Export-Platform Foreign Direct Investment

Karolina Ekholm
Stockholm School of Economics and CEPR

Rikard Forslid
University of Stockholm and CEPR

James R. Markusen
University of Colorado, Boulder,
NBER, CEPR

Abstract

A poorly-understood empirical phenomenon is export-platform affiliate production for sale in third countries rather than in the parent or host countries. Our model identifies conditions under which a firm in each of two large, high-income countries use a small, low-cost country solely as an export platform to serve the other high-income country but not the firm's home market. A critical role for intermediate inputs is identified in supporting such an equilibrium. We then consider a free-trade area between one of the large, high-income countries and the small, low-cost country. For a range of parameters, the firm in the insider country may adopt a home-country export-platform strategy and the outsider firm a third-country export-platform strategy: e.g., both a US and European firm adopt a plant in Mexico solely to serve the US, and each maintains a plant in Europe to serve Europe. This particular outcome is interesting because it is the *outsider* firm which is the relative beneficiary of the free-trade area. Our empirical section emphasizes its relevance: US affiliates located inside a free-trade area concentrate their exports to other free-trade-area countries

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Corresponding author:

James R. Markusen
Department of Economics
University of Colorado
Boulder, CO 80309-0256
1-303-492-0748(voice) -8960 (fax)
james.markusen@colorado.edu

1. Introduction

In 2000, 64 percent of total sales of foreign manufacturing affiliates of US multinationals were sold domestically, while 36 percent were exported (BEA data). Out of the latter figure, about a third were exported back to the US and about two thirds were exported to third countries. The literature on FDI provides a good theoretical and empirical understanding of the phenomenon of affiliate production for local sale, often associated with horizontal FDI. It also provides an understanding of affiliate production for export to the parent country, a phenomenon often associated with vertical FDI. However, we know little about affiliate production for export to third countries, which we will refer to as third-country export-platform FDI. This is likely due to the fact that most of our theoretical understanding is largely derived from two-country models, which by definition cannot address third-country exports.

The importance of export-platform (henceforth EP) FDI is documented in a study by Hanson, Mataloni, and Slaughter (2001). Using data on the foreign operations of US multinationals, they report that although the average share of exports in affiliate sales has remained constant at about one third, there has been a substantial increase in Mexico and Canada after the formation of NAFTA. Their econometric analysis suggests that EP FDI is promoted by low host-country trade barriers and discouraged by large host-country markets.[1]

Table 1a presents some examples that motivate the analysis. The data are sales by foreign manufacturing affiliates of US multinationals, broken down into the share of total sales exported sales back to the US, the share of total sales exported to third markets, and the share of total exports that go to third markets (data from Markusen and Maskus 2001, 2002). The first line of data presents average figures for all 39 host countries in the data set, and subsequent lines present three groups of countries where there is some common feature of the

[1]Note that according to this definition of export-platform FDI, situations where the foreign affiliate exports back to the home country are included. We will need more precise, if awkward, terminology, and use "third-country EP" FDI to refer to production solely for export to third countries, "global EP" FDI for balanced exports to both parent and third countries, and "home-country EP" FDI for exports back to the parent only (this last is traditionally called vertical FDI, but all of these cases have elements of vertical FDI).

group data.

The first group of countries, some small and/or low-income countries in the EU, have the highest proportion of affiliate exports going to third countries of all countries in the sample, and a very low proportion going to the US. The second group of countries drawn from Southeast Asia, display significantly more balance between exports to the US and exports to third countries. These countries do not make up an integrated regional market, and we interpret the data as meaning that affiliate exports serve global markets. The third group of countries in Table 1 are the US's NAFTA partners, Canada and Mexico. In these data, the shares of export going to the US and to third countries are more or less the reverse of those for the first group of countries.

As indicated above, we have a good understanding of the division of affiliate production into local sales and total export sales in Table 1, but the *composition* of export sales remains both a theoretical and empirical puzzle. The purpose of this paper is to present a simple model showing the conditions under which EP FDI is likely to arise and the conditions under which sales to third countries dominate the affiliate's production. We present a three-region model in which two regions are identical, large markets.[2] These regions and their firms are denoted W (west) and E (east) and collectively these two regions are referred to as N (north). We are thinking here of the US-Canada market and high-income EU being W and E respectively. The third country is a small, low-cost country, denoted S (south).

We assume that the world has two firms in the multinationalized sector, one headquartered in W and one in E, referred to as firms W and E respectively. We also assume there is no domestic demand in the small, low-cost country, so that all output of affiliate plants (if any) in that country is exported. These two assumptions alone greatly reduce the

[2]Other theoretical treatments of EP production are Motta and Norman (1996), Neary (2002) and Yeaple (2003). All these models and ours make different assumptions for the common objective of limiting the range of possible outcomes. In Neary and Motta-Norman, exporting back to the parent is ruled out by assumption, something we very much want to endogenize. Our model is closer to Yeaple, but our production structure on and trade costs for final and intermediate goods is rather different from his. Futhermore, he maintains a symmetry assumption throughout, while we also analyze asymmetric cases, which turn out to be crucial for interpreting the empirical evidence.

number of cases that must be considered and allow us to focus on the *composition* of affiliate exports.

The two firms must produce an intermediate good at home, but final output can be produced anywhere. The first case we consider involves symmetric trade costs on all links, so that the two firms will each adopt the same number of plants, and either both or neither will have a plant in S. It is not immediately clear, at least to us, why a firm would put a plant in S solely to serve the other northern market but not also serve its home market given this symmetry. But we show that third-country EP production does arise as an equilibrium when costs in S are low, but there are moderate costs of shipping intermediate goods or services from the north to S. This identifies a crucial role for intermediates in our model: the existence of and positive trade costs for intermediates is a *necessary condition* for a plant in S dedicated to third-country exports.

The second case we present is motivated by the discussion of free-trade areas above and by the data in Table 1. We assume that W and S form a free-trade area. The cost to firm E of shipping intermediates to a plant in S puts that firm at a strategic *disadvantage* relative to firm W. On the other hand, firm E enjoys the *advantage* of shipping final output duty free to W from its plant in S, while firm W must pay trade costs to ship final output from a plant in S to E.

One theoretical outcome in particular is shown to be relevant in our empirical section: US affiliates inside free-trade areas have their exports concentrated to other free-trade area members. Although reasonably intuitive, this outcome is especially interesting because the theory identifies this as a case where the *outsider* firm is likely to be the bigger beneficiary of the free-trade area.

2. A Symmetric, Three-Region Model

We adopt a partial-equilibrium framework which is very familiar from the strategic trade-policy literature. Elements of the model are as follows.

Three countries: E (east), W (west), and S (south).

E and W are identical; together they can be referred to as the north (N).
S is a small, low-cost country, with no demand for X (demand in S is added in appendix 2).
One final good (X) and one intermediate (Z), components or services (e.g., management)
Z and X activities have constant marginal costs.
One unit of Z is needed to produce one unit of X.
A fixed cost F for intermediates and the first plant, and a fixed cost G for a second plant.
Trade costs for X and Z that are specific to each link, some of these may be zero.

Assume that there are two firms producing X, one headquartered in W and one in E, and these can be referred to as firms W and E respectively. Assume that each firm must produce its intermediate good/service Z in its home country. Production of X, or "assembly" as we shall sometimes refer to it, may be done in any or all countries. A firm can export components/services to a foreign assembly plant and that plant may in turn serve only the local market or export to one or both of the other countries. If a firm wants only one plant in the north, it will choose its home country (firm W will not have a single plant in E given symmetry and trade costs for components).

The term *regime* will denote the number and location of plants. Regimes will be denoted by a two or three-letter code, with the first letter referring to the firm, and the second and third (if any) letters referring to its plant locations. WW, for example, means that firm W has an assembly plant in W and WWS means that firm W has assembly plants in W and S. In the latter case, it must be true that the plant in S only serves E, since S has no demand, and the firm would not have a plant in S to serve its home market (W) when it has a plant there as well and would not serve E from both W and S given the existence of constant marginal costs and plant-specific fixed costs. An extension of the analysis with demand in S is added is presented in Appendix 2.

Let superscript W or E refer to the identity of the firm. A double subscript is used on X quantities along with the firm-identifier superscript. The first subscript is the country of production and the second is the country of sale. X_{ij}^{k} is then production by firm k in country i which is sold in country j. Sales of X in each region can come from five possible sources (firms and countries). Sales in W can come from local production of its own firm, imports from E's production in E, imports of its own firm's production in S, imports of E's production in S and from E's production in a plant in W. Let p denote the price of X in a region. Inverse demand functions are given by:

(1) $$p_w = \alpha - \beta(X_{ww}^w + X_{ew}^e + X_{sw}^w + X_{sw}^e + X_{ww}^e)$$

(2) $$p_e = \alpha - \beta(X_{we}^w + X_{ee}^e + X_{se}^w + X_{se}^e + X_{ee}^w)$$

All intermediate production of Z occurs in a firm's home region by assumption, and the unit cost will be identical in W and E. A subscript 'n' denotes a common value for W and E. Assembly cost can differ between north and south however, so the unit costs (inclusive of the identical cost of Z) of X assembled in north and south are given by c_n and c_s.

The per-unit specific trade costs for the final (assembled) good will be denoted τ, and the specific trade cost for a unit of Z will be denoted σ. Throughout the paper, we assume equal trade costs between W and E, so the common values of these trade costs will be denoted τ_n and σ_n. On N-S links, intermediates only flow from north to south (if at all) and X flows only from south to north (if at all). In our symmetric case of the present section, we assume that W-S and E-S trade costs are equal and equal to the common values of W-E costs:

(3) $$\tau = \tau_n = \tau_{sw} = \tau_{se}, \qquad \sigma = \sigma_n = \sigma_{ws} = \sigma_{es}$$

Equilibrium is found as the sub-game perfect solution to a two-stage game in which firms first select the number and location of their plants, and then play a Cournot-Nash game in outputs. Solving the second stage problem first, we then have a normal-form representation in which a payoff matrix gives the profits to the firms for the first-stage choices by both firms.

