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Does Economic Integration cause Foreign Direct Investment?

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Abstract

This paper develops a game theoretic model to analyse the comparative importance of economic integration, external barriers to trade and market size as determinants of oligopolists' international trade and foreign direct investment activities. A threecountry model is developed in order to contrast the impact of changes in market accessibility and market size on the trade/fdi choices of firms. Whereas increased market size is likely to lead to dispersed fdi, economic integration is more likely to lead to concentrated fdi with the investing firm supplying the majority of the countries in the regional bloc by intra-regional exports. The welfare impacts of economic integration are ambiguous. One important welfare effect arises where an outside firm exports to the regional bloc prior to economic integration and chooses to invest in the regional bloc as a result of integration. In sharp contrast to the traditional customs union literature this will lead to a reduction in product prices, a reduction in the profits of domestic firms within the integrated economies, and an increase in total surplus.

1. Introduction

This paper investigates the comparative importance of economic integration, external barriers to trade and market size as determinants of oligopolists' international trade and foreign direct investment activities.

The primary motivation for the paper is our desire to formulate a more satisfactory explanation of the spectacular growth of Japanese foreign direct investment (fdi) in the European Community than is currently available.[1] There is general agreement that the creation of the Single Market in the EC in 1993 has had a significant impact on Japanese companies' decisions to establish direct operations in the Community (and, indeed, more recently on similar decisions by companies from Korea and Taiwan). But there is little agreement on precisely why this has been the case.

Increased external barriers to trade, decreased internal barriers to trade and increased market size have all been identified as determinants of fdi in the EC. The European Community has undoubtedly adopted a much stricter anti-dumping stance with respect to Japanese exports since about 1985: see Gittelman and Dunning (op. cit.) and Tharakan (1991). It has been suggested that the completion of the European Single Market in 1993 will strengthen this policy change and lead to the development of "Fortress Europe". Secondly, there is the view embodied in the concept of "the single market" that 1993 will create a single European market comparable in size to that of the United States. Thirdly, it has been argued that economic integration as embodied in the 1993 proposals will improve market accessibility by reducing the intra-EC barriers to the movement of goods.

What is not clear is whether these are complementary, competing or even different explanations. We provide a formal analysis that distinguishes between these three influences and gauges their relative importance.[2] Our approach is in the tradition of the game theoretic models of foreign direct investment (Horstmann and Markusen (1987), Smith (1987), Rowthorn (1992), Motta (1992)) but since these models are two-country models they do not allow us to investigate the effects of economic integration such as is taking place in the EC. The point is that the geographic extent of such a regional group makes it inappropriate to treat it as a point market with zero internal distribution costs. In other words, it is important to draw a distinction

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[1]   For recent contributions, see Bachtler and Clement (1990), Balasubramanyam and Greenaway (1992), Gittelman and Dunning (1992), JETRO (1991), Klein and Welfens (1992), Mayes (1990), Thomsen and Nicolaides (1991), Woolcock (1990) and Yannopoulos (1990).

[2]   The first two factors have been extensively analysed. Smith (1987), Rowthorn (1992) and Motta (1992) are particularly valuable in making explicit the role of market size and external barriers to trade as determinants of oligopolists' exporting/fdi choices. Fdi is shown to be a natural response to anti-dumping legislation and/or an anticipated tariff wall and to increases in the size of the host-country market. Similar arguments, although not in a formal framework, are to be found in the discussion of the OLI paradigm by Dunning (1988) and of internalisation by Buckley and Casson (1976).

between *market accessibility* and *market size*. The 1993 proposals affect the former but may have only a marginal impact on the latter. These proposals also have a differential effect on firms with domestic production bases within the integrated markets and those with domestic production bases outside these markets. We need to be able to comment upon the importance of this effect.

Our analysis has a wider relevance. An increasing proportion of trade between developed nations is intra-industry as opposed to inter-industry trade. At least as dramatic but perhaps less well documented has been the rapid increase in foreign direct investment. There is little doubt that these phenomena are interconnected. With world production dominated by international oligopolies it is natural that there will be an increasing degree of market interpenetration by exporting firms (intra-industry trade). We should also expect to see international oligopolists making strategic location decisions in choosing how to serve their target markets.[3] By far the greatest proportion of intra-industry trade and investment has taken place between developing nations and has led to the emergence of a Triad of regional trading blocs (United Nations, 1992) each containing a free-trade bloc -- the EC, the North American Free Trade Area (NAFTA) and the Association of South East Asian Nations (ASEAN). If we are correct in arguing that market accessibility affects the exporting/fdi choice, then our analysis is as relevant to developments in NAFTA and ASEAN as it is to the EC.[4]

Our analysis proceeds as follows. In section 2 we present the model on which our analysis is based and in section 3 we identify the pay-off matrix and the feasible subgame-perfect equilibria of the model. Section 4 illustrates the effects on these equilibria of economic integration that changes external trade barriers, market accessibility and market size. In section 5 we discuss some of the welfare and policy implications of our analysis. The main conclusions are summarised in section 6.

2. The Model

We begin with a reasonably general specification of the model before introducing a number of simplifying features that will make the analysis more tractable. Assume that there is a set of ϑ countries with country $I \in \vartheta$ containing n_i domestic firms: the notation $i \in I$ denotes the ith domestic firm in country I. The total number of firms is :

$$N = \sum_{i \in \vartheta} n_i \qquad (1)$$

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[3]   We do not consider other supply modes such as licensing or franchising.

