P^d K} \cdot dK$$

(19) $$dP^d = (1+t) \cdot dP^* + P^* \cdot dt$$

With some manipulation, this yields the following:

(20) $$dY = \left(-m \cdot dP^d - \frac{g_{KP^d}}{g_{KK}} \cdot g_K \cdot dP^d + t \cdot dm + m \cdot dt\right) \cdot e_Y^{-1}$$

Equation (20) includes both static and dynamic effects. The first term is the traditional terms-of-trade effect, while the second captures long-run changes in the endogenous capital stock (the accumulation effect). The last two terms then capture standard tariff revenue and allocation effects. (Recall that in the Heckscher-Ohlin setup, the term g_{KK}^{-1} is not defined for diversified equilibria.)

We can relate the mechanics identified in equation (20) to trade and consumption through Figure 1. In Figure 1, $\mathbf{OO^T}$ is the tariff-distorted offer-curve. An improvement in the terms of trade increases the steady state rate of consumption. Let point *A* in Figure 1 represent the initial equilibrium. With an increase in the terms of trade, *B* will be the new equilibrium. This can be caused either by a decrease in the price of the import good or an equi-proportionate

[4] The offer curve can geometrically be derived from the transformation curve of the two goods and the indifference map (see also Atsumi, 1971).

increase in the export price. We know that $e_Y = P^Y$, which is generically positive. Hence, we need to determine if the four terms within the brackets when added are positive. Since we don't have a change in tariffs, the last term has no effect. The term $(-m_X dP^d)$ is positive, as you pay less for your import good. This yields a positive terms of trade effect, translated into an income gain. The second term shows that we also get an additional accumulation effect. This will be positive (recall that we are specialized). Finally, the third term is positive, as the decrease of the relative price of the import good gives a boost to its volume. All the above effects take place as we move along the long-run offer curve $\mathbf{OO^T}$ pictured in Figure 1. As trade expands, we have an increase in steady-state capital and steady-state income. If the terms of trade deteriorate (and as trade then falls) then the opposite of the above effects occur. Note that the inclusion of endogenous capital amplifies the standard static result.

We next turn to what happens when the country unilaterally liberalizes trade. In terms of Figure 1, the equilibrium shifts from A to C. In fact by lowering its import taxes, the country is effectively able to improve its terms of trade all by himself. At first glance, this seems to be a trade policy with only positive effects. However, now the last term of equation (20) surfaces as well. This is always negative, as it reflects a loss of tariff income. For a small country, this loss is exactly compensated by the first term, as the lower tax rate lowers the import price by the same amount. In addition, the decrease of the distortionary import tax improves allocation in both production and consumption. This gives the standard result that the best trade policy for a small country is free trade with the rest of the world. We also have an extra negative dynamic effect linking tariffs to capital stocks and the macro size of the economy. This can be seen from the second term. For a small Heckscher-Ohlin-Ramsey economy, unilateral liberalization always induces capital accumulation, because export goods become more expensive relative to the import goods. Turning back to Figure 1, this means that national income is higher at point *C* than at point *A*.

3. Preferential Trade Arrangements

3.2 Both PTA members are small countries vis-à-vis the world

We start by assuming A and B are small relative to the outside country and that the formation of a PTA has no effect on world prices. Country A is large relative to B. (We will later relax these assumptions so that world prices are affected by the change in volume of trade.) We distinguish between three cases, which depend on the technology and size of the countries. First, if relative transformation technologies are such that both import the same good, a PTA will be totally ineffective as both only trade with the outside country. Second, if they import different goods, the formation of a PTA can cause either trade diversion from the outside country to the partner or trade creation among the partners. Finally, there also exists the possibility that one of the partner countries initially does not initially trade at all, neither with its partner nor with the outside country. In this case the formation of a PTA can also cause trade to be diverted from the outside country towards the (initially non-trading) partner country.

We assume that initially country B exports good *X2*, country A exports good *X1*, and combined they export good *X1* to the rest of the world. This situation is depicted in Figure 2, where the free trade and tariff-ridden long-run offer curves of both partner countries and the world prices are shown. Here, if there were only bilateral trade between A and B, trade would take place at *D.* However, the rest of the world offers an even higher price to A than at point D, so that A also trades with the rest of the world. Thus, before the PTA, all trade takes place at world prices and net trade between both partners and C is equal to *JE.* When we introduce the PTA, we will realize a mix of trade creation and trade diversion.

In order to deconstruct what happens when A and B form a PTA, we can make use of the Engel curve, which represents the desired consumption of two goods at various income levels with the same relative prices. The Engel curve for country A, trading at point *E*, is shown in Figure 3a. The point *E* in Figure 3a is the same equilibrium as that represented by point E in Figure 2. At this equilibrium, the value of GDP (in terms of the composite good) is Y^{0}, with trade taking place from production point $X1^{P}$ along world price line P^{wo}, though internal prices are P^{d0}. Knowing that production won't change when internal domestic prices stay the same, we can easily construct different trade triangles for given internal prices and depending on the external terms of trade. For example, point *E* represents consumption of $X1^{0}$and $X2^{0}$ at prices P^{d0}, with a corresponding amount of our GDP composite *Y* given by the iso-curve Y^{0}. Production takes place at $X1^{p}$, and $X1^{p}X1^{0}e^{0}$ is the initial trade triangle. As we shift the terms of trade and keep constant internal prices, consumption shifts, with a corresponding shift of GDP. If we take the world price set that, at free trade, also yields internal price P^{d0} , this implies equilibirum point *F* with a lower GDP. Note that point *F* in Figure 3a is the same as point *F* in Figure 2. For combinations of tariffs and world prices, we can map trade triangles from Figure 3a into Figure 2. This yields what we call the Kemp curve, which links these trade vectors between points *E* and *F*, and which is represented in Figure 2 by the line between these two points. It is the properties of the equilibrium at point *F* that let us identify internal prices at point E as those corresponding to the intersection of the free trade offer curve and the Kemp curve.