Candidate regimes in the symmetric case are as follows:[3]

[3]Asymmetric outcomes with multiple equilibria are possible in this type of model (Horstmann and Markusen 1992, Markusen 2002, chapter 3). The second appendix of the paper where demand in S is added, there are asymmetric, multiple equilibria. In that appendix, we present an intuitive argument why there are no asymmetric/multiple equilibria in the present symmetric case with no

WW EE	national firm regime: each firm serves its rival's market by exports
WWE, EEW	horizontal firm regime: each firm serves its rival's market with a local plant
WWS, EES	third-country EP regime: each firm serves its rival's market from a plant in S
WS ES	global EP regime: each firm serves its rival's market and its own market from a single plant in S

Consider the second stage first and assume that the regime is the *national firm* outcome, WW EE. This duopoly problem and algebraic results are quite familiar and so the derivations are omitted. Equilibrium quantities are:

$$(4)\qquad X_{ww}^{w} = X_{ee}^{e} = \frac{\alpha - c_n + \tau_n}{3\beta} \qquad\qquad X_{we}^{w} = X_{ew}^{e} = \frac{\alpha - c_n - 2\tau_n}{3\beta}$$

As we will note later, this regime can occur when G and the cost of trading components/sevices are relatively high (or low for final goods) and S's cost advantage is relatively small. Consider next the the *horizontal* outcome WWE EEW. Equilibrium quantities are:

$$(5)\qquad X_{ww}^{w} = X_{ee}^{e} = \frac{\alpha - c_n + \sigma_n}{3\beta} \qquad\qquad X_{ee}^{w} = X_{ww}^{e} = \frac{\alpha - c_n - 2\sigma_n}{3\beta}$$

As we will note later, this regime can occur when the cost of trading components is small (relative to τ), G is small and S's cost advantage is relatively small. Now consider the *third-country EP* case in which each firm maintains a plant in its home country to serve its own market and a plant in S to serve its rival: WWS EES. Equilibrium quantities are now:

$$(6)\qquad X_{ww}^{w} = \frac{\alpha - (2c_n - c_s) + \sigma_{es} + \tau_{sw}}{3\beta} \qquad\qquad X_{se}^{w} = \frac{\alpha - (2c_s - c_n) - 2\sigma_{ws} - 2\tau_{se}}{3\beta}$$

$$(7)\qquad X_{ee}^{e} = \frac{\alpha - (2c_n - c_s) + \sigma_{ws} + \tau_{se}}{3\beta} \qquad\qquad X_{sw}^{e} = \frac{\alpha - (2c_s - c_n) - 2\sigma_{es} - 2\tau_{sw}}{3\beta}$$

Suppose finally that each firm produces only from a plant in S: *global EP* regime WS ES, incurring trade costs on components and shipping X back home. Outputs are:

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demand in S.

(8) $$X_{sw}^{w} = \frac{\alpha - c_s - \sigma_{ws} - \tau_{sw}}{3\beta} \qquad X_{se}^{w} = \frac{\alpha - c_s - \sigma_{ws} - \tau_{se}}{3\beta}$$

(9) $$X_{se}^{e} = \frac{\alpha - c_s - \sigma_{es} - \tau_{se}}{3\beta} \qquad X_{sw}^{e} = \frac{\alpha - c_s - \sigma_{es} - \tau_{sw}}{3\beta}$$

Let π_{ij}^{w} denote the profits for firm W when it has plants in i and j. It is also reasonably well known that in this familiar model, profits are just the sum of β times the squared outputs sold in each market minus fixed costs. Profits in the four regimes are given by the following formulae, with identical expressions for firm E.

(10) $$\pi_{w}^{w} = \beta(X_{ww}^{w})^2 + \beta(X_{we}^{w})^2 - F \qquad \text{(WW EE)}$$

(11) $$\pi_{we}^{w} = \beta(X_{ww}^{w})^2 + \beta(X_{ee}^{w})^2 - F - G \qquad \text{(WWE EEW)}$$

(12) $$\pi_{ws}^{w} = \beta(X_{ww}^{w})^2 + \beta(X_{se}^{w})^2 - F - G \qquad \text{(WWS EES)}$$

(13) $$\pi_{s}^{w} = \beta(X_{sw}^{w})^2 + \beta(X_{se}^{w})^2 - F \qquad \text{(WS ES)}$$

A particular goal of this section is to establish the conditions under which there exists a third-country EP equilibrium. To get some intuition behind the results to follow, consider a non-strategic experiment in which the firm wants to *minimize the costs* of supplying a *fixed and equal amount* of output to each market. Let $\Delta c = c_n - c_s > 0$, the cost *disadvantage* of the north, and let g denote the fixed costs of a second plant divided by this fixed output. Exploiting the trade-cost symmetry in (3):

(a) For firm W to prefer third-country EP production WWS to horizontal production WWE it must be that Δc is greater than the cost of shipping X from S (the cost of shipping components is the same in either case): $\Delta c > \tau$

(b) For firm W to prefer third-country EP production WWS to a single plant in the south, WS, Δc plus the added cost of a second plant must be less than the cost of shipping components to S and shipping X back home: $\Delta c < \sigma + \tau - g$

(c) For firm W to prefer third-country EP production WWS to a single home plant serving the other country by exports, WW, Δc must exceed the cost of shipping components to S plus the fixed costs of a second plant (the cost of shipping X to E is the same in either case). $\Delta c > \sigma + g$

It is relatively easy to find parameters that satisfy all three conditions. For example, let plant fixed costs, g, become very small. With a very small, g, these conditions reduce to both trade costs must be positive, but their sum not larger than the cost differential.

$$\tau + \sigma > \Delta c > [\tau, \sigma] > 0$$

We now turn to the analytical conditions for a Nash equilibrium. These are closely related to the cost conditions, but the true deviation conditions take into account that g, the fixed cost per unit of output, is a *variable* and depends on the strategies of both firms.

A difficulty is that when each firm has four strategies, there are a large number of possible deviations to check in order to establish Nash equilibria. Furthermore, which strategies are equilibria depend very much on parameter values. For example, if plant fixed costs are zero, one-plant strategies will generally be ruled out while if plant fixed costs are very high, then two-plant strategies will be eliminated. Here we will just present the conditions for the third-country EP outcome WWS EES to exist as an equilibrium in the symmetric case, whereas all the possible regimes will be treated in numerical simulations below. We assume the WWS EES is an equilibria, and check for profitable deviations. The algebra for establishing these conditions is not particularly informative so we relegate it to appendix 1.

Given that firm E plays EES, firm W cannot profitably deviate from WWS if three conditions (corresponding to the three possible deviations) hold.

(14) $\Delta c > \tau$ (WWS to WWE unprofitable)

(15) $\Delta c < \sigma + \tau - \frac{3}{4}\left[\frac{3\beta}{\alpha - c_n}\right]G$ (WWS to WS unprofitable)

(16) $$(\Delta c - \sigma) + \frac{(\Delta c - \sigma)^2}{\alpha - c_n - 2\tau} > \frac{3}{4}\left[\frac{3\beta}{\alpha - c_n - 2\tau}\right]G$$

(WWS to WW unprofitable)

It is fairly easy to establish the existence of parameter values that satisfy all three inequalities. Note first that, from the first two, σ *must be positive*. This is perhaps non-intuitive: positive trade costs for intermediates is a *necessary condition* for pure third-country EP production in the symmetric case. The correct intuition is that, if σ is zero and W wants a plant in S to serve E, it must also want to serve its own market from that plant in S (if (14) holds, then (15) fails to hold if σ is zero).

Suppose that we pick parameter values for Δc and σ (holding c_n and τ constant) such that the first two inequalities "marginally" hold, where ϵ is a small number.

(17) $$\Delta c - \tau = \epsilon, \quad \sigma = [\Delta c - \tau] + \frac{3}{4}\left[\frac{3\beta}{\alpha - c_n}\right]G + \epsilon = \frac{3}{4}\left[\frac{3\beta}{\alpha - c_n}\right]G + 2\epsilon$$

The first equation uniquely determines the value of the free parameter c_s (given c_n and τ) and the second equation then determines σ. Substituting from this second expression, the third condition (16) (a firm does not want to deviate to a national firm strategy) will hold if

(18) $$\Delta c > \frac{3}{4}\left[\frac{3\beta}{\alpha - c_n}\right]G + \frac{3}{4}\left[\frac{3\beta}{\alpha - c_n - 2\tau}\right]G - \frac{(\Delta c - \sigma)^2}{\alpha - c_n - 2\tau} + 2\epsilon$$

This inequality must hold if we make G, the plant-specific fixed cost small enough. In other words, given that the first two inequalities (14, 15) hold, the third (16) will hold if G is sufficiently small to prevent closure of the southern plant. Alternatively, it will hold if β is small, which could be thought of equivalent to saying that the northern markets for X are big.

Consider then a diagram of equilibrium regimes in (c_s, σ) space shown in Figure 1. The transport cost σ falls moving to the right. Let (14), (15), and (16) holding with equality define three loci. Figure 1 shows these three conditions, with the solid segments of each equation giving the relevant sections as boundaries of the third-country EP regime. Condition (14) defines a horizontal line, (15) has a slope -1 (or +1 in Figure 1, since σ falls moving to the right). (16) is also linear with a slope -1 (or +1 in the Figure).

By transitivity, the intersection of (14) and (16) is also a condition for a firm to be indifferent between deviating to a national or horizontal strategy, and other points of indifference must occur at the same value of σ since c_s is not involved in the latter indifference condition. Thus there will be a vertical boundary separating WW EE and WWE EEW at that value of σ.

These results have not established that there are no areas of multiple equilibria. Our second appendix on adding demand in the south (where there are multiple equilibria) presents an intuitive argument why there are not multiple equilibria in this symmetric case. Because we are primarily interested in the third-country EP case, we will not work through all possible deviations needed to fully characterize figure 1, and turn to simulations.

