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Abstract

An interesting empirical phenomenon is export-platform foreign-direct investment, particularly affiliate production for sale in third countries rather than in the parent or host countries. This is rather poorly understood because our theoretical understanding of multinationals is largely derived from two-country models. Our model shows how affiliate production solely for third countries can occur when a firm in each of two large, high-income countries has a domestic plant to serve its own market, and uses a plant in a small, low-cost country to serve the other high-income country. Third-country export-platform FDI can also occur when the host and third countries are inside a free-trade area and the parent is outside. Our empirical section shows that US affiliates located inside a free-trade area concentrate their exports to other free-trade member countries, consistent with parameterizations of our model in which the *outside* firm is the chief beneficiary of the free-trade area. Affiliates located outside of free-trade areas such as those in Southeast Asia show a balance between exports to the parent and exports to third countries, consistent with parameterizations that generate "global export-platform" production.

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1. Introduction

In 2000, 64 percent of total sales of foreign affiliates of US multinationals were sold domestically, while 36 percent were exported. 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 referred to as 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 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 export platform FDI is promoted by low host-country trade barriers and discouraged by large host-country markets.[1]

Table 1 presents some summary statistics that motivate the analysis. The data are sales by foreign affiliates of US multinationals, broken down into local sales in the host market, export sales back to the US, and export sales to third markets (data compiled and analyzed in Markusen and Maskus 2001, 2002). The first line of data presents average figures for all 39 host countries

[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 to use more precise terminology, and use "third-country export-platform" FDI to refer to production solely for export to third countries, "global export-platform" FDI for balanced exports to both parent and third countries, and "home-country export-platform" FDI for exports only back to the parent (this last is traditionally called vertical FDI, but all of these cases have elements of vertical FDI).

in the data set, and subsequent lines present three groups of countries where there is some common feature of the group data.

The first group of countries, Ireland, Belgium, Greece, Holland and Portugal has the highest proportion of affiliate sales going to third countries of all countries in the sample, and very low proportions of their sales going back to the US. The countries which display third-country export-platform sales most clearly are not developing countries, but smaller countries inside the EU.

The second group of countries, Hong Kong, Indonesia, Malaysia, Philippines, and Singapore display a concentration of their sales in exports relative to local sales, but there is a balance between exports back 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 affiliates are used in industries such as electronics to serve global markets, Europe and Japan as well as the US itself.

The third group of countries in Table 1 are the US's NAFTA partners, Canada and Mexico. Local sales in these countries are close to the proportions for the total sample, in part reflecting the fact that both countries are big markets and likely reflecting the fact that these numbers for Mexico reflect import-substituting horizontal production prior to NAFTA. The interesting thing about these data is that 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. But they share the characteristic that the affiliates' exports are largely to the geographically close, integrated market.

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 export-platform FDI is likely to arise and the conditions under which sales to third countries dominates 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 the EU. 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 each of the large, high-cost markets. We also assume that 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 number of cases that must be considered and allow us to focus on the *composition* of affiliate exports.

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 and, when they do, the export patterns of those plants will be symmetric. Third-country export-platform production arises when low production costs in S lead a firm to use S to serve the other N country, but the savings on fixed costs from closing the home plant do not offset the costs of shipping components to S and final output back home.

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. Firm E must pay a trade cost to ship components to a plant in S (if there is one) and a cost to ship final output back to E, but enjoys costless shipping of final output to W from its plant in S. The cost to firm E of shipping components 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.

[2]Other theoretical treatments of export-platform 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 important for interpreting the empirical evidence.

We then turn to empirical analysis. We show that US affiliate exports to third countries are especially high when the host country is a member of a geographically concentrated and integrated economic block, and the parent country is outside the block (the EU). Conversely, exports are concentrated in shipments back to the parent when the parent is an inside country (NAFTA). These results are consistent with a restricted range of parameters in our model. US affiliates located in the non-integrated Southeast Asian region on the other hand, show evidence of global export-platform FDI, consistent with a certain parameterization of our symmetric model.

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.

There are 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).
There is one final good (X) and one intermediate good (Z) referred to as components.
Z and X activities have constant marginal costs.
One unit of Z is needed to produce one unit of X.
There is a fixed cost F for components and the first plant, and a fixed cost G for a second plant.
There are 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 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 ship components 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 (e.g., firm W will not have a single plant in E).

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 denoted c_z, identical in W and E. A subscript 'n' denotes the common value for W and E. c_{xn} denotes the cost of assembly in the north and c_{xs} the cost in the south. Notation for the unit cost of X assembled in each of the three regions is then:

(3) $$c_n = c_{xn} + c_z \qquad c_s = c_{xs} + c_z$$

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. In this section, we will restrict ourselves to symmetry between W and E, so the common values of these trade costs will be denoted τ_n and σ_n. On N-S links, components only flow from north to south (if at all) and X flows only from south to north (if at all). In our symmetric case, these costs are then given by

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

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]

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 export-platform regime: each firm serves its rival's market from a plant in S
WS ES	global export-platform 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:

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

(6) $$X_{we}^{w} = X_{ew}^{e} = \frac{\alpha - c_n - 2\tau_n}{3\beta}$$

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[3]Asymmetric outcomes with multiple equilibria are possible in this type of model, as noted in 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. There we present an intuitive argument why there are no asymmetric/multiple equilibria in the present symmetric case with no demand in S.

As we will note later, this regime can occur when G and the cost of trading components 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:

$$(7) \qquad X_{ww}^{w} = X_{ee}^{e} = \frac{\alpha - c_n + \sigma_n}{3\beta}$$

$$(8) \qquad X_{ee}^{w} = X_{ww}^{e} = \frac{\alpha - c_n - 2\sigma_n}{3\beta}$$

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 export-platform 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:

$$(9) \qquad X_{ww}^{w} = \frac{\alpha - (2c_n - c_s) + \sigma_{es} + \tau_{sw}}{3\beta} \qquad X_{se}^{w} = \frac{\alpha - (2c_s - c_n) - 2\sigma_{ws} - 2\tau_{se}}{3\beta}$$

$$(10) \qquad X_{ee}^{e} = \frac{\alpha - (2c_n - c_s) + \sigma_{ws} + \tau_{se}}{3\beta} \qquad X_{sw}^{e} = \frac{\alpha - (2c_s - c_n) - 2\sigma_{es} - 2\tau_{sw}}{3\beta}$$

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

$$(11) \qquad X_{sw}^{w} = \frac{\alpha - c_s - \sigma_{ws} - \tau_{sw}}{3\beta} \qquad X_{se}^{w} = \frac{\alpha - c_s - \sigma_{ws} - \tau_{se}}{3\beta}$$

$$(12) \qquad X_{se}^{e} = \frac{\alpha - c_s - \sigma_{es} - \tau_{se}}{3\beta} \qquad X_{sw}^{e} = \frac{\alpha - c_s - \sigma_{es} - \tau_{sw}}{3\beta}$$

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.

(13) $\pi^w_w = \beta(X^w_{ww})^2 + \beta(X^w_{we})^2 - F$ (WW EE)

(14) $\pi^w_{we} = \beta(X^w_{ww})^2 + \beta(X^w_{ee})^2 - F - G$ (WWE EEW)

(15) $\pi^w_{ws} = \beta(X^w_{ww})^2 + \beta(X^w_{se})^2 - F - G$ (WWS EES)

(16) $\pi^w_s = \beta(X^w_{sw})^2 + \beta(X^w_{se})^2 - F$ (WS ES)

To get some intuition behind the results to follow, consider a non-strategic experiment in which the firm wants to *minimize the costs* of suppling 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 (4):

(a) For firm W to prefer third-country export-platform 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 export-platform 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 export-platform 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. $\Delta c > \sigma + g$

We now turn to the analytical conditions for a Nash equilibrium. These are closely related to, but not identical with the cost conditions just discussed. The 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 export-platform outcome WWS EES to exist as an equilibrium in the symmetric case, whereas all the possible regimes will be treated in the 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.