After the formation of the PTA, domestic prices remain the same in A as long as A still trades with C. This is because, at the margin, supply prices are then set by rest-of-world prices, inclusive of the tariff. In this case the new equilibrium for *A* is again located on the Engel curve, where A has a lower income due to the loss of tariff revenue. Now A and B trade more with each other -- OG -- and A trades less with the rest of the world -- GH [5]. Note that the relatively small country B now trades with A at what are for him the more beneficial domestic prices of A. Clearly country B has gained from the PTA, but country A has lost due to the trade diversion. The national income effect of countries A and B can be examined with the help of Figures 3a and 3b, respectively.

In Figure 3a, Country A is specialized in production of $X1$ at $X1^p$, trading to equilibrium point E. After the formation of the PTA, country A trades triangle $X1^pX1^bG$ with B against worse terms of trade. Remaining trade with the rest of the world leads to a trade equilibrium at point H. Because internal prices stay the same nothing changes at the production side. Again it can be seen that the new equilibrium is located on the Engel curve, where A has a lower income Y^1 due to the loss of tariff revenue.

While Country A realizes a fall in income, Country B (specialized in $X2$) is able ex-post to obtain a higher income due to the improved terms of trade and the additional dynamic accumulation effect. Figure 3b represents these changes for Country B. The initial trade equilibrium for Country B in Figure 2, indicated by point J, is also represented by point J in Figure 3b. The new long-run equilibrium is represented in Figures 2 and 3a by point G. Note that there is an expansion of the economy, represented by the shift in production from $X2^{P,0}$ to $X2^{P,1}$. There is also an increase in national income, from Y^0 to Y^1.

Our analysis so far yields another interesting insight. After the formation of the PTA, the smaller Country B may be hesitant to decrease common external tariffs for imports from the outside country. This deteriorates his terms of trade and means also de-accumulation of his capital stock and a general contraction of the economy. After the formation of the PTA the situation is very much like the Ricardo-Viner model for the two countries combined, where labour in each country can be seen as the specific factor of the good in which the country is specialized and capital the mobile factor. By decreasing the external tariff the relative price of the import good decreases, which means that the specific factor of that good (i.e. labour in country B) looses income. The joint GDP will increase by such a move towards free trade with the rest of the world.

We now turn back to our system of equations. As country B only trades with A and country A also with the rest of the world, we have

[5] Whether A trades more or less with C actually depends on the long-run offer curve of B and the Engel-curve of A. However, in order to let trade fall, B not only has to export less than before, but also less than the decreased import demand from A.

$$
\begin{aligned}
&dY^a = \left((t^{ai} - t^{ae}) \cdot dm^{ab} + t^{ae} dm^a + m^{ai} dt^{ai}\right) \cdot e_{Y^a}^{-1} \\
&dm^a = e_{P^a Y^a} \cdot dY^a < 0, \quad and \\
(25) \qquad &dY^b = \left(-m^b \cdot dP^b + g_K^b \cdot \frac{g_{KP}^b}{g_{KK}^b} \cdot dP^b + t^{bi} \cdot dm^{ba} + m^{bi} \cdot dt^{bi} \right) \cdot e_{Y^b}^{-1} \\
&dm^b = dm^{ba} = -dm^{ab} = \left(e_{P^b P^b} - g_{P^b P^b} - g_K^b \cdot K_{P^b}\right) \cdot dP^b + e_{P^b Y^b}^b \cdot dY^b > 0
\end{aligned}
$$

The change in intra-club tariffs that follows from the PTA formation has effect on Country A's domestic prices, but does mean a loss in tariff revenue. In addition, in total A will also import less (see Figure 3a). Hence, country A looses steady state income as trade with B becomes more expensive. Country B gains in a national income sense from the PTA due to the improved terms of trade, the increased volume of trade, and the dynamic effect of capital accumulation.

What is the effect on the combined national income of the PTA partners? The fact that domestic prices in A are unaltered means that the loss of tariff revenue captured by the last term in (25) is fully accounted for by the increase in the export price of country B. The combined effect can be presented as follows.

$$
(26) \quad dY^a \cdot e_{Y^a} + dY^b \cdot e_{Y^b} = \left(g_K^b \cdot \frac{g_{KP}^b}{g_{KK}^b} \cdot dP^b + (t^{ai} - t^{ae}) \cdot dm^{ab} + t^{ae} \cdot dm^a + t^{bi} \cdot dm^{ba} \right)
$$

The effect on combined GDP depends on the total of the effects in equation (26). If we first ignore the dynamic effect (i.e. the first term) then we have to focus on the last set of terms in equation (26). This is because, as pointed out by Ethier and Horn (1984), when trade was ex-ante non-discriminatory, trade diversion generated by the marginal preferential tariff reduction must have a zero first-order effect on income. In equation (26), this can be seen by the fact that when t^{ai} and t^{ae} are equal the second term cancels out. However, any trade creation, as captured by the last terms, must have a first order effect. Hence, a marginal change must raise joint welfare. Of course, if we want to analyze discrete changes or even a complete move towards a PTA, this zeroing of the middle term no longer holds. In the general case, therefore, the second term in (26) is non-zero (with a negative impact) and from the equation it is impossible to tell the net effect related to classic effects. We can say (with Kemp 1969 still in mind) that a move towards a PTA raises incomes as long as the new internal prices for B are moving in the direction of the optimal international prices (i.e. replication of relative world prices). The additional accumulation effect only amplifies this result.