The lower panel of Figure 1 presents numerical simulations for the model over a grid of values of σ and c_s, with the values τ and c_n and G held constant. The profits for the two firms are calculated to form a 4x4 payoff matrix, in which each firm has four strategies: a single plant at home, plants at home and in the other Northern country, a plant at home and in S, and a plant in S only. The simulation program then finds all pure-strategy Nash equilibria over this 4x4 payoff matrix. No cases of asymmetric or multiple Nash equilibria were found.[4]

The analytical results in the top panel of Figure 1 correspond to simulation equilibria for the parameters used to generate the lower panel (footnote 4). The bottom panel displays the (identical) profits of the two firms for a 21x21 grid of value for σ and c_s. Highest values for σ and c_s are found in the northwest corner of the top panel and the west corner of the bottom panel. Both costs decrease along the diagonal line moving from point A to point B in

[4] $\tau = 1.25$, $c_n = 4$ and $G = 1.1$ are held constant. Other parameter values held constant throughout are $\alpha = 12$, $\beta = 1$, and $F = 3$. In the horizontal equilibria of Figure 1, for example, these base parameter values imply trade costs on final goods of about 25 percent of average costs, 10 percent for components, and equilibrium markups of about 25 percent.

This value of τ is toward the high end of estimates by Hummels (2001), but this is chosen to support the horizontal outcome in which trade is eliminated. The markups are close to Hummels' average estimates. However, we emphasize that we have not made any attempt to "calibrate" the model, but have picked values for clarity of exposition: that is, we choose values to show all possible theoretical outcomes. The empirical analysis indicates which of the latter are more relevant.

the respective panels.

When the cost of trading intermediates is high and the south has a small cost advantage, the equilibrium regime is WW EE: each firm has a single plant at home and serves the other Northern country by exports. As the cost of trading components/services falls, each firm opens a second plant, in S if production costs in S are low, or in the other northern country if the south's advantage is small. When component trade costs are low and the south has a big advantage, both firms just maintain a single plant in S: WS ES.[5]

Firms' profits suffer in the two-plant strategies. This is the usual prisoner's dilemma outcome: each firm has an incentive to switch to two plants if its rival has a single plant, but confers a negative "pecuniary externality" on its rival when doing so: the switcher is (locally) indifferent between the lower margin cost exchanged for the higher fixed cost, but its rival is worse off by the former's lower marginal cost. Profits rebound when the firms switch to a single plant in S, an effect similar but opposite (a higher marginal cost is exchanged for a lower fixed cost). Now each firm benefits in its rival's market, not its own market, because the rival now pays trade costs to serve its own market from S rather than locally: a "prisoners's delight". Consistent with our earlier discussion, the third-country EP outcome WWS EES occurs at moderately low values of σ and c_s, but not so low that the firms close their domestic plants. Again, we emphasize that a positive σ is a necessary condition for the third-country strategy pair to be an equilibrium.

3. An Asymmetric Case: W and S form a Free-Trade Area

Statistics in Table 1 and the associated discussion above suggest that the third-country EP phenomenon may be associated with and encouraged by free-trade areas formed by a large (high demand), high-cost partner and a smaller, low-cost country. We turn to this case in this section. Suppose that W and S form a free-trade area, so all costs between them are

[5]Much of the multinationals' literature has emphasized the case where intermediates are headquarters' services, which may have low unit trade costs. This ties in nicely with our present model: two-plant strategies are chosen when the intermediates' (services) trade costs are low compared to goods.

reduced to or toward zero. We maintain our earlier assumption that E-W and E-S trade costs are the same (equations (3)).

There are a large number of possibilities depending not only on the initial regime but also on values of other parameters being held constant (see Motta and Norman (1996) who fully characterize the solution in a similar situation, but without exports back to the parent). Indeed, we have to add one more strategy for firm W, which now might want to have a plant in E to serve E, but have a plant in S to serve its home-market W (WSE). We term this home-market EP production, which is never optimal in the symmetric case: if firm W wants a plant in S to serve W, it must also want to use that plant to serve E. Thus the normal-form representation of the game is now a 5x4 payoff matrix, with 20 rather than 16 cells and it is likely that asymmetric outcomes are equilibria. The analytics are much more complicated than in the symmetric case. We will therefore concentrate on looking at some simulations, providing cost conditions on the attractiveness of alternatives as we did above to help developing some economic intuition.

Each firm gains something from the free-trade area and suffers a corresponding disadvantage due to the benefit for the other firm. Firm W can ship intermediates freely to S while firm E cannot, so we can say that firm W gains a market access advantage in intermediates. Firm E can ship X freely from S to W while firm W cannot ship freely from S to E, so firm E enjoys a market access advantage in final goods. Thus it is far from clear whether the insider firm W or the outsider firm E benefits absolutely and/or relatively more from the W-S liberalization.

Figure 2 reproduces the top panel of Figure 1, but with a larger range of values for c_s which we need to illustrate the various outcomes. Figure 3 shows the effects over this parameter space of reducing the W-S trade costs by 50% from Figure 2. Now we see the emergence of a number of asymmetric regimes in which the choices of firms W and E differ from one another. Figure 4 shows the effects of an 100% reduction in W-S trade costs from Figure 2.

Consider first the left-hand side of Figures 2-4 where the costs of trading intermediates is relatively high. A dominant effect of the W-S liberalization is the switch from symmetric strategies, whether national, horizontal, or third-country EP to a single plant in S for the insider firm W (global EP) and to a plant at home and a plant in S for firm E (third-country EP). Suppose the firms both choose horizontal strategies initially and then W-S costs fall. When the cost of trading intermediates is high (relative to the costs for finished goods and relative to plant fixed costs), the attractiveness of the W-S liberalization for outsider firm E is to use the south to supply its rival in west, but to maintain a plant at home (avoiding the costs of shipping intermediates to S). For firm W, the attractiveness of the W-S liberalization is to put a plant in S to serve its home market. However, if the cost of sending intermediates to its plant in E is relatively high, it would close the plant in E, send intermediates cheaply to S and ship the output to E (global EP). This outcome is like a US firm having a single plant in Mexico to serve both the US and the EU, while the EU firm has a plant in Mexico to serve the US and a plant at home. Or it could be a US firm having a plant at home and one in Ireland to serve Germany, and a German firm having a plant in Ireland to serve both the US and Germany.

We would like to concentrate on the right-hand side of Figures 2-4, since the outcomes here resemble what we see in data. Here, the emergence of asymmetric regimes takes the form of firm W shifting from horizontal to home EP, and firm E shifting from horizontal to third EP. The parameter range which gives global EP for both firms also increases. In order to generate some analytical results, we will consider the case where the cost of shipping intermediates is zero (i.e., we are at the right-hand edge of Figures 2-4: $\sigma = \sigma_{ws} = 0$).

The condition for a firm to be indifferent between horizontal and global EP given the other firm chooses horizontal is the same for both firms. Switching from horizontal to global EP involves changing revenues in both W and E, and the reduction of one plant fixed cost. With $\sigma = 0$, firms W and E are indifferent if $2\Delta c = \tau + \tau_{ws} - g$: the added costs of producing in both northern markets equals the cost of shipping X from S to E and from S to W, minus g, plant fixed costs per unit of output. Thus both firms will switch from horizontal to global EP strategies at the same value of τ_{ws} .

(19) $\Delta c > (\tau + \tau_{ws})/2 - g/2$ (E shifts from EEW to ES, W from WWE to WS)

where g, fixed costs per unit of output, is: $g = \dfrac{2(\tau - \tau_{ws})^2 + 9\beta G}{2(2\alpha - \tau - \tau_{ws} - 2c_s)}$

Firm W's condition to shift from horizontal to home EP is the same as firm E's condition to switch from horizontal to third EP (WWE to WSE given firm E plays horizontal, EEW to EES given firm W plays horizontal). This involves only revenues in market W for both firms and no change in fixed costs. With $\sigma = 0$, the firms will do this if the cost savings exceed the cost of shipping X back to W:

(20) $\Delta c > \tau_{ws}$ (E shifts from EEW to EES, W from WWE to WSE)

Finally, suppose that firm W has chosen home EP and firm E has chosen third EP over horizontal strategies, the decision just analyzed. The condition for each firm to switch to global EP, shutting their plants in E is the same (WSE to WS, EES to ES). This involves only revenues in market E for the firms so, with $\sigma = 0$, each firm will close its plant in E if the cost saving plus the saving of plant fixed costs exceed the cost of shipping X from S to E:

(21) $\Delta c > \tau - g$ (E shifts from EES to ES, W from WSE to WS)

where g, fixed costs per unit of output, is now given by: $g = \dfrac{9\beta G}{4(\alpha - \tau - c_s)}$

Now suppose that we start in the symmetric equilibrium of Figure 2 (no free-trade area), $\tau = \tau_{ws}$. Moving from a high to low value of c_s (increasing Δc) the equilibrium will jump from horizontal to both firms choosing global EP at the critical value of c_s given by (19): $\Delta c = \tau - g/2$. At this value of c_s, (20) fails to hold. There is no WSE EES equilibrium when $\tau = \tau_{ws}$ as shown in Figure 2.

Now decrease τ_{ws}. Eventually, τ_{ws} falls to a point where the critical values of c_s for (19) and (20) to hold are the same. This occurs when $\tau - g = \tau_{ws} = \Delta c$. But at this value of τ_{ws} , (21) holds as well. Thus there is a singularity where all of (19)-(21) hold. Both firms are indifferent between horizontal and global EP at these critical value of c_s and τ_{ws} . In addition, W is indifferent between these and home EP and E is indifferent between these and third EP.

Now decrease τ_{ws} further. The critical value of c_s for (20) to hold now exceeds the critical value of c_s for (19) to hold, while the critical value of c_s for (21) to hold stays constant. There will now exist a set of values for c_s such that home EP (firm W) and third EP (firm E) is strictly preferred to horizontal or global EP strategies for both firms. This is exactly what we see on the right-hand edge of Figure 3, with this interval growing as W-S trade costs go to zero in Figure 4.