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

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

(19) $$(\Delta c - \sigma) + \frac{(\Delta c - \sigma)^2}{\alpha - c_n - 2\tau} > \frac{3}{4}\left[\frac{3\beta}{\alpha - c_n - 2\tau}\right]G$$ (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*. Transport costs for the intermediate good have to be positive or, for example, the firm will want to shut its home plant and serve markets from the south (if (17) holds, then (18) 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.

(20) $$\Delta c - \tau = \epsilon \quad \text{and}$$

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

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 (19) (a firm does not want to deviate to a national firm strategy) will hold if

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

This inequality must hold if we make G, the plant-specific fixed cost small enough. In other words, given that the first two inequalities (17, 18) hold, the third (19) 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 for a viewing reason which will become clearer shortly. Let (17), (18), and (19) 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 export-platform regime. Condition (17) defines a horizontal line, (18) has a slope -1 (or +1 in Figure 1, since σ falls moving to the right). (19) is also linear with a slope -1 (or +1 in the Figure).

By transitivity, the intersection of (17) and (19) 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 export-platform 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 just mentioned. 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 (this was chosen because this is the best viewing rotation in the bottom panel, and then we tried to make the top panel consistent with that). Both costs decrease along the diagonal line moving from point A to point B in the respective panels.

When the cost of trading components 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 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 both component trade costs are low and the south has a big advantage, both firms just maintain a single plant in S: WS ES. The bottom panel of Figure 1 shows that both firms' profits suffer in the two-plant strategies. This is the usual prisoner's dilemma outcome: at these parameter values 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.

Figure 2 looks at the A-B diagonal shown in Figure 1 with high values of σ and c_s at the left and low values on the right. The drop in profits when the firms invade each others market with a branch plant (in the rival's market or in the south) is a pro-competitive effect which

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[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.

negatively impacts the local firm as just mentioned . In the initial WW EE national-firm strategy, the trade costs on X “insulate” the firms somewhat from competing with one another, an effect familiar from the strategic trade-policy literature. Profits rebound when the firms switch to a single plant in S, an effect similar but in a sense opposite to this insulation effect. 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 export-platform outcome WWS EES occurs at moderately low values of σ and c_s, but not so low that the firms close their domestic plants.

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 export-platform 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 reduced to or toward zero. There are unfortunately a number of possibilities (see Motta and Norman (1996) who fully characterize the solution in a similar situation, but without exports back to the parent). We will look at two interesting cases, (a) when W-E and E-S trade costs are low so that the initial equilibrium without the free-trade area is the national firm strategy WW EE, and (b) these costs are high for final goods (but not components) so that the initial equilibrium is the horizontal outcome WWE EEW.

Anticipating the results, each firm gains something from the free-trade area and suffers a corresponding competitive disadvantage due to the benefit for the other firm. Firm W can ship components free to S while firm E cannot, so we can say that firm W gains a market access advantage in components. 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. This suggests that which firm gains more may depend on whether τ is large or small relative to σ. We show that this is indeed the outcome.

The first case is shown in Figure 3, where we assume $\sigma = \tau$. These costs are equal on all links at the left-hand edge of the diagram, and the initial equilibrium is the national-firm strategy. Let $\sigma_{ws} = \tau_{ws}$ denote the costs on the W-S link which we will reduce moving to the right in Figure 3, holding $\sigma = \tau = 1$ on the W-E and E-S links (i.e., σ and τ without subscripts in what follows indicate a common value). Rather than run through all the algebra, we will just present the intuition behind the results in Figure 3 since, as will become clear shortly, there are other cases for different parameters including ones in which certain regimes do not exist as equilibria.

Consider the intuition derived from simple cost arguments earlier, again letting g denote the fixed costs of a second plant per unit of output (note that g is actually a variable, depending on other costs and the strategies of both firms). Given the initial equilibrium WW EE when $\sigma_{ws} = \tau_{ws} = 1$, reductions in these values will cause firm W to want to shift its single plant to S when the cost disadvantage of the north exceed the cost of shipping components to S and shipping final output back to W (note that given the initial parameterization, W will never want to have two plants). The cost condition here involves changes in the way both markets are served.

(22) $$c_n + (c_n + \tau) > (c_s + \sigma_{ws} + \tau_{ws}) + (c_s + \sigma_{ws} + \tau) \quad \Rightarrow \quad \Delta c > \tau_{ws}/2 + \sigma_{ws}$$ (W shifts from WW to WS)

Firm E on the other hand, may wish to build a second plant in S dedicated to serving W, third-country export-platform production. The conditions to want to shift from the national strategy to third-country export-platform production relate only to the cost of serving W.

(23) $$c_n + \tau > c_s + \sigma + \tau_{ws} + g \quad \Rightarrow \quad \Delta c > \tau_{ws} + g$$ (E shifts from EE to EES)

since $\sigma = \tau$ by assumption. Finally, E may wish to have just a single plant in S to serve both markets, global export-platform production. The shift from third-country to global export-platform production is given by the cost condition for serving E.

$$c_n + g > c_s + \sigma + \tau \quad \Rightarrow \quad \Delta c > \tau + \sigma - g \qquad (24) \qquad \text{(E shifts from EES to ES)}$$

The shift from third-country to global export-platform production arises when the cost disadvantage of the north exceeds the cost of shipping components to the south, shipping the output back, minus the savings in the fixed costs of a second plant. This is an interesting condition in that it does not directly involve W-S trade costs at all. It does so indirectly since, as these costs fall, firm W becomes steadily more competitive in E and E's equilibrium output falls. Thus g rises as W-S trade costs fall, and so the right-hand side of (24) falls.

Figure 3 gives results for a parameterization such that all three regimes in (22)-(24) exist as $\sigma_{ws} = \tau_{ws}$ falls. Note that this need not be the case; for example, regime WS EES will not exist if G is sufficiently high. Figure 3 shows that firm W is the beneficiary of the W-S liberalization, since it becomes more competitive in country E and in serving its own market as well. The exception to this statement is in the neighborhood of the shift from WS EE to WS EES: firm E gains a lower marginal cost of serving W (at the expense of incurring G) which harms firm W in market W (there is no change by either firm in serving E). Then there is a discrete jump up for firm W when firm E shuts its domestic plant, incurring higher costs of serving its own market but saving a fixed cost.

Finally, it is interesting to note that, as W-S trade costs continue to fall in the WS ES region of Figure 3, firm E is still being made worse off in spite of its lower-cost access to market W. This is a competitive or "rent-shifting" effect: the cost saving to firm E is outweighed by the fact that firm W continues to enjoy lower and lower costs for shipping its components to S while firm E does not.

In our empirical section to follow, we will analyze the share of affiliate's exports (if any) going to the third country, the other northern country rather than back to the parent. The difference between the two firms is most striking in the WS EES region where the insider firm W has a global strategy (affiliate exports divided between W and E) and outsider firm E has a third-country export-platform strategy (all affiliate exports go to W, the insider country).

The second case we would like to consider is when trade costs for X are higher than in Figure 3 and higher than those for components, and plant fixed costs are moderate so that firms choose the horizontal strategies WWE EEW initially when W-S trade costs are the same as on other links. Figures 4 and 5 show outcomes for somewhat different values of c_s and G, and different relationships between τ and σ. In Figure 4, $\sigma = \tau/3$ while in Figure 5 $\sigma = 2\tau/3$.