In the above case, it was assumed that after the formation of the PTA country A still trades with the rest of the world. However, it also possible that after forming a PTA both partner countries only trade with each other. Now domestic prices will change in country A. When moving towards a free trade agreement, A keeps trading with both countries until their terms of trade, as perceived by domestic consumers, become equal. Further preferential tariff reductions between A and B result in the standard gains of trade liberalisation. The net effect for country A depends on the losses due trade diversion and the gains from trade creation. Of course, country B still has gained.

Finally, we consider the last case where one of the countries initially does not trade with either of the two other countries. This case is presented in Figure 4, where A does not trade with C due to the similar technologies and the existence of impeding trade costs. In panel a of Figure 4, country A is the natural trading partner of country B, while in panel b it is C. Ex-ante country B imports good *X1* from C, which offers a better terms of trade than A and trade takes place at *E.* However, after the formation of the PTA it becomes possible that B starts trading with A due to the now discriminatory tariffs. When moving towards a complete free trade area (i.e. as we incrementally drop the tariffs), nothing happens until the perceived offer (given by the intercept of Kemp curve and the free trade offer curve) of A is just marginally better than the offer of C. Once this happens, country B's trade will divert towards the partner country A. In panel b, this involves trade diversion to the more expensive partner. However, in this case moving further to free trade now only results in the traditional gains from free trade. As depicted in Figure 4a and b, when B is small relative to A, the gains go to B in the form of an improved terms of trade and less distorted domestic prices. Once the relative domestic price of the export good of B increases, capital starts accumulating which results in more production. After the FTA is established trade takes place at *F* where A and B only trade with one another. In panel b, the external terms of trade for B is worse than before. The overall effect for country B depends on the losses due to trade diversion relative to the gains from further trade liberalization with the partner country. We only can tell with certainty that the steady-state income gains outweigh the losses when after the formation of the PTA the external terms of trade have improved for B.

In algebraic terms, we can express the effects for country B discussed above as follows:

$$(23b) \qquad dY^b = \left(-m^b dP^b + g_K^b \cdot \frac{g_{KP}^b}{g_{KK}^b} \cdot dP^b + t^{bi} \cdot dm^{ba} + t^{be} \cdot dm^{be} + m^{bi} \cdot dt^{bi} \right) e_{Y^b}^{-1}$$

Again the degrees of trade creation and trade diversion (as in Figure 4b) are reflected in the third and fourth term. When B initially shifts trade from C to A due to the lower internal tariff rate, this results in a negative effect on income. However, further liberalisation causes a positive volume of trade and terms of trade effect. Of course, if after the formation of the PTA the external terms of trade have remained the same, we know that these positive terms of trade effect exactly offset the negative effects of the initial trade diversion. When additionally the relative domestic price of the export good has improved, country B has gained (in a national income sense) from the PTA. In terms of Figure 4, as long as the new internal PTA price is better for B (in other words above the world offer curve) then country B gains.

For country A there are no income effects if both A is large and they move to a complete FTA. Hence, the combined effect for the large and small partners depends only on the net effect for country B. (However, if A is not large he gains from a positive terms of trade effect, which then eats into the income gains of the smaller country.)

4. Empirics

In the previous section we developed an analytical framework linking regional integration (PTAs), through resulting terms-of-trade shifts, to induced changes in capital stocks. The basic message is that we can expect induced investment (either positive or negative depending on terms-of-trade changes) to be concentrated in the smaller partner. The sign of the investment effect is linked to the sign of terms-of-trade changes. In the case where the rest-of-world is large, the larger PTA country does not experience dynamic income gains, but rather the standard loss in tariff revenue (which is a gain for the smaller PTA partner). However, even for a small country the gains are not certain, as there is the possibility of trade diversion from cheap imports from the rest of the world towards more expensive imports of its larger partner country. In this section we confront our theoretical results with the actual pattern of investment surrounding recent PTA episodes.

A good first indicator would be the change of the terms-of-trade following PTA formation, as this captures the induced price changes of all traded goods. Within our analytical model, it is the domestic relative price of the specialized good that causes the capital stocks to adjust, but the more readily available external terms of trade can give a rough and more directly comparable approximation of whether the gains from trade creation outweigh the losses of trade diversion.

Several cases can be distinguished in the past 30 years where a relatively small country has formed or joined a PTA involving a large partner country or group of partner countries. These include, for example, the three major enlargement episodes of the EU: the Northwest enlargement in 1973 (UK, Denmark, and Ireland); the Mediterranean enlargement in the 1980s (Greece 1981, Spain and Portugal 1986); and the Northeast enlargement in 1995 (Austria, Finland, and Sweden). In the Western hemisphere we have the formation of the North America Free Trade Agreement (NAFTA) with first an agreement between the US and its smaller neighbor Canada in 1989 and later the accession of Mexico in 1994, and also MERCOSUR.

In theory, the induced investment should appear in the small countries that have experienced an increase in their terms of trade in the period following accession to the PTA. However, if the time of accession would be known or at least expected in advance, investment effects could arise before the actual accession period in expectation of higher future prices. Figures 5 and 6 plot investment indices (relative to an OECD aggregate) for recent PTA episodes for the 6 years around the time of accession.[6] The relative increase in the terms of trade in the year of accession for each country is shown in parenthesis.