We have thus establish that there are parameters which will support an equilibrium where firm W chooses the home EP strategy and firm E chooses the third-country EP strategy. This is more likely to occur as (a) trade costs for intermediates are quite low relative to costs for final goods, (b) the W-S liberalization is relatively deep, and (c) the cost advantage for the south is in an intermediate range.

This outcome is like a US firm choosing a plant in Mexico to serve the US and a plant in Europe to serve Europe. A German firm chooses a plant in Europe to serve itself and a plant in Mexico to serve the US. Again, we have spent time analyzing this case out of the many possibilities indicated in Figures 3 and 4 because it resembles what we find in the data.

There are interesting effects on firm profits from the introduction of the W-S FTA for different values of c_s. Consider moving down column $\sigma = 0.10$ of Figure 3 (50% reduction) and comparing firm profits to the base case in Figure 2. The changes in profits for the firms are shown in Figure 5: *moving horizontally left to right* Figure 5 are the values of c_s corresponding to *moving down a column* of Figure 2-3.

Regions A-D of Figure 5 are areas where both firms choose the horizontal strategy prior to the FTA (see Figure 2). In region A, the South is not sufficiently attractive for the firms to switch despite the 50% reduction in W-S trade costs. Region B, where firm W chooses home EP and firm E chooses third EP, is interesting. Neither firm changes the number of plants (2) from the base case. Rather, both firms move their plant in W to S. The *relative gainer here is firm E,* and indeed there is a range of values of c_s where firm W is (slightly) worse off. The intuition is as follows: (a) both firms get the same positive cost advantage Δc from moving the plant from W to S; (b) both firms incur the same cost disadvantage of shipping output from S to W, τ_{ws} ; (c) firm W incurs the cost disadvantage of shipping intermediates to S, σ_{ws} ; but (d) firm E incurs no change in its cost of shipping intermediates: it was already shipping intermediates to its plant in W at the cost σ.

In region C of Figure 5, firm W switches to the one-plant global EP strategy while firm E switches to third EP (two plants before and after the switch). Firm W is trading lower fixed costs for a higher marginal cost in this switch. But as we noted earlier, this higher marginal cost confers a positive competitive benefit on firm E, which gets a big upward jump in profits.

In region D, both firms switch to global EP strategies. In this case, both firms are supplying both markets from S, so trade costs for final goods give neither firm an advantage. But firm W can ship intermediates duty free to S while firm E cannot. Since both firms were in a symmetric position before the FTA, its introduction must confer a relative benefit on firm W and this is the result shown in Figure 5.

Finally, neither firm switches in region E of Figure 5. Both firms benefit by the cheaper access for final goods into W, but firm W benefits more by the cheap costs of getting its components to S.

Our concentration has been on the parameters c_s, since this determines the overall competitiveness of locating in the south, and σ, the trade cost for intermediates which has been shown to have a somewhat surprisingly important role to play in determining the equilibrium regime (for a constant value of τ). We might want to think of the relationship between τ and σ as varying by industry: industries with a low need for home intermediates or perhaps where the intermediates are largely knowledge-based services would have a large difference between the two costs.

In the symmetric world in which S is not in a free-trade area with either W or E (Figures 1 and 2), we predict S affiliates to either export largely to third countries or have a balanced export pattern to both home and third countries, the latter occurring when (τ - σ) is relatively large. In the asymmetric world, we predict that an outsider firm uses S as a third-country EP, and the insider firm uses S either as a global EP, or as a home-country EP, the latter occurring when (τ - σ) is relatively large.

4. Empirical Analysis

In the symmetric case, affiliates either have balanced exports between sales to the parent country and to third countries, or exports concentrated in sales to third countries. For affiliates in countries which are members of free-trade areas, affiliates exports may be concentrated to other countries in the free trade area, but while this seems intuitive, we showed that it is in fact only true for certain ranges of parameters. Because of the number of possible outcomes (number of regimes that can be equilibria), it is especially valuable here to turn to the data for some insights.

In this section, we shall utilize data on exports from affiliates of US multinationals to show two things: (i) that the pattern of exports sales of foreign affiliates of US multinationals does indeed resemble the regime WSE EES, i.e. the one in which the outsider firm chooses third-country EP while the insider firm chooses home-country EP, and (ii) that EU membership increases the share of third-country exports sales in a manner consistent with the model.

Our dataset contains information about US manufacturing affiliates' in 39 host countries 1984-2000. It is based on publicly available data on US multinationals collected by the Bureau of Economic Analysis (BEA). A weakness of the data is that exports to third countries are aggregated over all countries. Thus while we might reasonably conjecture that US affiliate exports from Ireland to third countries are almost exclusively to other EU countries, we cannot know this for sure.

The US is an insider country with respect to the NAFTA countries, Canada and Mexico, while it is an outsider country with respect to the integrated European market. We carry out two sets of regressions, both using exports to third countries as a share of total affiliate exports as dependent variable: (i) random-effects regressions estimating the effect of being located in the North American and European region, respectively, as well as the effect of entering the NAFTA and EU free-trade areas, and (ii) fixed effect regressions estimating the effect of the latter. While both regressions will give us estimates of the effect of entering a free-trade area on the share of third-country exports, the random-effects regression will also tell us whether there are significant differences in the share of third-country exports between affiliates located in North America, Europe, and elsewhere. The latter is important since these geographical regions constitute relatively integrated markets independent of the formation of formal free-trade areas through NAFTA and the EU. However, since non-observable factors at the country level may affect the likelihood of entering a free-trade area as well as the affiliates' propensity to export to third countries, it is important to control properly for fixed country effects in order to assess the impact of entering a free-trade area on the share of third-country exports. Therefore, we show results from both random and fixed effects estimations.

The independent variables used are constructed from the following dummy variables:[6]

North American geography (NA GEO)	= 1 for Canada and Mexico in all years
European geography (EU GEO)	= 1 for 17 European countries in all years (EU 15 plus Norway and Switzerland)
NAFTA	= 1 for Mexico at/after 1994, Canada at/after 1989
EU	= 1 for an EU 15 country at/after accession (Portugal, Spain, Sweden, Finland, Austria enter during the sample period)
Low-income (LI)	= 1 for countries that according to the World Bank GNI per capita below 14 730 USD in 1999.

[6]With respect to the NAFTA and EU dummies, it should be noted that countries joining a regional free-trade area often have preferential trading agreements with membership countries prior to formal accession, so these dummies will not necessarily capture the relevant aspects of being part of a regional free-trade area. Furthermore, although countries such as Norway and Switzerland are not members of the European Union, they are still very much integrated with the rest of Europe through their membership in the European Free Trade Association (EFTA). Norway is part of the European Economic Area (EEA) since 1992. While Canada and the US formed a free-trade area in 1989, the auto sector, and important multinationalized industry, was integrated beginning in 1967.

High-income (HI)	= 1 - LI

We are particularly interested in finding out whether affiliates located in low-income countries within free-trade areas exhibit the export pattern suggested by our model. We therefore interact the low-income dummy with the regional dummies as well as the FTA dummies, NAFTA and EU. We do the same for the high-income dummy.

A group of control variables from the Markusen-Maskus data set are also used (Carr, Markusen, and Maskus, 2001, Markusen and Maskus 2001, 2002).[7]

GDP	host-country GDP (real US$, trillions)
Skilled share (SKL)	host-country skilled labor as a share of total labor (ILO)[8]
Investment cost (INVC)	an index of host-country investment costs/barriers (Global Competitiveness Report, 0.0-1.0)
Trade cost (TC)	an index of host-country trade costs/barriers (Global Competitiveness Report, 0.0-1.0)
Distance (DIST)	distance from Washington DC (1000s kilometers)

Table 2 shows the results from the regressions. We have added time dummies to take out any time effects affecting the whole sample. One reason for including time dummies is that there may be trend-wise changes in the overall pattern of exports to different destinations. Another is that it is a way to deal with potential problems arising from the way data is collected. The observations used are based on comprehensive surveys including the universe of US multinationals, so-called benchmark surveys, in some years, while they are based on a combination of the latest benchmark survey and a survey of a smaller sample of firms in intermittent years. Since there may be systematic differences between firms included in the samples and firms only included in the benchmark surveys, we need to control for the possibility that there are systematic differences in the composition of affiliate sales and exports between benchmark years and intermittent years.

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[7]Previous studies using this data-set have shown that these variables are important in determining levels of affiliate activity and some of them the composition of sales between local sales and exports.

[8]The sum of occupational categories 0/1 (professional, technical and kindred workers) and (administrative workers) in employment in each country, divided by total employment.

The estimated coefficients in Table 2 of the interacted dummy variables give us the predicted deviation in the dependent variable for countries belonging to that country group. The results of the random-effects regression in columns (1) and (2) show that affiliates in Canada as well as in Mexico export less to third countries than affiliates in other countries.[9] Affiliates in Europe exhibit the opposite pattern: they have more exports to third countries, irrespective of whether they are high or low income countries.[10] The difference between North America and Europe is striking. According to our estimates in column (2) for example, the share of third country exports is about 80 percentage points (22.6 - (-58.8) = 81.4) higher in affiliates in Europe than in affiliates in North America when controlling for other factors.

The difference in the estimated effect on third-country exports between being located in North America, on the one hand, and being located in Europe, on the other, is consistent with the predictions of the asymmetric model under the parameterization whereby the regime WSE EES arises in equilibrium (Fig. 4). When the affiliates belong to an insider firm (affiliates located in Canada and Mexico) their exports is mainly directed to the parent country because third countries are served by local affiliates. However, when affiliates belong to an outsider firm (affiliates located in Europe), their exports are mainly directed to other countries within the region because the parent country is served by a local plant. This particular equilibrium regime arises when trade costs for components are significantly lower than for final goods.