There are two important differences between Figure 3 and Figures 4-5. One is that it is firm E now which is the first to deviate and second, it is firm E which is better off as W-S trade costs fall. Firm E will want to move its second plant from W to S (EEW to EES) when

(25) $$c_n + \sigma > c_s + \sigma + \tau_{ws} \quad \Rightarrow \quad \Delta c > \tau_{ws}$$ (E shifts from EEW to EES)

Firm W will consider two deviations. First, it is possible that firm W will now want to keep its plant in E, but serve its own market from S, which we could call “home-country” export platform production, closely related to “vertical” production in more traditional two-country models. Firm W will want to make this switch if

(26) $$c_n > c_s + \sigma_{ws} + \tau_{ws} \quad \Rightarrow \quad \Delta c > \tau_{ws} + \sigma_{ws}$$ (W shifts from WWE to WSE)

Comparing (25) and (26) it is immediately clear that firm E will want to make the shift as W-S trade costs fall before firm W wants to switch. This does not imply that WSE is going to be an equilibrium strategy, firm W could instead close it plant in E and open a plant in S to serve E (third-country export-platform production). Firm W will want to switch from horizontal to third-country export-platform production if

(27) $$c_n + \sigma > c_s + \sigma_{ws} + \tau \quad \Rightarrow \quad \Delta c > \tau + \sigma_{ws} - \sigma$$ (W shifts from WWE to WWS)

Which of conditions (26) and (27) is satisfied first as W-S costs fall depends on the relationship between τ and σ. Let τ_{ws}* denote the value of τ_{ws} at which (26) just holds with equality (for the relevant σ_{ws}, which appears in both (26) and (27)). Firm W will prefer the home-country export-platform strategy WSE to third-country export-platform production WWS if

(28) $$\tau_{ws}^{*} < \tau - \sigma$$

This inequality must hold if τ is sufficiently large relative to σ and will be reversed if this difference is small (but τ must be greater than σ if the initial equilibrium is to be the horizontal strategies!). This is indeed the difference in the parameterizations of Figures 4 and 5: τ is large relative to σ in Figure 4 (so (27) holds) and smaller in Figure 5.

Figure 4 shows that firm E is the first to shift as W-S trade costs are reduced as suggested above. Further decreases in W-S trade costs now make firm E better off and firm W worse off in contrast to Figure 3. With $\tau_{ws} > \sigma_{ws}$, the low-cost of shipping X from S to W is worth more for firm E than the low cost of shipping components from W to S is worth for firm W. The second regime shift in Figure 4 is firm W shifting to the home-country export-platform strategy. From this point on, further reductions in W-S costs make both firms better off, and firm W's profits will exceed those of firm E as W-S free trade is approached (not shown due to the scaling).

The region WSE EES in Figure 4, in which firm W has a home-country export platform strategy and firm E has a third-country strategy is interesting, because it conforms closely to the data for NAFTA and the EU that we looked at in Table 1. In this region, both the affiliates of the insider and outsider firms are specialized in serving the insider northern market.

Figure 5 uses values of τ and σ that are closer together so inequality (28) is reversed. Once again, the gradual lowering of W-S trade costs causes firm E to move first, switching from a horizontal strategy to a third-country export-platform strategy. The second regime shift is to WWS EES with both countries adopting third-country export-platform strategies. In both these regions, the further lowering of W-S trade costs benefits the outside firm E and harms the inside firm W. Finally, due to the choice of different parameter values from Figure 4, firm W shift to a global export-platform strategy in Figure 5. Initially, this increases firm E's profits significantly, as firm W now has higher marginal costs of serving its own market, but this increase is eroded with further reductions in W-S costs, with profits of firm W eventually exceeding those of firm E as W-S costs go to zero (again, not shown for scaling reasons).

The pattern of affiliate exports for the insider and outsider firms in the WS EES regime is similar to the same regime region in Figure 3. The outsider firm's exports are entirely to the insider country, while the insider's exports are balanced between the two markets.

Referring back to Table 1 and anticipating the results in the next section, the data for US affiliates most closely resembles the WSE EES equilibrium of Figure 4: when the affiliate in a free-trade area has the insider country as parent, exports are highly concentrated in sales to the parent, whereas when the parent is an outsider, we will see that the affiliates exports are concentrated to third countries. While this may seem an intuitive conclusion, Figures 3-5 emphasize that it is far from an inevitable outcome.

4. Empirical analysis

In the symmetric case, affiliates in countries which are not members of a free-trade area may have relatively balanced exports between sales to the parent country and to third countries or 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.

Ideally, we would like to have a world data set on affiliate production, sales and exports so that we could compare US and European affiliates in Mexico for example. We do not have such a data set, and the best that we have is the US Bureau of Economic Analysis (BEA) data which is on a bilateral basis, the US either being parent or host. Thus we can compare affiliates where the US is an insider country (e.g., Mexico) versus affiliates where the US is an outsider to a free-trade area (e.g., Ireland), but we cannot compare insider and outsider affiliates in the same host country, which is what we would like to do. A further weakness is that the inward data (US affiliates of foreign firms) does not break exports down into exports back to the parent versus exports to third countries. Thus for our purposes, the only useful data is on US outward investments. A weakness of the US outward 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.

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 BEA.

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. The US has far-reaching preferential trading agreements with Israel, but so has the EU. The countries in Southeast Asia are typical low-cost countries that, unlike Mexico and the countries in Southern Europe, do not belong to a regional free-trade area. We thus want to use Southeast Asian countries as a group against which to evaluate results for NAFTA and the EU. Israel will be specified separately as well.

We carry out three sets of regressions; (i) one in which the dependent variable is defined as exports to the *US* as a share of total affiliate *sales*, (ii) one in which it is defined as exports to *third countries* as a share of total affiliate *sales*, and (iii) one in which it is defined as exports to *third countries* as a share of total affiliate *exports*.

The independent variables include the following dummy variables:

North American geography = 1 for Canada and Mexico in all years

European geography = 1 for 17 European countries in all years
(EU 15 plus Norway and Switzerland)

Southeast-Asian geography	= 1 for Hong Kong, Philippines, Indonesia, Malaysia, and Singapore in all years
Israel	= 1 for Israel in all years
NAFTA[5]	= 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)

A group of control variables from the Markusen-Maskus data set are also used (Carr, Markusen, Maskus, 2001, Markusen and Maskus 2001, 2002).[6]

GDP	host-country GDP (real US$, trillions)
Skilled share (SKL)	host-country skilled labor as a share of total labor (ILO)[7]
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 OLS regressions. In these regressions we have simply treated the data as a pooled cross section, allowing observations on each country to be correlated, but assuming independence across countries. We have added time dummies to take out any time effects affecting the whole sample. One reason for including time dummies is that

[5] 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.

[6] 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.

[7] The sum of occupational categories 0/1 (professional, technical and kindred workers) and 2 (administrative workers) in employment in each country, divided by total employment.

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 in some years, so-called benchmark surveys, 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.[8]

Table 2 presents results from regressions with and without the control variables. The estimated coefficients of the dummy variables give us the predicted deviation in the dependent variable for countries belonging to the country group captured by the dummy variable, the point of reference being a group of countries belonging to neither country group captured by dummy variables.

The top row of table 2 shows that affiliates in Canada and Mexico export more to the US and less to third countries than affiliates in other countries. Entering into NAFTA is predicted to reinforce this pattern insofar as the estimated coefficients indicate that it increases exports to the US as a share of total affiliate sales with about 10 percentage points. Affiliates in Europe exhibit the opposite pattern; they have less exports to the US and more exports to third countries. The estimated coefficients of the EU dummy, however, are statistically insignificant in all OLS regressions.