The strongest investment response after accession to the EU occurred in Ireland, Spain and Portugal. In MERCOSUR, there is a similar pattern for Uruguay. Next, the accessions of Mexico and Canada to the NAFTA also show an investment boom, though like the case of Uruguay it started before the actual entry. This might be explained by the fact that in these cases strong expectations already existed several years before entry. If we then examine whether these countries also experienced a positive terms of trade effect at the year of accession, we can indeed observe this for all countries but Mexico[7]. The investment boom in Mexico could be explained by other NAFTA-related factors, in particular the fact that it became a partner with its strong neighbor, the US, which may have boosted investor confidence by reducing the country risk associated with concurrent economic reforms[8]. Note that, for the most part, for countries that did not experience induced investment the figures show no improvement in the terms-of-trade at the time of accession. The exception is the countries of the Northwest enlargement, which seem to have a positive terms-of-trade effect but no sign of any investment effect.

Our sample is small, limiting our room for empirical maneuver. We have estimated the correlation coefficient between the investment effect over the 6-year period (INV) with the terms-of-trade effect (TOT). The result is reported in Table 1. We do indeed find a positive correlation between the two variables, although we should be cautious given the relatively low significance and limited number of data points.

[6] In all cases the date of entry was January 1, and, hence, the year of accession is the first year as partner.

[7] Bhagwati and Panagariya (1991) have suggested that the forming of a FTA between high-protected Mexico and low-protected US might result in trade diversion fo r Mexico and, hence, no terms of trade gain.

[8] Indeed it was this strong commitment of the US that made a quick recovery possible of the Peso-crisis in 1995.

***Table 1.* correlation coefficient**

	TOT
INV	0.52
	(1.82)[1]

[1]t-value of correlation coefficient, which is significant for a 10% critical value.

Source: OECD Statistical Compendium, CD-ROM 1999 (INV), Monthly Bulletin of Statistics, United Nations, several volumes and World Economic Outlook (TOT).

5. Summary

A basic goal of this paper has been to develop a formal general equilibrium treatment of an issue now highlighted in the computational and policy literature - investment effects in the context of regional trade agreements. Surprisingly, while this has been a high profile issue in the policy literature on NAFTA and EU enlargement, the theoretical literature has not focused on the relevant trade-theoretic underpinnings. While we examine some of these issues, we admit up front that many are left outstanding and merit further development. These include extension beyond the basic Heckscher-Ohlin structure explored here, movement away from the assumption of perfect substitutability between national products, and the introduction of production externalities/economies (like specialization effects).

Our approach has involved working with a well-known trade model (the Heckscher-Ohlin model), modified to include inter-temporal optimization. The resulting hybrid model (the Heckscher-Ohlin-Ramsey or HOR model) exhibits steady-state properties identical to those of the standard Ricardian trade model. This allows us to use well-developed tools from trade theory to develop geometrically the non-local (i.e. non-marginal) impact of PTAs, in the steady-state, on PTA partners and outside countries.

A basic result is that induced investment effects are concentrated in the smaller PTA partner country. In the case where the rest-of-world is large, the larger PTA country does not experience comparable direct induced investment or associated long-term income effects. It does experience the standard loss in tariff revenue (which is a gain for the smaller PTA partner), a loss is magnified over time as the small country expands under the PTA. However, even for a small country income gains are not certain, as there is the possibility of trade diversion from cheap imports from the rest of the world towards more expensive imports of its larger partner country. Hence, in order to assess the overall investment effects for a small country it is necessary to assess the relative strengths of the forces causing trade creation and trade diversion. For all parties (PTA partners and outsiders), an induced draw-down of capital stocks hinges on terms-of-trade losses. Empirically, terms-of-trade shifts may then be a smoking gun linking PTA episodes with associated investment shifts. Turning to data, we work with the terms of trade around PTA formation as indicator to represent both forces, which brings us closer to where we expect the investment effects to occur. Empirical evidence is presented which appears consistent with our theoretical results.

References

Atsumi, H. (1971), "The Long-run Offer Function and a Dynamic Theory of International Trade." *Journal of International Economics*, 267-299.

Baldwin, R.E. (1989), "The Growth Effects of 1992." *Economic Policy* 4, no. 9: 247-283.

Baldwin, R.E., J.F. Francois, and R.E. Portes, (1997), "Costs and Benefits of EU Enlargement to the East," *Economic Policy*, April 1997.

Baxter, M. (1992), "Fiscal Policy, Specialization, and Trade in the Two-Sector Model: The Return of Ricardo?" *Journal of Political Economy*, 100, 713-744.

Bhagwati, J. and A. Panagariya (1991), *The Economics of Preferential Trade Agreements*, The AEI Press, Washington, D.C.

Dixit, A.K. and V. Norman (1980), "*Theory of International Trade.*" Cambridge University Press.

Ethier, W. (1979), "The Theorems of International Trade in Time-Phased Economies." *Journal of International Economics*, 9, 225-238.

Ethier, W. and H. Horn (1984), "A new look at economic integration, in H. Kierzkowski, ed., *Monopolistic competition in international trade*, North-Holland, Amsterdam.

Francois, J.F. (1997), "External Bindings and the Credibility of Reform." In A. Galal and B. Hoekman, eds., *Regional Partners in Global Markets:Limits and Possibilities of the Euro-Med Agreements*, CEPR, London and ECES, Cairo.

Fernandez, R. and J. Portes (1998), "Returns to Regionalism: An Analysis of Nontraditional Gains from Regional Trade Agreements." *The World Bank Economic Review*, 12 (2).

Inada, K. (1968), "Free Trade, Capital Accumulation and Factor-Price Equalization." *Economic Record*, 44, 322-341.