In order to assess whether changes in trade costs due to free-trade areas are associated with changes in the share of third country exports we turn to the estimates of the interaction between the FTA dummies and the income status dummies. A fixed–effects regression is

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[9]According to a Hausman's specification test we cannot reject the null hypothesis of no systematic difference between coefficients of the fixed and random effect models, implying that we find no evidence of correlation between the random effects and the regressors (assuming that the model is correctly specified).

[10] We cannot reject the hypotheses that the coefficients of the regional dummies are the same for high and low income countries in column (1), which is why we also present the results of a specification without the interaction between region and income status in column (2).

presented in column (3) of Table 2. While neither of the estimated coefficients of entering NAFTA is statistically significant, the estimated coefficients of entering the EU are. The estimate of the interaction between the EU and low-income dummy is positive, significant and quantitatively large: being a low-income country entering the EU is associated with an increase in the share of third country exports by 10.5-12.5 percentage points depending on the specification. The estimate of the interaction between the EU and high-income dummy, on the other hand, is negative and significant, implying a decrease in the share of third country exports by about 6-7 percentage points.

To test the prediction that the response to the formation of a FTA is asymmetric depending on whether firms are outsiders or insiders we compare the estimated coefficient of the interaction between low-income and EU (which is positive, large, and significant) with the estimated coefficient of the interaction between low-income and NAFTA (which is positive, close to zero, and insignificant). The hypothesis that these two coefficients in column (3) are the same can be rejected at the 10 percent level, but not at the 5 percent level (F-statistic = 3.05, p-value = 0.08). The low precision of the estimate of the effect of being a low-income country entering NAFTA is perhaps not very surprising considering that this is identified solely through changes in the share of third country exports by Mexican affiliates. In addition, Mexican affiliate exports to "third" include Canada, another insider country, and Canadian affiliate exports to third include Mexico. On the other hand, we find the results for the EU rather strong: affiliate exports in low-income countries in Europe have shifted away from the US and towards third countries as these countries have become members of the EU - a result consistent with the prediction of our model.[11]

Few of the estimated coefficients of the control variables turn out statistically significant. The coefficient on investment costs is the only one that is highly significant. But

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[11] We have also tried including a trend variable interacted with the FTA dummies to capture the effect of ongoing trade liberalization within NAFTA and the EU. Presumably, countries joining the EU in the mid 1990s (Austria, Finland, and Sweden) entered an area with lower trade costs than countries joining ten years before (Portugal, and Spain). However, these trend variables are highly correlated with the EU and NAFTA dummies and create problems with multicollinearity. They are therefore not included in the regressions reported in Table 2, but are closely consistent with the reported results.

theory gives us little guidance as to the signs and magnitudes of how these controls should affect the share of third-country exports (as opposed to levels of sales, for example) in any case.

Some summary figures are given in Table 3. The Table uses results from the random effects regression of column (2) of Table 2.[12] The statistics in Table 3 give the difference, in percentage points, in exports to third countries as a share of total exports for affiliates located in North American or Europe relative to affiliates located in other countries. "NA GEO + NAFTA*LI" adds together the coefficients "NA GEO" from the previous line (and Table 2) and the "NAFTA*LI" coefficient in Table 2. The number -59 for this coefficient gives the percentage point difference in the share of total exports which go to third countries for a low-income North American country (Mexico) in a year in which it is a member of NAFTA relative to an "other" country neither in North America or in Europe. Other numbers are similarly defined.

Results clearly indicate a very big difference between NAFTA and EU affiliates. Again making the assumption that third-country exports of European affiliates go to other European countries, we conclude that affiliates exports in both areas are highly concentrated to other free-trade area members. Furthermore, entry into the EU for a low-income country leads to a big jump up in this share to other free-trade area countries, and a fall in the share to third for the entry of a high-income country. This suggests that expansion of the EU tends to shift export-platform production toward the lower-income entrants.

Overall, the numbers in Table 3 are closely consistent with the home EP (insider firm) - third EP (outsider firm) equilibrium from our theory section. Implicitly, they also indicate that other affiliates not in a free-trade area have a much more balanced pattern of exports, consistent with the global EP outcome in the symmetric model.

[12]We use the results with a single geography variable for the high and low-income countries for the reasons indicated in footnote 10.

5. Summary

Export-platform direct investment is usually taken to refer to a situation where the output of a foreign affiliate is largely exported rather than sold in the host country. Our approach adopts a three-country model, with two identical large, high-cost countries and a small, low-cost country. This requires somewhat more precise terminology, so we differentiate between third-country, home-country and global EP production.

We consider two cases. In the first, trade costs for intermediates are the same on all trade links as are the trade costs for assembled final goods. The northern firms both choose a plant in S and choose third-country strategies when S has a moderate cost advantage, and trade costs for intermediates are moderate but not too low relative to the costs of shipping final goods. When the south has a large cost advantage and trade costs for intermediates are very low, the firms chose a global EP strategy. An important finding is that trade costs for intermediates is a necessary condition for the third country strategy: if they are zero, then a firm choosing a southern plant would use it to serve both northern countries, a global strategy.

Our second case involves a free-trade area, reducing the trade costs between one high-demand, high-cost country and the low-cost, low-demand country. When S has a moderate cost advantage, trade costs for intermediates are low relative to those for final goods and the liberalization is deep, the insider northern firm chooses a home EP strategy and the outsider firm chooses a third-country EP strategy.

We showed that, for the outcome just discussed, it is the outsider firm which may benefit relative to the insider firm and indeed the insider firm can actually lose from the free-trade agreement. The intuition is that the outsider's ability to export final goods cheaply to the insider country from the plant in S is worth more than the insider's ability to export intermediates cheaply to a plant in S.[13]

[13] In the negotiations over NAFTA, US firms were particularly concerned with raising barriers to European and Japanese firms to prevent them from or at least penalize them for using Mexico as an export platform to the US, which is consistent with this result (see Lopez-de-Silanes, Markusen and Rutherford, 1996).

We then turn to empirical analysis, examining the shares of exports by affiliates to the parent and third countries. Results for US affiliates in NAFTA and EU countries are most consistent with the WSE EES equilibrium of Figures 3 and 4, where the insider firm pursues a home-country EP strategy, serving itself from S and serving the other high-income country from a plant in that country. The outsider firm pursues a third-country EP strategy, serving itself with a local plant and serving the insider country from a plant in S. Entry of a low-income country into the EU leads to a redirection of exports to other free-trade-area member, consistent with the model and with these countries being chosen as export-platforms for the region.

For other countries not in NAFTA or the EU, we implicitly find a much more balanced pattern of affiliate exports, consistent with the summary statistics in Table 1. This is in turn consistent with the symmetric version of our model that generate global or third-country EP production in Figures 1 and 2.

Returning to the NAFTA and EU empirical results that are consistent with the WSE EES equilibrium of Figure 4, these results are then also consistent with the theoretical scenario in which it is the *outsider firm* which is the relatively larger beneficiary of the free-trade area.

One final point relates our results to earlier theory. Referring back to Figures 1-4, our empirical results resemble the WSE EES outcome for the asymmetric case and WS ES for the symmetric case as just discussed. Our theoretical results in Figures 1-4 indicate that these occur when trade costs for intermediates are modest relative to trade costs for final goods. This may fit well with some relatively new theory that assumes parents supply knowledge-based services to affiliates which, although they require large fixed costs to develop, may be supplied to affiliates at low costs once created (e.g., the knowledge-capital model by Markusen, 2002).

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Appendix 1: derivations

Here we present the derivations for the boundary conditions (14)-(16).

(A) Firm W cannot profitably deviate from WWS EES to WWE EES

For the third-country EP case to be an equilibrium, it must not be profitable for a firm to choose to locate its second plant in the other Northern country instead of in the South. Suppose that we are in the former configuration, and W considers shifting its second plant from S to E. This is very straightforward, since it does not involve changes in fixed costs, and no change by either firm in market W. Thus from (11)-(12), all that we need to check is whether or not W's equilibrium supply to E is larger under WWS or WWE. The condition for a deviation from WWS to WWE to be unprofitable is:

(A1) $X_{ee}^{w} = \left[\alpha - 2(c_n + \sigma) + c_n\right]/(3\beta) < X_{se}^{w} = \left[\alpha - 2(c_s + \sigma + \tau) + c_n\right]/(3\beta)$

This simplifies to

(A2) $c_n - c_s = \Delta c > \tau$

which is the same as the inequality in (14).

Conditions in which the number of plants change along with output are much more complicated due to the fact that variable profits are quadratic in outputs. For the third-country EP case to be an equilibrium, it cannot be profitable for firm W to deviate from WWS to WS, serving both markets from S given that firm E chooses EES.

(B) Firm W cannot profitably deviate from WWS EES to WS EES

There is no change in either firm's supply to market E, so we just need to compare firm W's supplies to its own market taking into account that WS involves one less G. The condition for this deviation to be unprofitable is:

(A3) $\left[\alpha - 2(c_s + \sigma + \tau) + (c_s + \sigma + \tau)\right]^2 < \left[\alpha - 2c_n + (c_s + \sigma + \tau)\right]^2 - 9\beta G$

which simplifies to

(A4) $\left[\alpha - c_s - \sigma - \tau\right]^2 < \left[\alpha - 2c_n + c_s + \sigma + \tau\right]^2 - 9\beta G$

Add and subtract c_n from the left hand term in brackets:

(A5) $\left[\alpha - c_n + (c_n - c_s - \sigma - \tau)\right]^2 < \left[\alpha - c_n - (c_n - c_s - \sigma - \tau)\right]^2 - 9\beta G$

Let $(\alpha - c_n) \equiv \gamma$ *and* $(c_n - c_s - \sigma - \tau) \equiv \delta$, then (A5) can be written as:

(A6) $(\gamma + \delta)^2 < (\gamma - \delta)^2 - 9\beta G \quad or \quad 2\gamma\delta < -2\gamma\delta - 9\beta G$

Collecting terms and dividing through by 4γ, this becomes

(A7) $c_n - c_s - \sigma - \tau = \Delta c - \sigma - \tau < -\frac{9\beta}{4\gamma}G$ or

(A8) $$\Delta c < \sigma + \tau - \frac{9\beta}{4\gamma}G = \sigma + \tau - \frac{3}{4}\left[\frac{3\beta}{\alpha - c_n}\right]G$$

which is the same as the inequality in (15).