The results for the Southeast Asia dummy and the Israel dummy suggest that affiliates located in these countries tend to export a larger share of their total sales than affiliates in other countries (the estimated coefficients in the regressions of exports to the US and exports to third

[8] To base the analysis solely on observations from benchmark surveys would not give us sufficient information to identify any effects arising from entering into NAFTA or EU.

countries as a share of total affiliate sales are positive and significant). On balance, however, they tend to export more to the US than to third countries (since the estimated coefficients of the ASIA and ISRAEL dummies in the last two columns are negative and significant).

An interesting finding in Table 2 is that few of the estimated coefficients of the control variables are statistically significant. The only statistically significant result is that investment costs tend to reduce exports as a share of total affiliate sales.

The results from the OLS regressions in Table 2 tell us that there are significant differences in the composition of sales and exports between countries belonging to different country groups. However, this analysis does not address the issue of whether belonging to a particular country group is what really matters for these differences to arise. It may be that there are country-specific differences unrelated to the structure of trade costs arising from belonging to a particular country group that happen to be such that a grouping along the lines in Table 2 will lead to statistically significant differences in the predicted shares.

In order to assess whether belonging to a particular country group is crucial for the differences to arise, we would ideally like to control for time-invariant country-specific differences in the composition of affiliate sales and exports. However, using fixed effects estimation or first differencing is clearly not a feasible empirical strategy if we want to estimate the effect of being located in a certain region. By carrying out a regression analysis based on a random-effects specification we are however able to go some way in addressing this issue. Table 3 presents the results from a random-effects estimation of the linear equation estimated with OLS in the previous table.[9] As is evident from this table, the point estimates of the coefficients of the country group dummies differ very little from the ones obtained by OLS. Again, entering into NAFTA is estimated to increase exports to the US as a share of total affiliate sales with about 10 percentage points. Entering into the EU now has a statistically

[9] The only difference between the two specifications is that the error term u_{it} in the OLS regression is divided into $u_i + e_{it}$ in the random effects regression, where u_i is treated as a random variable.

significant effect on exports to third countries as a share of total affiliate sales; this share is estimated to increase with about 6 percentage points.[10]

Again, few of the estimated coefficients of the control variables turn out statistically significant. Investment costs are estimated to have a negative effect on exports to the US as a share of total affiliate sales and a positive effect on exports to third countries as a share of total affiliate exports. The share of skilled labor is estimated to have a negative effect on exports to the US as a share of total affiliate sales, indicating that US affiliate production for export back to the US is unskilled-labor seeking.[11]

Table 4 presents the results of the estimation in a simple format to allow easier comparison and interpretation of the results. We can interpret our dummy variables as the effect of belonging to one of the groups relative to belonging to the "other" (control) group for common levels of the control variables. "Insider" refers to the fact that the US firm is inside the free-trade area while "outsider" is used for the European area. "Neither" is used for the Southeast Asian group while "Both" is used for Israel.

The difference between North America and Europe is striking, as are both areas relative to the Southeast Asian group and Israel. Affiliates in Canada and Mexico export a larger share of their total output than the control group, but this is highly concentrated in exports back to the US, with a smaller share of exports to third countries than the control group. Conversely, affiliates in the European countries also export a larger share of their output than the control

[10] We have carried out Hausman's specification test for the specifications including control variables. None of the results of this test are significant (p-values are around 0.99), implying that we find no evidence of correlation between the random effects and the regressors (assuming that the model is correctly specified). The estimated linear probability model with controls generates a few predicted values outside the 0-1 interval. More specifically, there are a few predicted values below 0 in regression (4) in Table 3 (the minimum value is -.03), while there are a few predicted values above 1 in regression (6) in Table 3 (the maximum value is 1.02). While the linear probability model thus is not strictly correct in these cases, we have maintained it in favor of a non-linear model because of its otherwise appealing properties.

[10] A similar result is found by Yeaple (2003).

group, but it is highly concentrated in exports to third countries, with a smaller share going to the US than the control group. Both the Southeast Asian group and Israel export a lot, but the composition of these exports are much more balanced between the US and third countries.

One interesting fact emerges in comparing the shares-of-sales and shares-of exports. Using the former, it is clear that joining NAFTA or the EU has a definite effect beyond simple proximity. Yet this does not occur using shares of total exports. Together, this implies that the added exports to members of the free-trade area after joining are at the expense of the share of local sales, not the share of exports to outside countries. We can think of the affiliates as being more integrated into the regional market as a consequence of entry into NAFTA or the EU.

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 regional free-trade area because the parent country is served by a local plant. This particular equilibrium regime arises when trade costs for components is significantly lower than for final goods.

The estimated effect on affiliate exports going to third countries of being located in Southeast Asia and Israel, on the other hand, are consistent with the predictions of the symmetric model under the parameterization whereby the regime WS ES arises in equilibrium, i.e. a case with relatively low trade costs in components and a relatively large difference in production costs between the North and the South. This corresponds to the case we have termed global export-platform FDI.

5. Summary

Export-platform direct investment is usually taken to refer to a situation where the output of a foreign affiliate is largely sold in third markets, not in the host country or exported back to the parent country. We refer to this more precisely as "third-country export-platform" production. Our approach adopts a three-country model, with two identical large, high-cost countries and a small, low-cost country.

We consider two cases. In the first, trade costs for components are the same on all trade links as are the trade costs for assembled final goods. The third-country export-platform strategy is preferred on a cost basis if the cost disadvantage of the north is (a) large relative to the cost of shipping final output (so that a horizontal strategy is not preferred) and (b) large relative to the cost of shipping components and the per-unit fixed costs of a second plant (so that a national-firm strategy is not preferred), but (c) not large relative to the cost of shipping components to S, and shipping final output back to the home and incurring the added per-unit fixed costs of the second plant (so that a single plant in S is not preferred). Results of this case also complement other results in the theoretical and empirical literatures. Horizontal affiliate production substitutes for trade while vertical or export-platform production complements trade.

Our second case involves export-platform FDI arising in a situation where one (of several) high-demand, high-cost countries forms a free-trade area with a low-cost, low-demand country. If there are two high-cost countries, then firms in both those countries may have an incentive to set up a plant in the low-cost country. When trade costs for final goods are not high relative to trade costs for components, it is the "insider" firm that first moves production to S and that benefits from the free-trade area, which strikes us as an intuitive result. But when trade costs for final goods are high relative to those for components, then we showed that it is the "outsider" firm that moves production first and that benefits at the expense of the insider firm. 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 components cheaply to a plant in S.[12]

We then turn to empirical analysis, examining the share of output that is exported 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 Figure 4, where the insider firm pursues a home-country export-platform 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 export-platform strategy, serving itself with a local plant and serving the insider country from a plant in S.

A group of Southeast Asian economies presents an interesting contrast. These countries do not have significant free-trade agreements with North America, Europe, or Japan, so US affiliates are neither insiders nor outsiders. We find that for these countries, there is a close balance between home-country and third-country exports, which is indeed consistent with parameterizations of our symmetric case that generate global export-platform production.

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 benefits from the free-trade area at the expense of the insider.

[12]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).

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Appendix 1: derivations

Here we present the derivations for the boundary conditions (17)-(19).

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

For the third-country export-platform 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 (14)-(15), 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 (17).

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 export-platform 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 (18).

(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 (19).

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 very 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 then 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).[13]

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.