Johnson, H.G. (1971), "Trade and Growth: A Geometrical Exposition." *Journal of International Economics*, 1, 83-101.

Kemp, M. (1969*), A contribution to the general equilibrium theory of preferential trading agreements*, North-Holland, Amsterdam.

Manning, R. and J. Markusen (1991), "National Product Functions in Comparative Steady-State Analysis." *International Economic Review*, 32: 613-624.

Ricardo, D. (1815), *The Principles of Political Economy and Taxation*. Reprint, London: Dent, 1976.

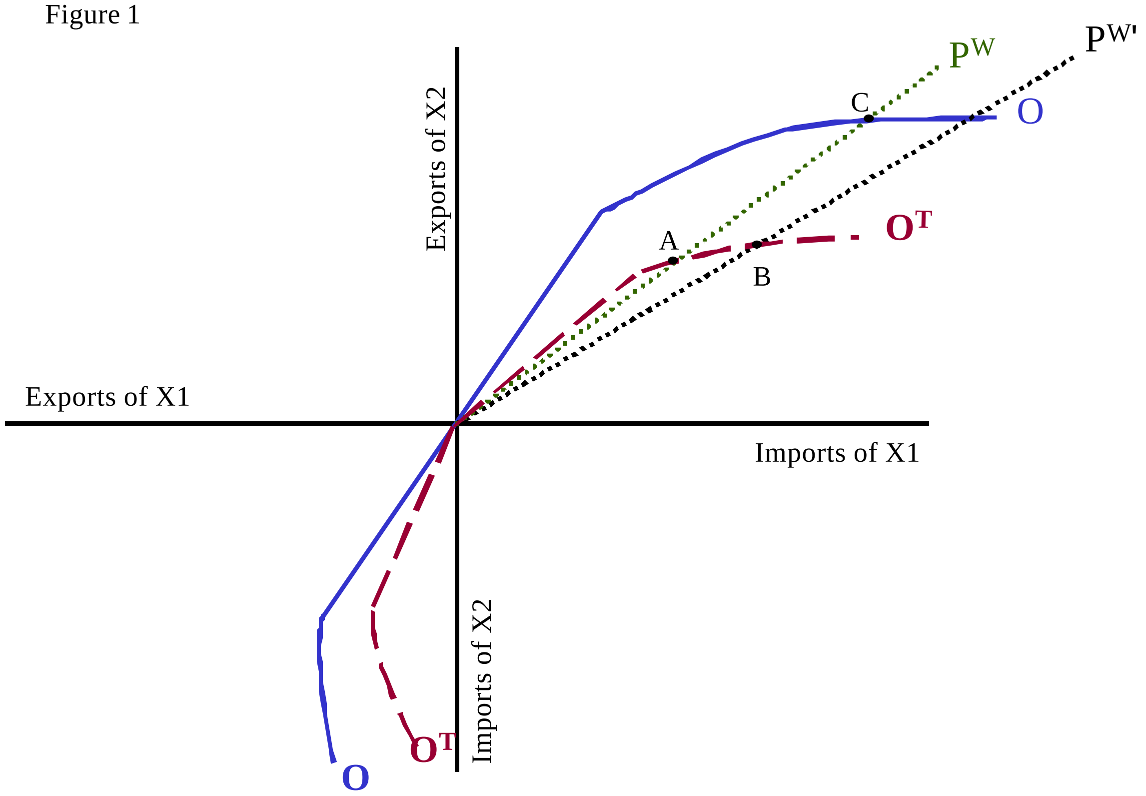
Schiff, M . and L. Winters (1998), "Dynamics and Politics in Regional Integration Arrangements: An Introduction." *The World Bank Economic Review*, 12 (2).

Woodland, A.D. (1982), *International Trade and Resource Allocation*, North-Holland, Amsterdam.

Wonnacott, P. and R. Wonnacott (1981), "Is Unilateral Tariff Reduction Preferable to a Customs Union? The curious Case of the Missing Foreign Tariffs." *American Economic Review*, 71, 704-713.