(C) Firm W cannot profitably deviate from WWS EES to WW EES

The procedure here is similar to the deviation just considered. There is no change in either firm's supply to market W, so we just need to compare firm W's supplies to E's market taking into account that WW involves one less G. The condition for this deviation to be unprofitable is:

(A9) $$\left[\alpha - 2(c_n + \tau) + c_n\right]^2 < \left[\alpha - 2(c_s + \sigma + \tau) + c_n\right]^2 - 9\beta G$$

which simplifies to

(A10) $$\left[\alpha - c_n - 2\tau\right]^2 < \left[\alpha - 2c_s + c_n - 2\sigma - 2\tau\right]^2 - 9\beta G$$

Add and subtract c_n from the right-hand term in brackets:

(A11) $$\left[\alpha - c_n - 2\tau\right]^2 < \left[(\alpha - c_n - 2\tau) + 2(c_n - c_s - \sigma)\right]^2 - 9\beta G$$

Following similar procedures, this can be reduced to:

(A12) $$\Delta c > \sigma + \frac{3}{4}\left[\frac{3\beta}{\alpha - c_n - 2\tau}\right]G - \frac{(\Delta c - \sigma)^2}{\alpha - c_n - 2\tau}$$

which corresponds to the inequality in (16).

Appendix 2: Adding demand in the South

This appendix briefly considers adding demand for X in the south and considers the symmetric case only. Two cases are illustrated in Figure 1A. In the top panel, S is still rather small, with demand 0.1 in proportion to E and W ($\beta_s = 10\beta_n$). North has a marginal cost c_n = 4 as in all our analysis, while the cost range for c_s runs from 3.1 at the top of the figure to 2.6 at the bottom in order to illustrate all the regimes (it runs from 3.0 to 2.5 in Figure 1). The values of σ are the same as in our earlier diagrams.

In most ways, Figure 1A is similar to Figure 1. The regimes are "shifted up", boundaries occurring at higher values of c_s. For example, firms will first put plants into S at higher values of c_s since this is offset by the lower cost of serving the demand in S.

The complication introduced is that there are now multiple equilibria for some parameter ranges, so the task of this section is to explain the intuition behind that. Assume again that there is no demand in S. Suppose that we are in the national-firm region WW EE and reduce c_s (move vertically downward in Figure 1A). Suppose also that we let the firms move sequentially, allowing firm W to move first. At some point, firm W will build a second plant in S, deviating from WW to WWS. This affects firm E only in firm E's own market. Thus if firm E can now move, it will also switch from EE to EES at the same value of c_s since this decision is only about how to serve market W.

However, it is more complicated when there is demand in S. The switch by firm W to WWS effectively reduces the residual market in S for firm E. Thus there will be a range of values of c_s such that, if firm W is just willing to build a plant in S, firm E is not and vice versa. We have a range of c_s values such that WWS EE and WW EES are both equilibria (the hatched region of Figure 1A). In effect, S is big enough to support one plant but not two. This effect is familiar from Horstmann and Markusen (1992).[14]

Similarly, consider the initial horizontal regime WWE EEW and no demand in S. When c_s falls to the point where W shifts its plant in E to S (WWE to WWS), that only affects firm E in its domestic market. Since the decision for firm E to shift its plant from W to S is independent of what is happening in its home market, E will also want to shift its plant even if W moves first. But with demand in S, if firm W moves first and is just willing to shift its plant from W to S, then E will not match this shift. WWS EEW and WWE EES are both equilibria (the shaded region of Figure 1A): effectively S can support one plant but not two.

The lower panel in Figure 1A considers a larger S, with demand equal to 0.25 in proportion to W and E ($\beta_s = 4\beta_n$). The cost range for c_s is 3.5 at the top to 2.5 at the bottom. Now a three-plant strategy becomes a possibility, a strictly horizontal outcome in which each firm has a plant in each country, with no trade in X. This occurs in the northeast region of the lower panel. Once again, we have boundary regions of multiple equilibria arising from exactly the same "pecuniary externality" just discussed. The new region where WWES EEW and WWE EEWS are both equilibrium (northwest - southeast cross hatching) arises from the same intuition. When firm W is just willing to put a plant into S to serve the local market (WWE to WWES), this reduces the residual demand for firm E and so E will continue to serve S by exports if W can move first. Thus in the simultaneous move game we have multiple equilibria. Note that the asymmetric equilibria always occur in a band between the symmetric ones. As the size of the S market becomes smaller the band shrinks and finally disappears.

[14]There is another complication: if firm W chooses WWS does it serve E from its plant in W or S? We assume firm W chooses the least-cost method of serving E, which is independent of E's strategy.

Table 1: Sales by US manufacturing affiliates: exports to the US and exports to third countries as shares in total sales and total exports, 2000

	export sales to the US	export sales to third countries	share of total export sales to third countries	share of total export sales to third countries group average
All countries in sample (39)	0.12	0.28	0.70	**0.70**
Ireland	0.16	0.71	0.82	**0.93**
Belgium	0.04	0.57	0.93	
Greece	0.01	0.16	0.97	
Holland	0.03	0.60	0.95	
Portugal	0.00	0.20	0.98	
Spain	0.02	0.35	0.94	
Hong Kong	0.36	0.32	0.47	**0.61**
Indonesia	0.04	0.14	0.78	
Malaysia	0.33	0.47	0.59	
Philippines	0.19	0.37	0.66	
Singapore	0.32	0.34	0.52	
China	0.13	0.23	0.63	
Canada	0.38	0.05	0.11	**0.14**
Mexico	0.39	0.08	0.17	

Table 2: Results from random-effects and fixed-effects regressions. Dep. var.: third-country exports as a a share of export sales

	(1)	(2)	(3)
NA GEO * HI	-0.502*	-	-
	(-2.23)		
NA GEO * LI	-0.558**	-	-
	(-3.08)		
NA GEO	-	-0.588**	-
		(-4.01)	
NAFTA * HI	-0.024	-0.026	-0.023
	(-0.51)	(-0.55)	(-0.49)
NAFTA * LI	0.003	0.004	0.009
	(0.07)	(0.08)	(0.21)
EU GEO * HI	0.319**	-	-
	(2.89)		
EU GEO * LI	0.119	-	-
	(1.04)		
EU GEO * LI	-	0.226**	-
		(2.83)	
EU * HI	-0.068*	-0.063*	-0.069*
	(-2.54)	(-2.39)	(-2.52)
EU * LI	0.126**	0.106*	0.124*
	(2.58)	(2.27)	(2.54)
LI	0.060	-0.015	
	(0.62)	(-0.21)	
GDP	0.002	0.001	0.004
	(0.66)	(0.53)	(1.16)
SKL	0.334	0.330	0.484
	(1.37)	(1.36)	(1.75)
INVC	0.004**	0.004**	0.004**
	(4.47)	(4.47)	(4.24)
TC	-0.0002	-0.0002	-0.0003
	(-0.44)	(-0.43)	(-0.61)
DIST	0.002	-0.004	-
	(0.16)	(-0.39)	
Time dummies	yes	yes	yes
R-sq. within	0.1181	0.1175	0.1194
between	0.6406	0.6223	0.0032
overall	0.6245	0.6257	0.0069
No. of obs.	549	549	549
No. of groups	39	39	39

Note: Figures in parenthesis are t-values. * indicates significance at the 5 percent level and ** at the 10 percent level. Results in columns (1) and (2) are based on random-effect regressions and in column (3) on fixed-effect regression.

NA GEO = 1 for US, Canada, Mexico in all years

EU GEO = 1 for 17 European countries in all years

NAFTA = 1 for Mexico at/after1994, Canada at/after 1989

EU = 1 for an EU 15 country at/after accession

LI = 1 for countries that according to the World Bank had GNI per capita below 14 730 USD in 1999. This includes Mexico, Venezuela, Turkey, South Africa, Argentina, Brazil, South Korea, Portugal, Philippines, Malaysia, Colombia, Chile, India, Greece, Spain, Egypt, Costa Rica, and China.

HI = 1-LI

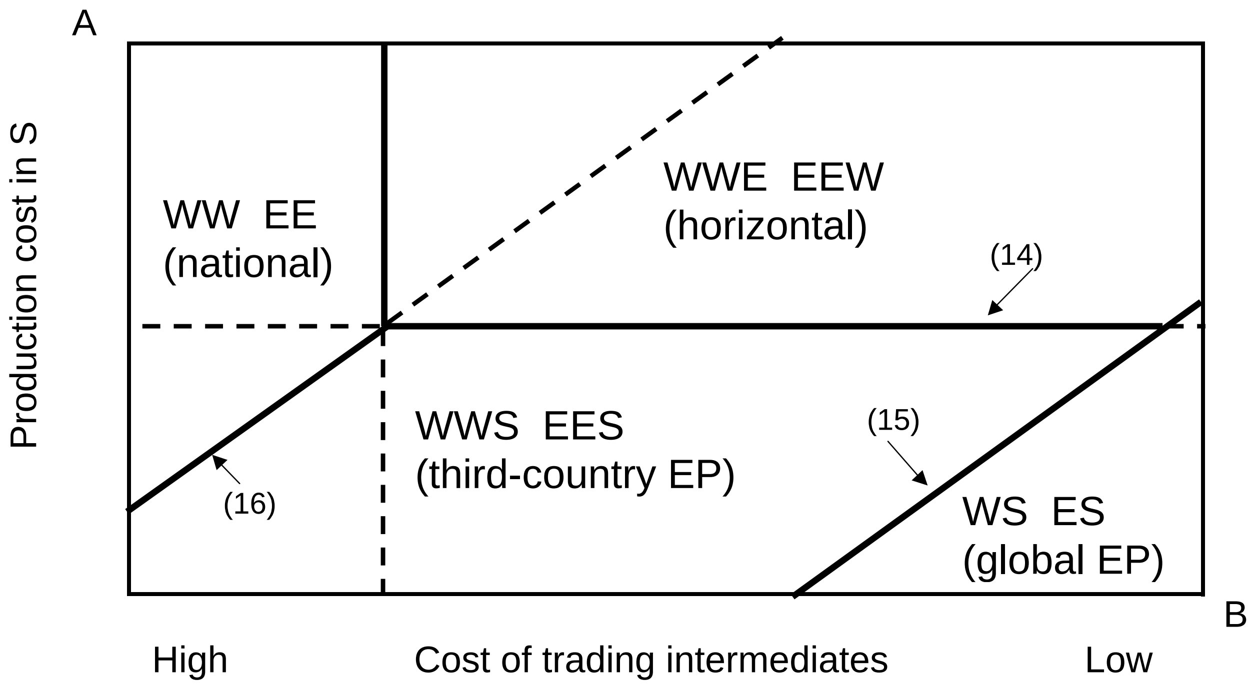
Table 3: Random effects regressions: predicted differences in percentage points from an "other" country (second regression of Table 2)