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[13]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: Distribution of sales by US affiliates between local sales, exports to the US, exports to third countries

Sales of foreign affiliates of US multinationals: shares in total, 2000

	local sales	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)	0.60	0.12	0.28	0.70	**0.70**
Ireland	0.13	0.16	0.71	0.82	**0.93**
Belgium	0.39	0.04	0.57	0.93	
Greece	0.83	0.01	0.16	0.97	
Holland	0.37	0.03	0.60	0.95	
Portugal	0.80	0.00	0.20	0.98	
Hong Kong	0.33	0.36	0.32	0.47	**0.60**
Indonesia	0.82	0.04	0.14	0.78	
Malaysia	0.20	0.33	0.47	0.59	
Philippines	0.44	0.19	0.37	0.66	
Singapore	0.35	0.32	0.34	0.52	
Canada	0.57	0.38	0.05	0.11	**0.14**
Mexico	0.53	0.39	0.08	0.17	

Table 2: Results from OLS regressions

Dependent variable:	*Exports to the US as a share of total affiliate sales*		*Exports to third countries as a share of total affiliate sales*		*Exports to third countries as a share of total affiliate exports*	
	(1)	(2)	(3)	(4)	(5)	(6)
NAgeo	0.239	0.160	-0.066	-0.186	-0.591	-0.504
	(7.40)	(4.14)	(-3.81)	(-2.81)	(-11.1)	(-6.89)
NAFTA	0.110	0.098	-0.005	-0.030	-0.030	-0.007
	(4.94)	(3.41)	(-0.43)	(-1.85)	(-1.41)	(-0.22)
EUgeo	-0.002	-0.087	0.268	0.154	0.165	0.241
	(-0.08)	(-2.10)	(6.66)	(3.03)	(3.11)	(3.87)
EU	-0.009	0.022	0.033	0.075	0.018	-0.012
	(-0.65)	(1.05)	(0.52)	(1.23)	(0.68)	(-0.42)
ASIAgeo	0.245	0.261	0.137	0.137	-0.203	-0.250
	(2.92)	(3.27)	(3.53)	(3.60)	(-2.55)	(-2.4)
ISRAEL	0.252	0.259	0.154	0.080	-0.256	-0.285
	(13.96)	(8.89)	(9.63)	(2.24)	(-5.39)	(-6.30)
GDP		-0.008		-0.030		-0.022
		(-1.21)		(-2.12)		(-1.75)
SKL		-0.021		-0.205		-0.118
		(-0.14)		(-0.99)		(-0.40)
INVC		-0.341		-0.475		0.307
		(-2.43)		(-2.69)		(1.58)
TC		0.034		-0.006		-0.228
		(0.42)		(-0.06)		(-1.80)
DIST		-0.007		-0.013		0.010
		(-1.62)		(-1.95)		(1.54)
Time dummies	yes	yes	yes	yes	yes	yes
Adj. R2	0.57	0.66	0.58	0.64	0.62	0.72
No. of obs.	648	547	648	547	647	549

Note: Figures in parenthesis are t-values. They are based on White's method for taking heteroskedasticity into account. Constant and time dummies not reported

North American geo	=1 for US, Canada, Mexico in all years
European geo	= 1 for 17 European countries in all years
South-East Asia geo	= 1 for HK, SIG, PHI, IND, MAL in all years
NAFTA	= 1 for Mexico at/after1994, Canada at/after 1989
EU	= 1 for an EU 15 country at/after accession

Table 3: Results from random effects regressions

Dependent variable:	*Exports to the US as a share of total affiliate sales* (1)	(2)	*Exports to third countries as a share of total affiliate sales* (3)	(4)	*Exports to third countries as a share of total affiliate exports* (5)	(6)
NAgeo	0.239	0.184	-0.076	-0.152	-0.597	-0.522
	(3.68)	(2.39)	(-0.85)	(-1.41)	(-5.79)	(-4.45)
NAFTA	0.103	0.108	0.005	0.012	-0.019	-0.012
	(4.87)	(5.25)	(0.22)	(0.53)	(-0.50)	(-0.37)
EUgeo	-0.012	-0.038	0.246	0.207	0.191	0.228
	(-0.37)	(-1.00)	(5.60)	(3.99)	(3.66)	(3.91)
EU	0.000	0.011	0.057	0.060	-0.016	-0.025
	(0.02)	(0.73)	(3.53)	(3.58)	(-0.61)	(-1.05)
ASIAgeo	0.241	0.241	0.133	0.168	-0.202	-0.234
	(5.51)	(4.49)	(2.19)	(2.23)	(-2.91)	(-2.86)
ISRAEL	0.248	0.329	0.150	0.111	-0.255	-0.339
	(2.83)	(3.65)	(1.24)	(0.89)	(-1.84)	(-2.47)
GDP		-0.005		-0.023		-0.005
		(-0.35)		(-1.35)		(-0.26)
SKL		-0.433		0.094		0.280
		(-3.29)		(0.59)		(1.36)
INVC		-0.332		0.000		0.422
		(-5.71)		(0.00)		(4.56)
TC		0.006		-0.003		-0.042
		(0.18)		(-0.07)		(-0.77)
DIST		-0.007		-0.007		0.012
		(-1.29)		(-0.93)		(1.35)
Time dummies	yes	yes	yes	yes	yes	yes
R2 (overall)	0.57	0.63	0.57	0.58	0.62	0.70
No. of obs.	648	547	648	547	647	549
No. of groups	39	39	39	39	39	39

Note: Figures in parenthesis are t-values. They are based on White's method for taking heteroskedasticity into account. Constant and time dummies not reported

North American geo	=1 for US, Canada, Mexico in all years
European geo	= 1 for 17 European countries in all years
South-East Asia geo	= 1 for HK, SIG, PHI, IND, MAL in all years
NAFTA	= 1 for Mexico at/after1994, Canada at/after 1989
EU	= 1 for an EU 15 country at/after accession

Table 4a: Regressions without controls, predicted differences in percentage points from an "other" country

		EXPORTS TO US, SHARE OF SALES	EXPORTS TO THIRD, SHARE OF SALES	EXPORTS TO THIRD, SHARE OF TOTAL EXPORTS
NA GEO	(insider)	24	-8	-60
NA GEO + NAFTA	(insider)	34	-7	-62
EU GEO	(outsider)	-1	25	19
EU GEO + EU	(outsider)	-1	30	17
SE ASIAN GEO	(neither)	24	13	-20
ISRAEL	(both)	25	15	-25

Table 4b: Regressions with control variables, predicted differences in percentage points from an "other" country

		EXPORTS TO US, SHARE OF SALES	EXPORTS TO THIRD, SHARE OF SALES	EXPORTS TO THIRD, SHARE OF TOTAL EXPORTS
NA GEO	(insider)	18	-15	-52
NA GEO + NAFTA	(insider)	29	-14	-53
EU GEO	(outsider)	-4	21	23
EU GEO + EU	(outsider)	-3	27	20
SE ASIAN GEO	(neither)	24	17	-23
ISRAEL	(both)	33	11	-34

Notes: random effects regressions with year dummies
"Asia geography group": Hong Kong, Singapore, Phillipines, Indonesia, Malaysia
"Other" country group: Argentina, Australia, Brazil, Chile, China, Columbia, Costa Rica, Egypt, Indian, Japan, Korea, New Zealand, South Africa, Turkey, Venezuela