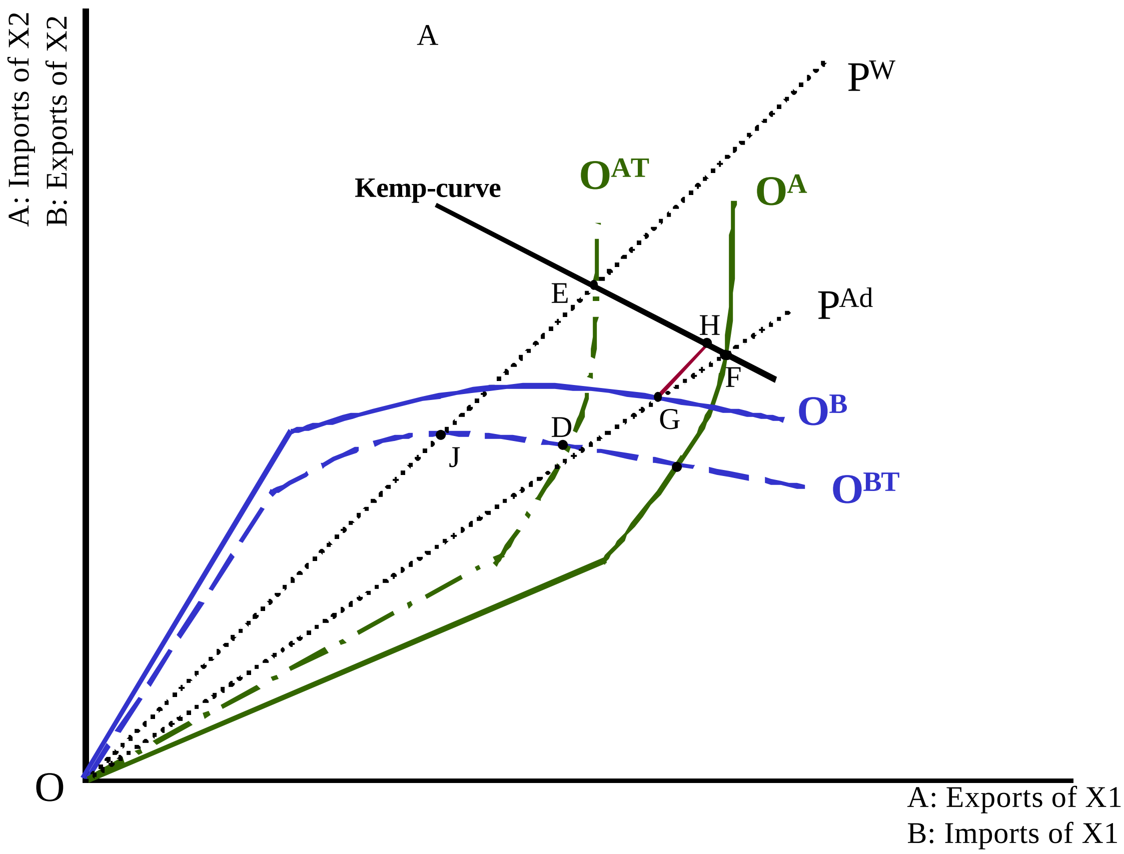
WTO, *Regionalism and the World Trading System*, Geneva.

Figure 1



P^W
$P^{W'}$
C
O
Exports of X2
A
O^T
B
Exports of X1
Imports of X1
Imports of X2
O^T
O

Figure 2



A: Imports of X2
B: Exports of X2
A
P^W
Kemp-curve
O^AT
O^A
E
P^Ad
H
F
G
O^B
D
J
O^BT
O
A: Exports of X1
B: Imports of X1