	Exports to third countries share of total exports: point estimates*
NA GEO	-59
NA GEO + NAFTA*LI	-59
NA GEO + NAFTA*HI	-56
EU GEO	23
EU GEO + EU*LI	33
EU GEO + EU*HI	17

*We present point estimates regardless of statistical significance. NA GEO + NAFTA LI, for example, adds together the coefficients on NA GEO and NAFTA LI from Table 2.

Note: "NA GEO + NAFTA" refers to a North American country in a year in which it is a member of NAFTA (Canada at/after 1989, Mexico at/after 1994). Similarily, "EU GEO + EU" refers to a European country in a year in which it is an EU member. Thus, for example the difference between "NA GEO" and "NA GEO + NAFTA" is the added effect of joining NAFTA.

Figure 1: Regimes as a function of cost of trading components, production cost in S



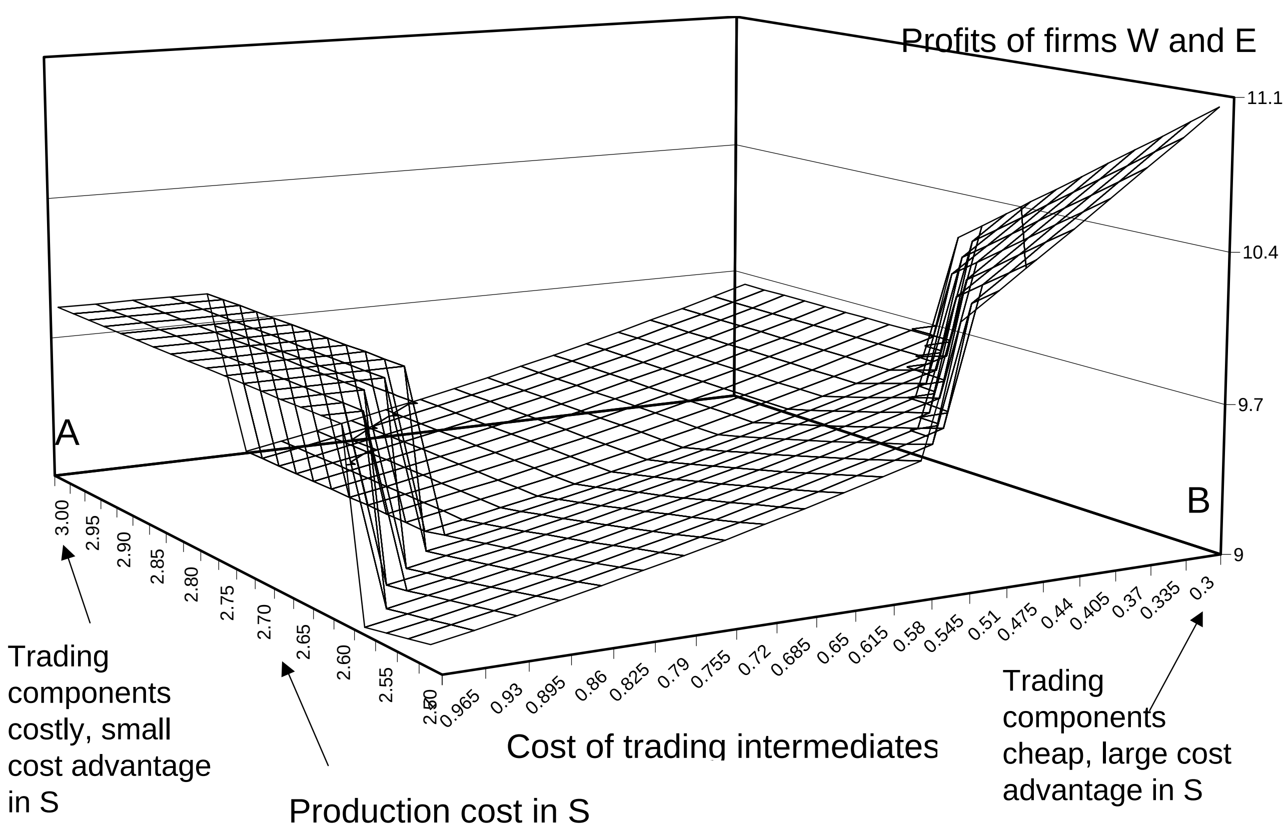


Figure 2: Symmetric base case: trade costs the same on all links

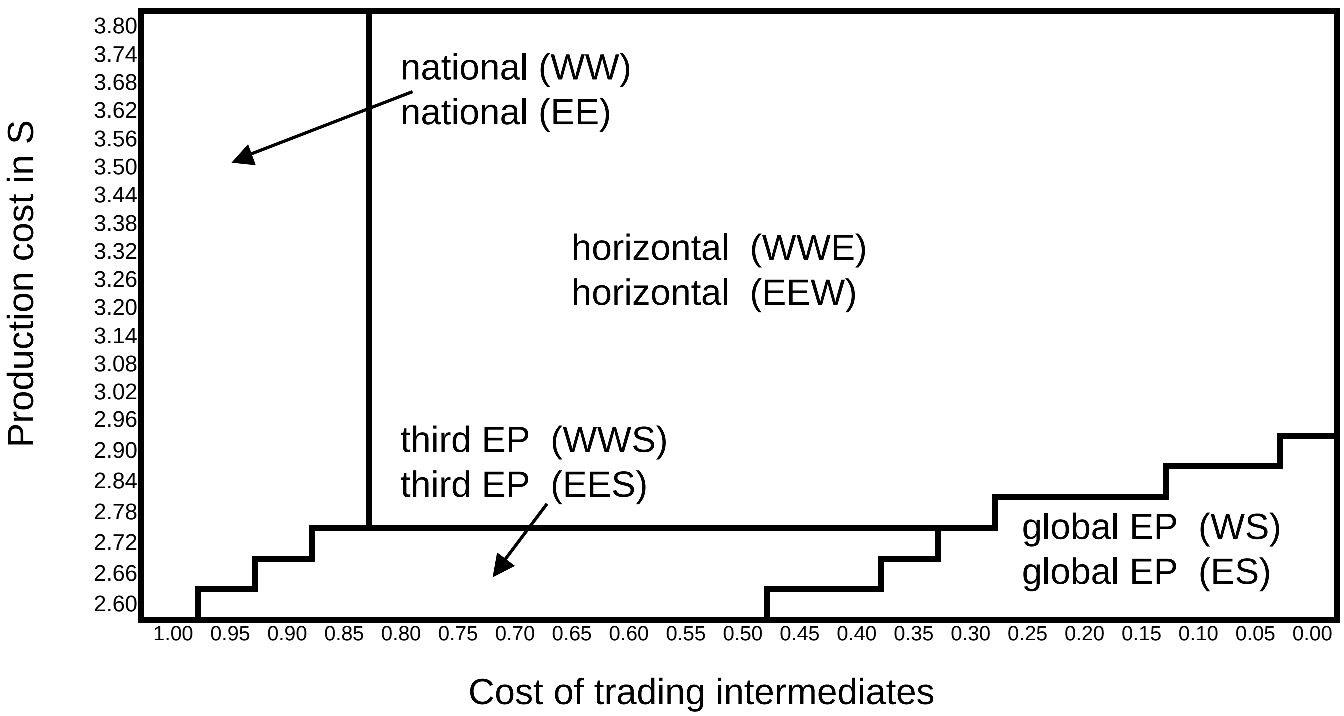
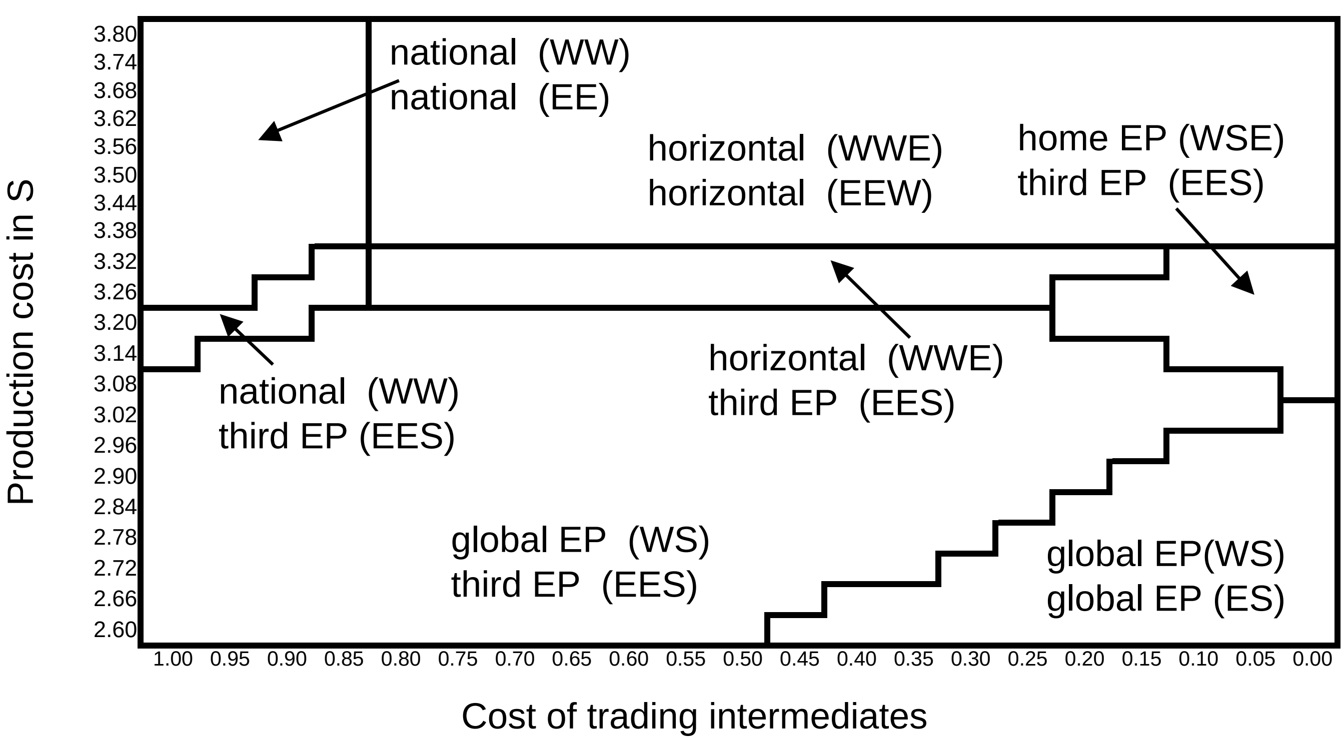