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

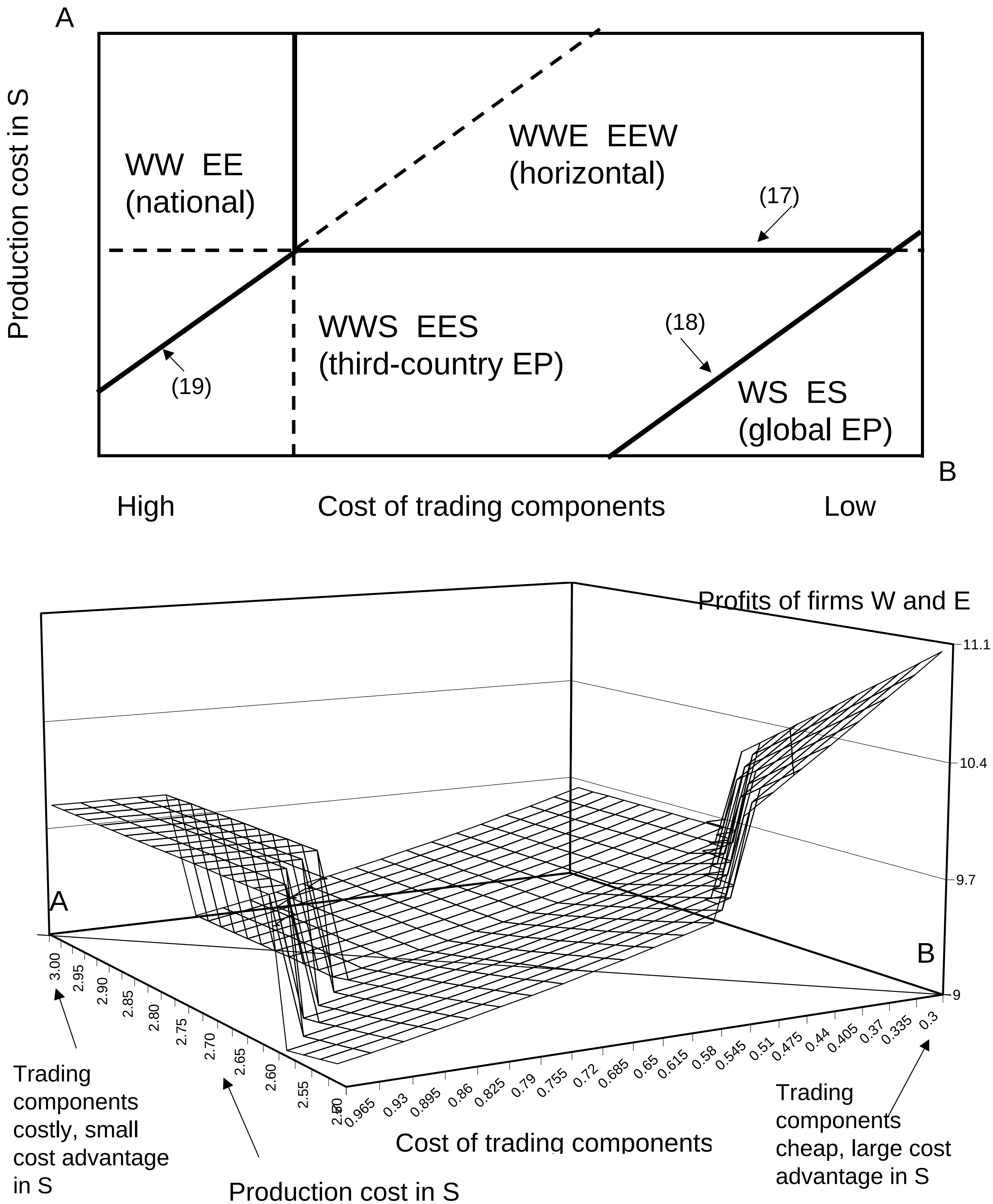
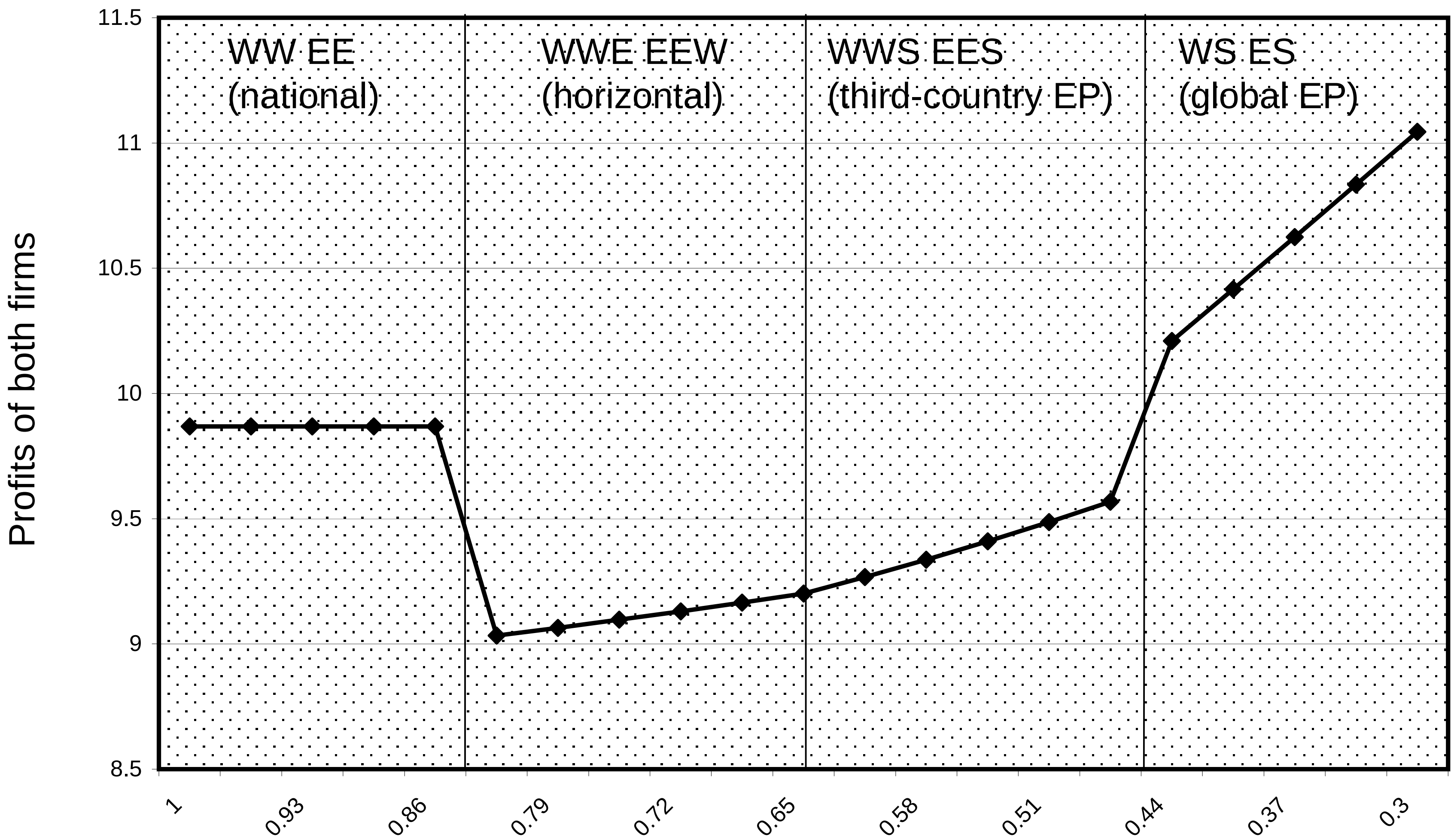


Figure 2: Symmetric model, lower cost of trading components, and production cost in South



Cost of component trade σ lowered in 3.5% steps, c_s lowered in 0.833% steps

Figure 3: Profits of Firms W and E: Reduce trade costs between West and South (c_s = 2.68, G = 2.2)