Figure 3a

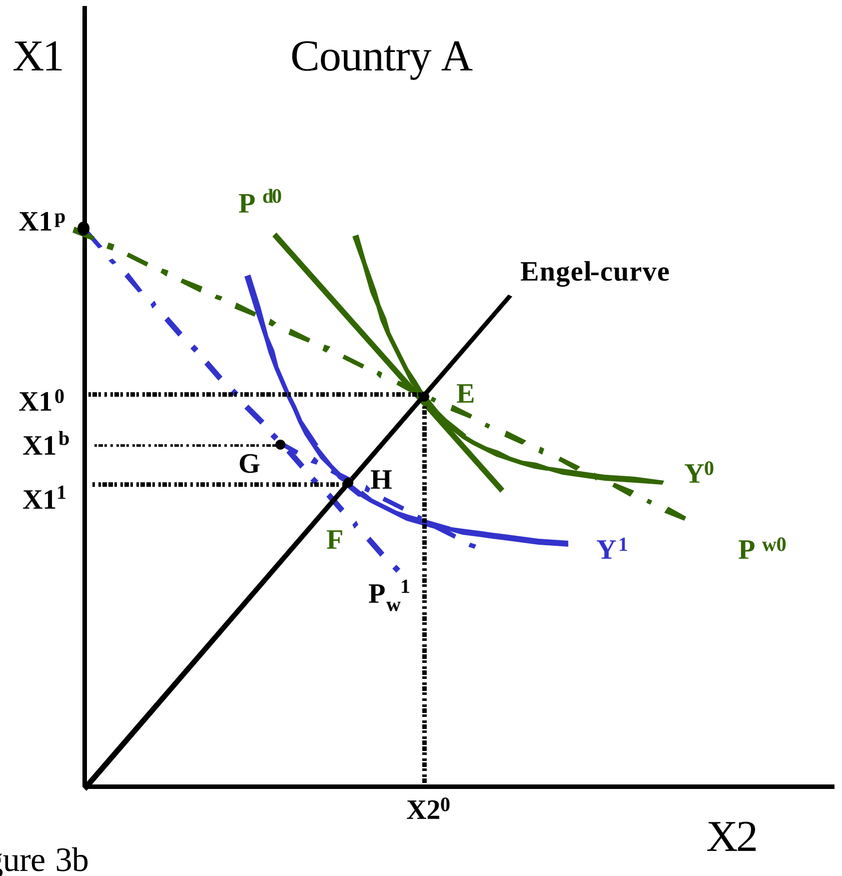


Figure 3b

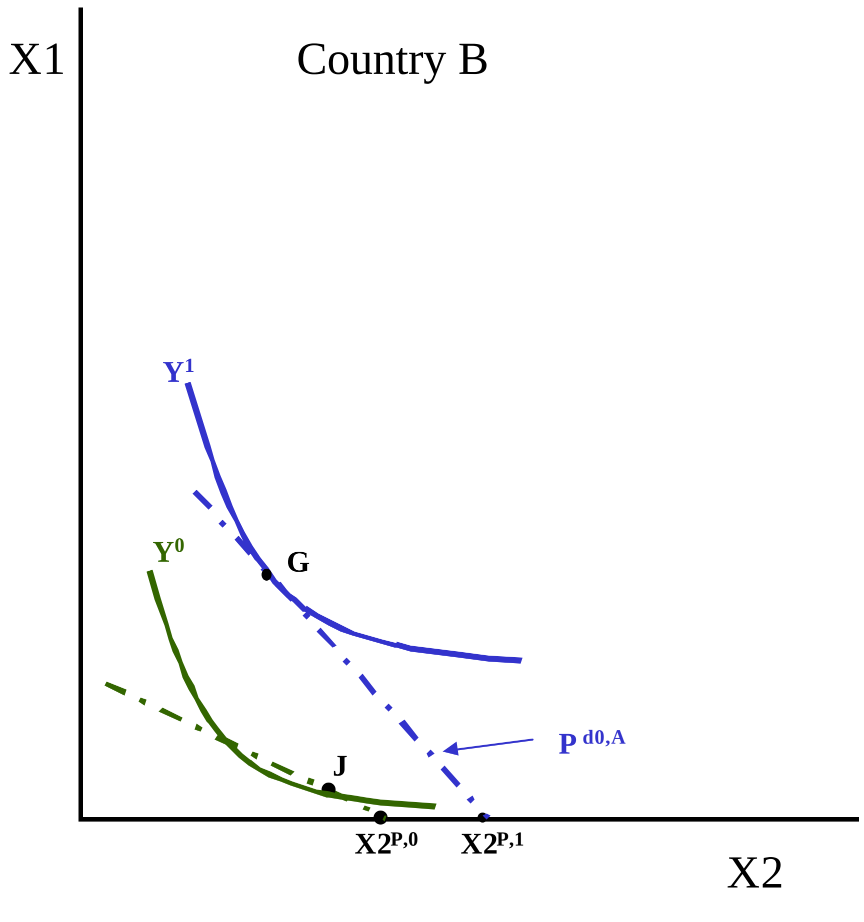


Figure 4a

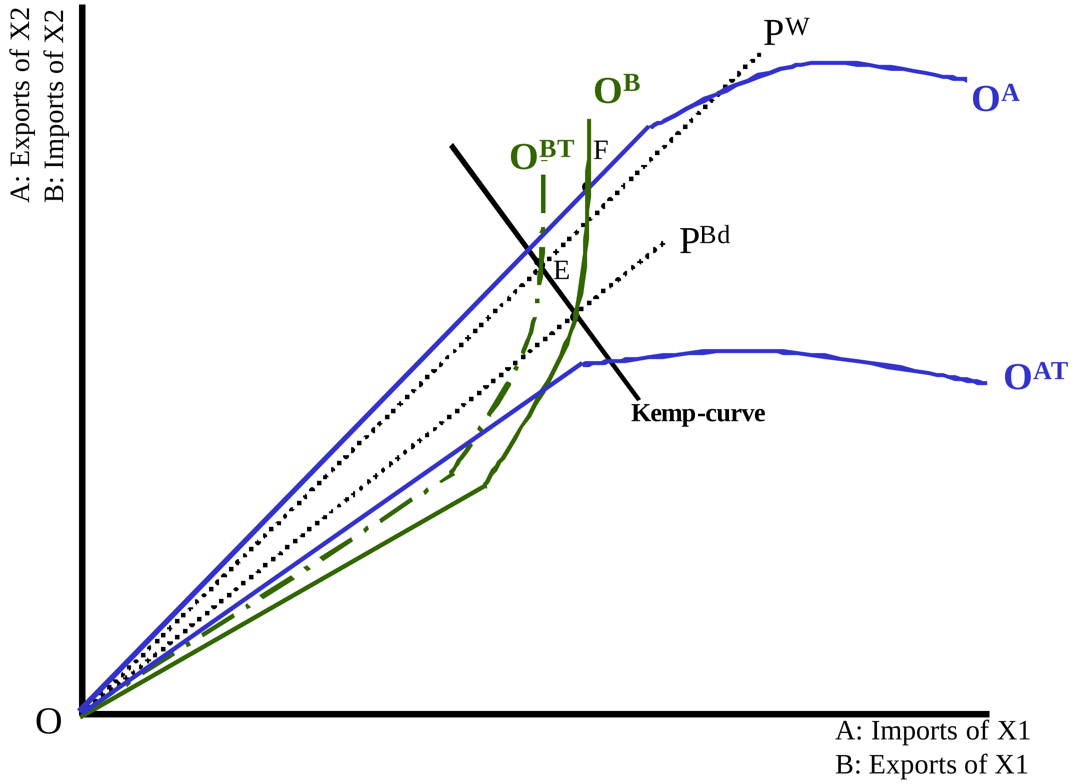


Figure 4b

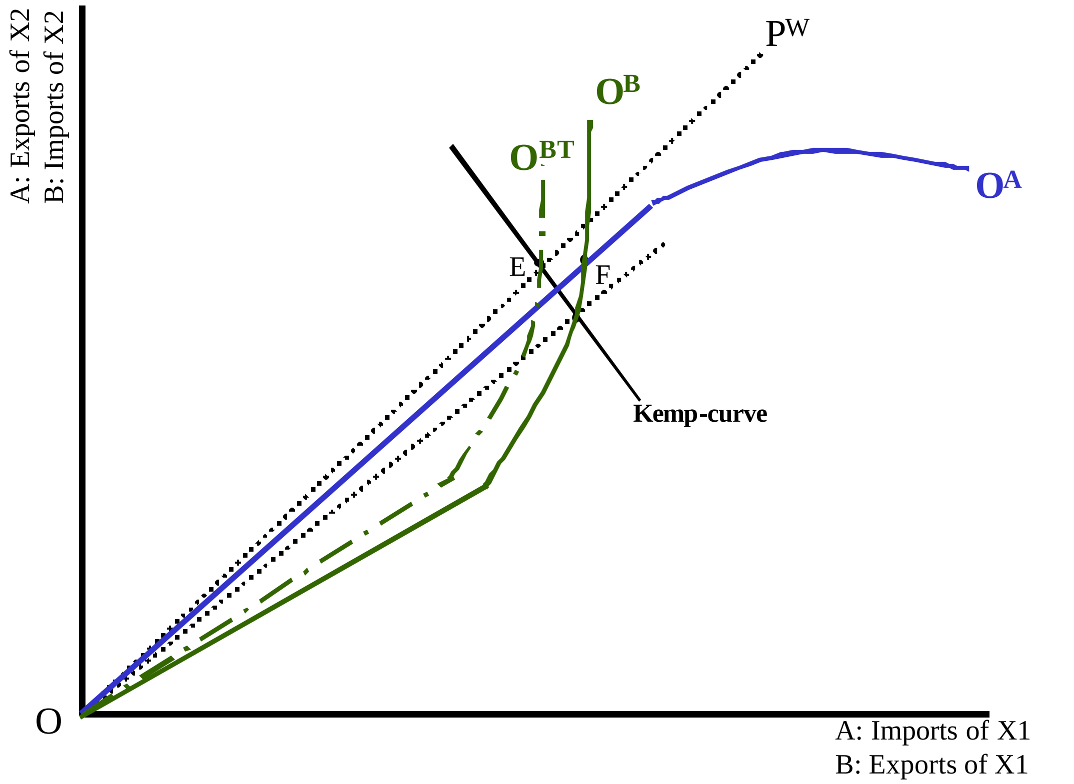