Figure 3: W-S trade costs reduced by 50% from Figure 2



top number: mode choice of firm W; bottom number: mode choice of firm E

Figure 4: W-S trade costs reduced by 100% from Figure 2

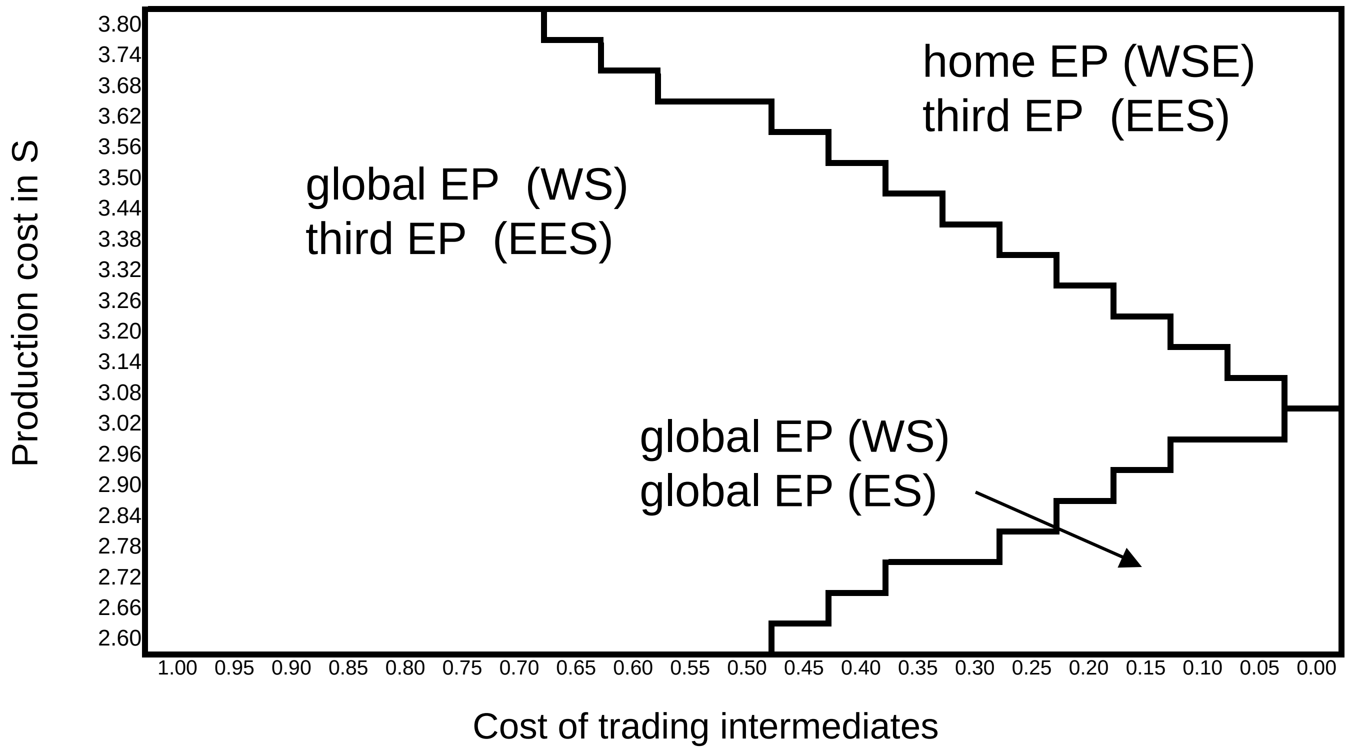
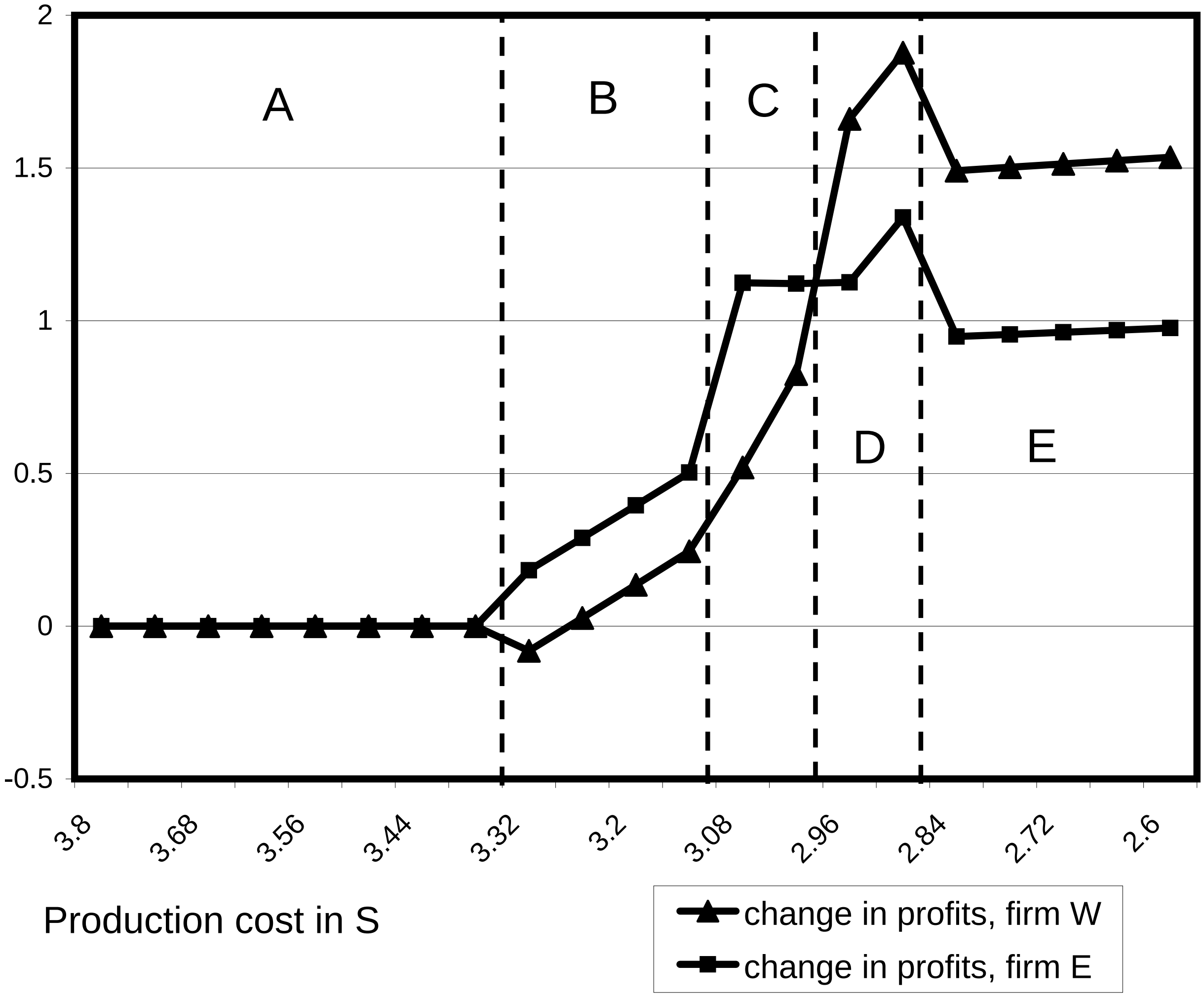


Figure 5: Change in firm profits following the introduction of the W-S free-trade area (50% trade-cost reduction) as a function of c_s (column σ = 0.1 of Figure 3)



Regions A, B, C, D: both firms horizontal initially (WWE EEW)

Region A:	no change, both firms horizontal	
Region B:	Firm W switches to home EP	WSE
	Firm E switches to third EP	EES
Region C:	Firm W switches to global EP	WS
	Firm E switches to third EP	EES
Region D:	Firm W switches to global EP	WS
	Firm E switches to global EP	ES
Region E:	no change, both firms global EP before and after	

Figure 1A: Regimes as a function of cs, σ; positive demand in south