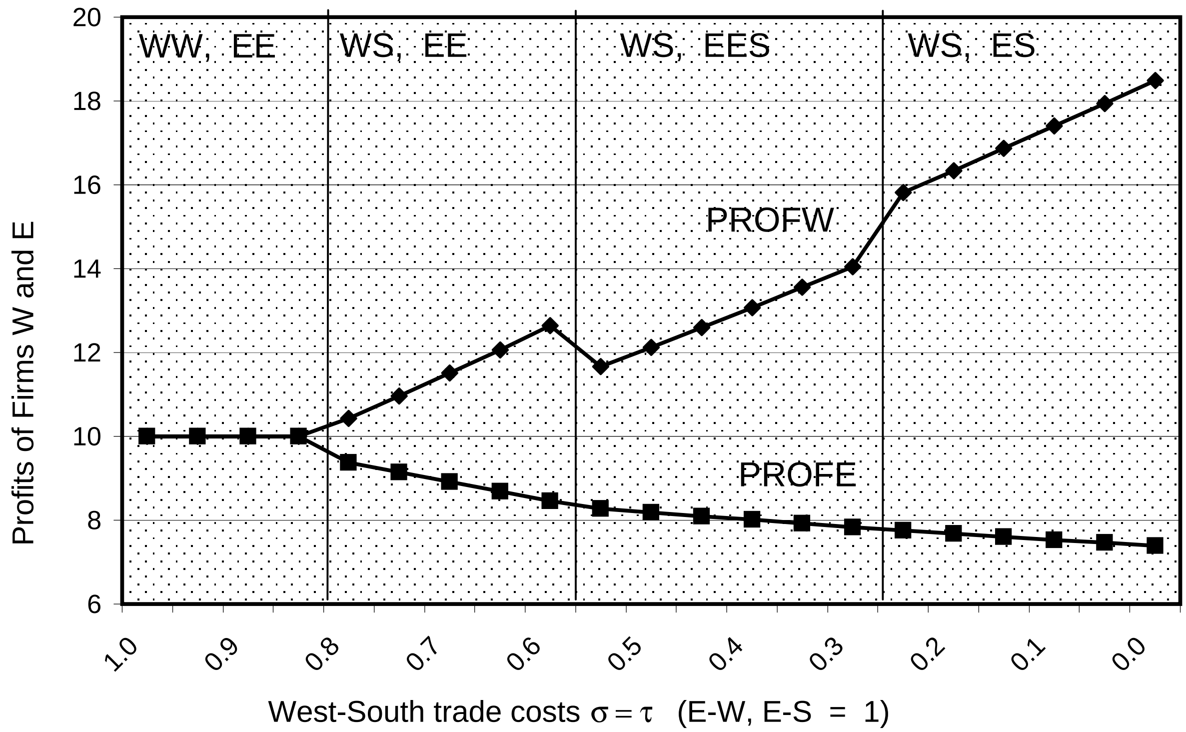


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Figure 4: Profits of Firms W and E: Reduce trade costs between West and South (c_s = 3.0, G = 1.75)

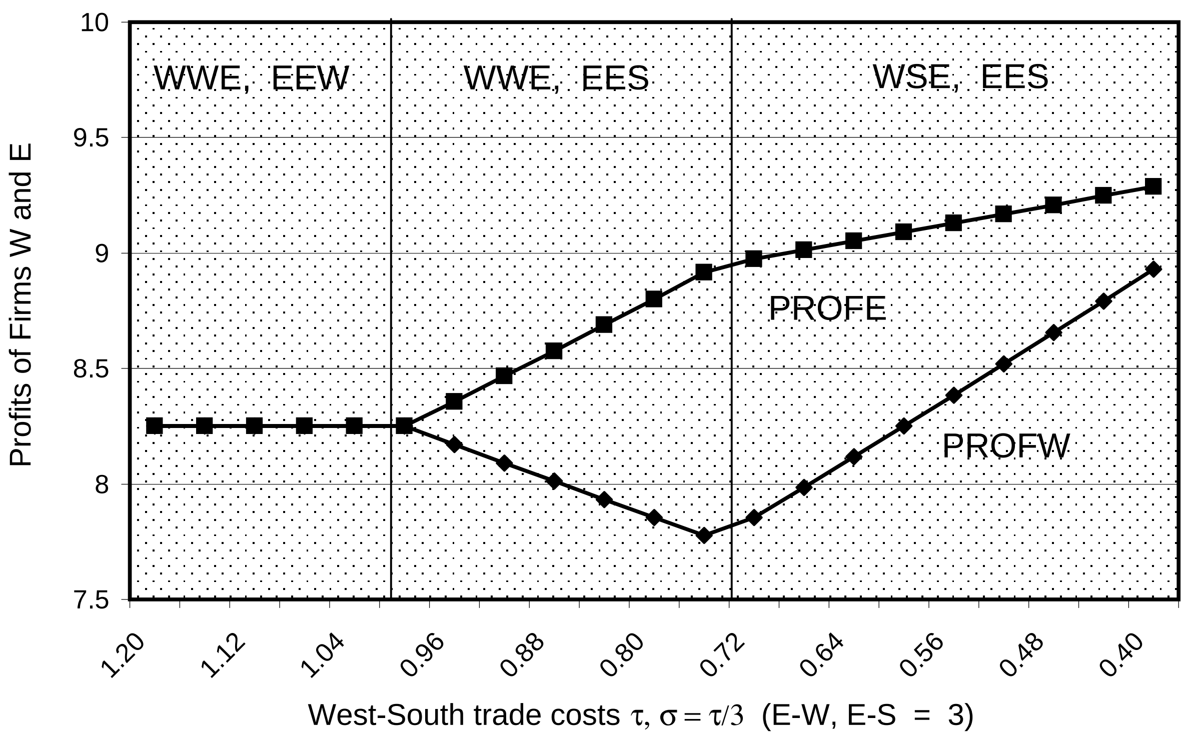


Figure 5: Profits of Firms W and E: Reduce trade costs between West and South (c_s = 2.6, G = 2.0)