Figure 5. Investment effects of integration - The case of Europe

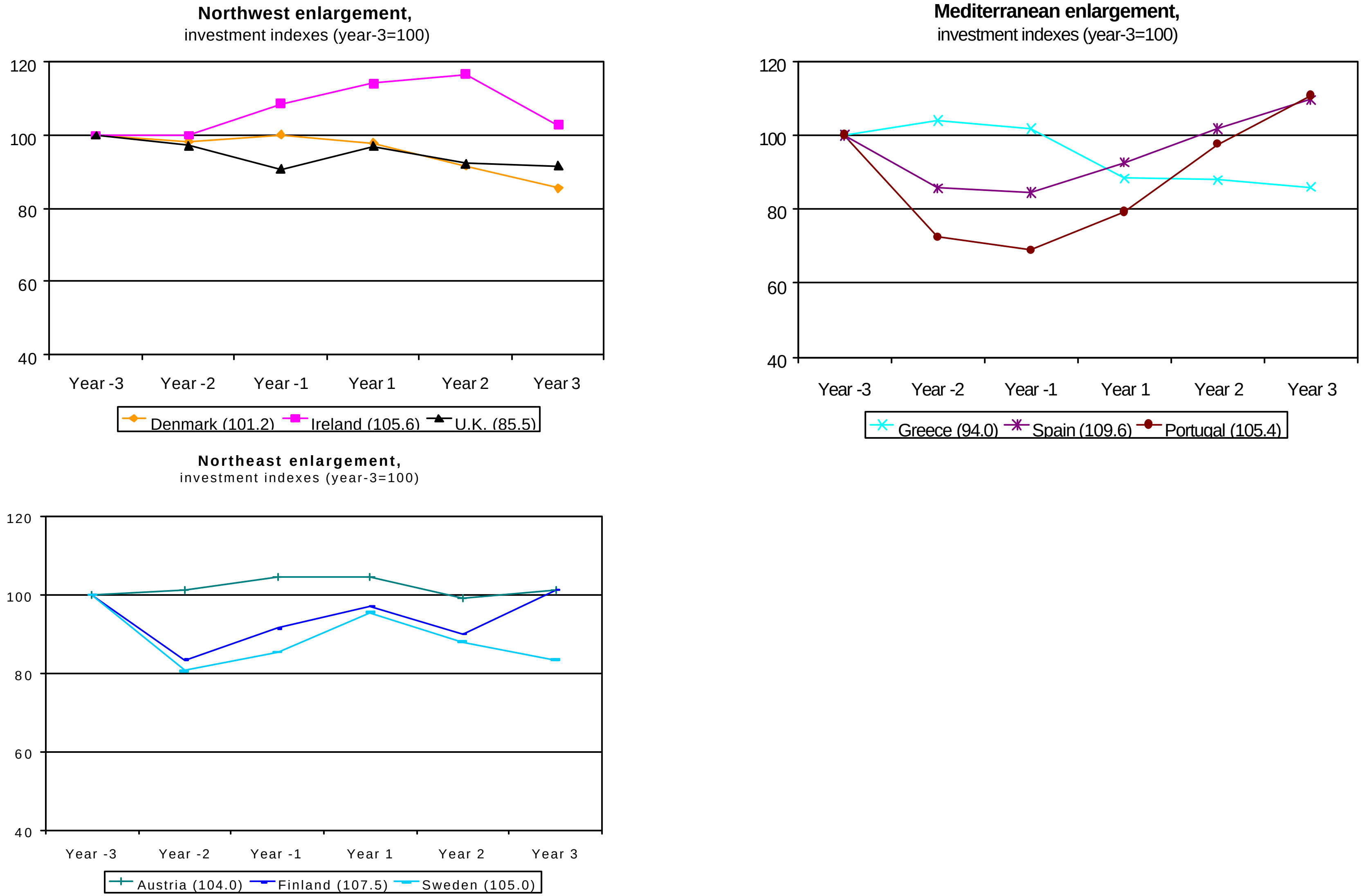


Figure 6. Investment effects of integration - The case of the Americas