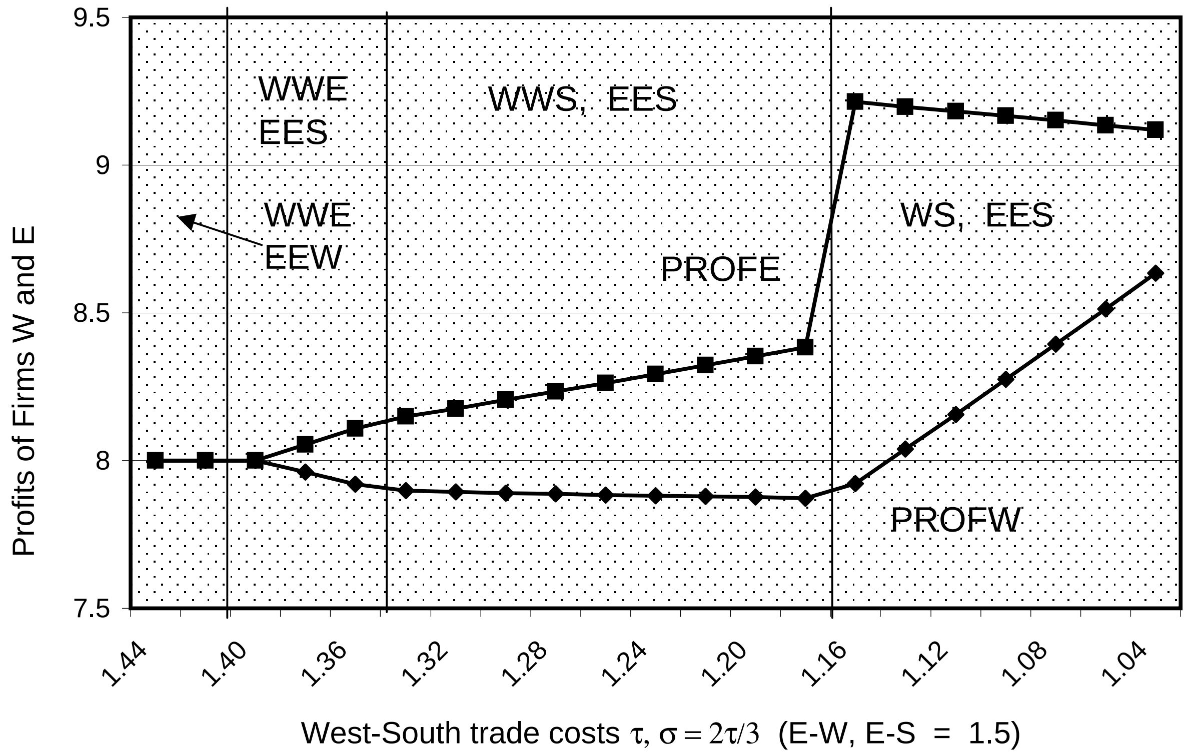
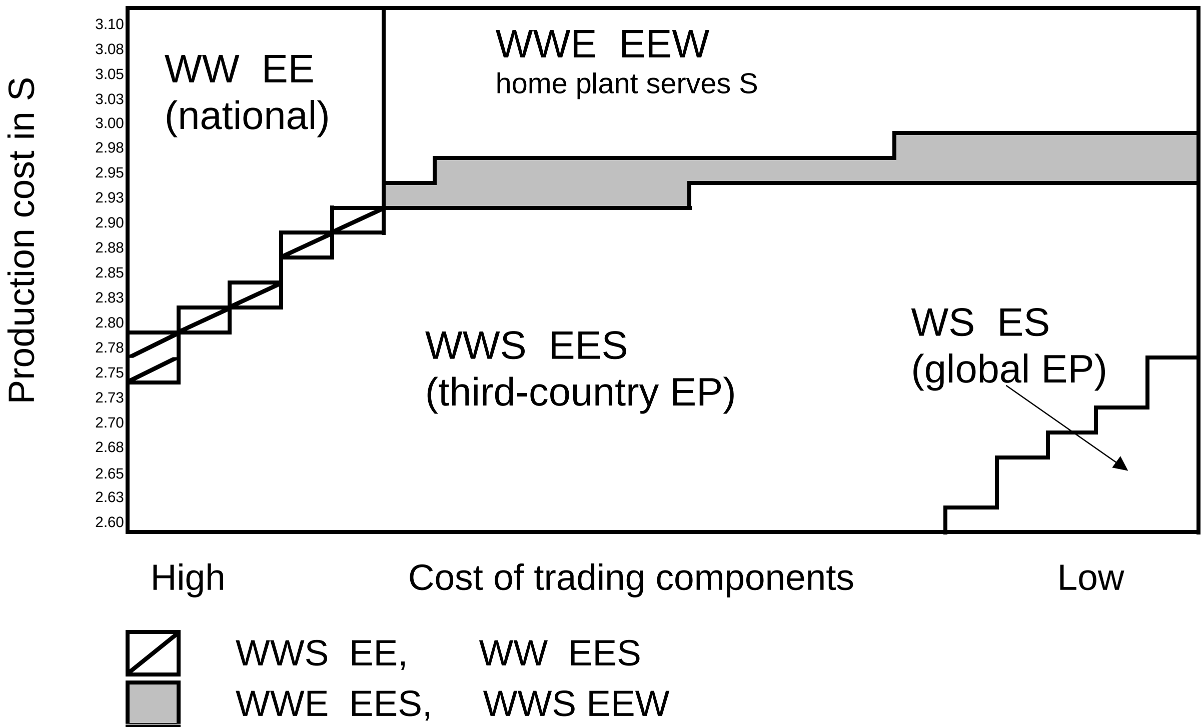
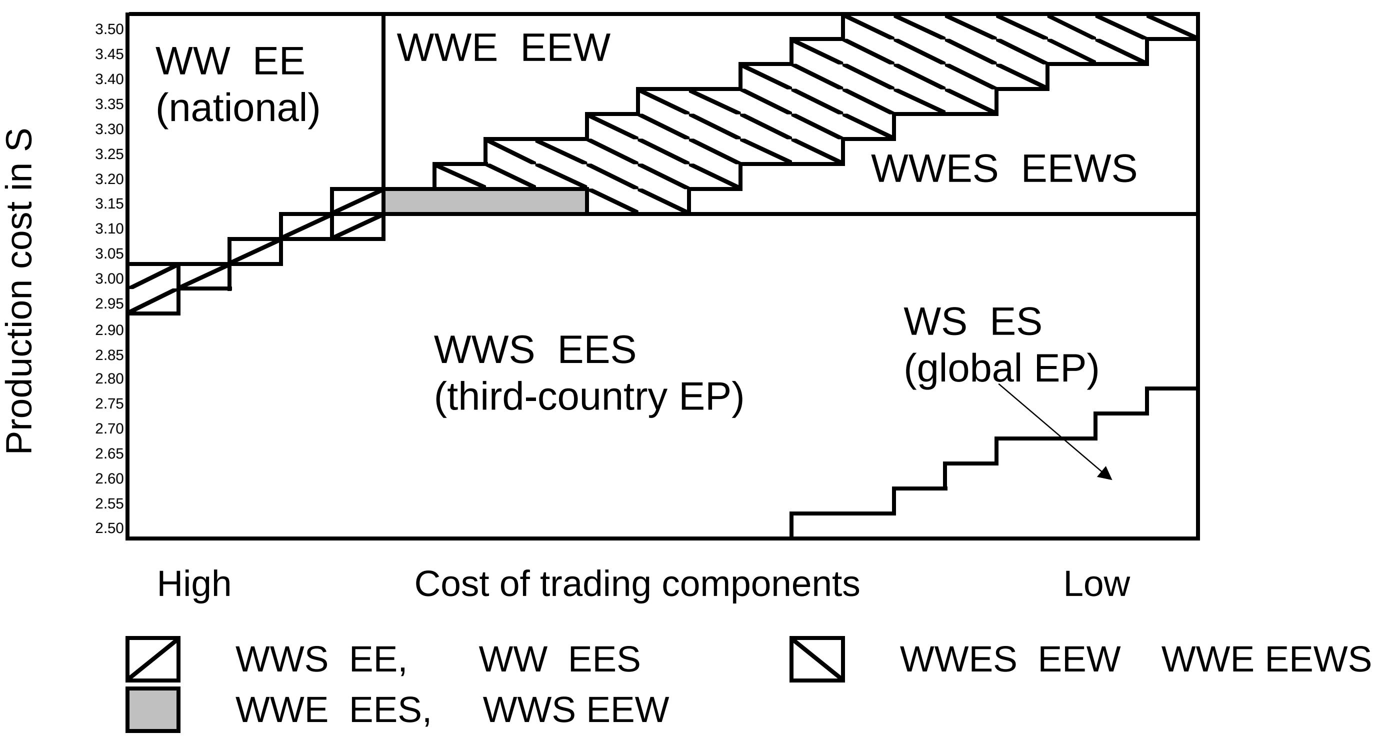


Figure 1A: Regimes as a function of cs, σ; positive demand in south

Panel A: S = 0.1 the size of W-E, cs range = 3.1-2.6



Panel B: S = 0.25 the size of W-E, cs range = 3.5-2.5



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