[4]   Gittelman and Dunning also imply this when they suggest that one reason for Japanese fdi occurring later in Europe than in the United States was because Europe was, until the 1993 proposals, "a collection of fragmented, relatively protected markets ... compounded by prohibitively high cross-border transaction costs". (op. cit. p. 250)

All firms produce a homogeneous product, the inverse demand for which in country I is :

$$P^I = a^I - Q^I/s^I \qquad (I \in \Im) \qquad (2)$$

where Q^I is aggregate supply to country I and s^I is a measure of market size.[5]

We assume that firm $i \in I$ always uses its domestic plant to supply consumers in country I (supply choice d^{Ii}). Firm $i \in I$ has four supply choices with respect to consumers in country $K \neq I$: not to supply K (ϕ_K^{Ii}); export from country I (e_K^{Ii}); fdi in K (f_K^{Ii}); or fdi in country H and export from H to K ($f_H^{Ii} e_K^H$). Marginal production costs are assumed constant for all a firm's plants but these costs may vary depending upon the country in which the plant is located. We further assume that the additional transfer costs of exporting between any pair of countries I and K consist of transport costs, tariff and non-tariff barriers to trade, each of which are constant per unit exported and are not firm-specific.[6] The unit production and transfer costs of firm $i \in I$ in supplying consumers in country K by mode m is denoted c_{Km}^{Ii} ($I,K,H \in \Im$; $m = e_K^{Ii}$, f_K^{Ii}, $f_H^{Ii} e_K^H$). It follows that unit transfer costs (transport costs plus tariff and non-tariff barriers to trade) between country I and country K are given by :

$$t_K^I = c_{Ke_K^{Ii}}^{Ii} - c_{Id^{Ii}}^{Ii} \qquad (I,K \in \Im; I \neq K; \text{all } i \in I) \qquad (3)$$

Establishment by firm $i \in I$ of a production facility in country K incurs a set-up cost F_K^{Ii} ($I,K \in \Im$; $I \neq K$): this set-up cost might include the information costs, legal costs and so on necessary to open a subsidiary in a foreign country. We assume $F_I^{Ii} = 0$ for all $i \in I$ and $I \in \Im$.[7] We denote by $F^{Ii} = \left(F_A^{Ii}, F_B^{Ii}, ... \right)$ the vector of set-up costs for firm $i \in I$.

A strategy for firm i in country I consists of two elements :

(i)   the *firm's location configuration* which is an $\Im$-dimensional vector

$$l^{Ii} = (l_A^{Ii}, l_B^{Ii}, ...) \qquad (I \in \Im; \text{all } i \in I) \qquad (4)$$

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[5]   To see this note that the demand function in country I is $Q^I = s^I(a^I - P^I)$.

[6]   It follows that we assume tariffs to be specific rather than *ad valorem*. We further assume that non-tariff barriers to trade -- border and other bureaucratic delays, country-specific engineering and other product standards, transactions costs associated with foreign exchange dealings, and so on -- can all be represented as increases in unit production costs. Rowthorn (op. cit.), by contrast, assumes these costs to be *ad valorem*.

[7]   In contrast to Horstmann/Markusen or Rowthorn (op. cit.) we treat the set-up costs for a firm's domestic plant as a sunk cost. In other words, we consider a game in which firms have already established their domestic production plants when the possibility to sell in another market opens. It is a simple matter to relax this assumption but doing so considerably expands the strategy space without introducing any new features to the particular issues on which we wish to focus in this paper.

where $l_K^{Ii} = 1$ if firm $i \in I$ establishes a local production facility in country K and zero otherwise. By definition $l_I^{Ii} = 1$ for all $i \in I$. The total set-up costs incurred by firm $i \in I$ from location configuration l^{Ii} is

$$l^{Ii} \times F^{Ii} \qquad (I \in \mathfrak{I}; \text{ all } i \in I) \tag{5}$$

We define a *market location configuration* as an N-component set

$$l = \{l^{A1}, l^{A2}, \ldots, l^{B1}, l^{B2}, \ldots\} \tag{6}$$

and denote by L the set of all possible location configurations l^{Ii} ($I \in \mathfrak{I}$; all $i \in I$).

(ii)   the *firm's supply configuration* which is an $\mathfrak{I}$-dimensional vector

$$s^{Ii} = (s_A^{Ii}, s_B^{Ii}, \ldots) \qquad (I \in \mathfrak{I}; \text{ all } i \in I) \tag{7a}$$

where $s_I^{Ii} \equiv d^{Ii}$; $s_K^{Ii} = \phi_K^{Ii}, e_K^{Ii}, f_K^{Ii}$, or $f_H^{Ii} e_K^H$ ($I \neq K$), and its related *quantity choice* which is an $\mathfrak{I}$-dimensional vector

$$q^{Ii} = (q_{Am}^{Ii}, q_{Bm}^{Ii}, \ldots) \qquad (I \in \mathfrak{I}; \text{ all } i \in I) \tag{7b}$$

where $q_{Km}^{Ii} > 0$ indicates that firm $i \in I$ is active in country K and supplies consumers in country K using mode m, incurring unit production and transfer costs c_{Km}^{Ii}; $q_{Km}^{Ii} = 0$ indicates that firm $i \in I$ chooses not to sell in country K : is not active in country K. Note that since there are no capacity constraints in the model, a firm will use only one supply mode to supply a particular country.

We define a *market supply configuration* and *market supply choice* as two N-component sets

$$s = \{s^{A1}, s^{A2}, \ldots, s^{B1}, s^{B2}, \ldots\} \tag{8}$$

$$q = \{q^{A1}, q^{A2}, \ldots, q^{B1}, q^{B2}, \ldots\} \tag{9}$$

It is assumed that :

$$s_K^{Ii} = f_K^{Ii} \text{ and } q_{Kf_K^{Ii}}^{Ii} > 0 \Leftrightarrow l_K^{Ii} = 1 \qquad (I, K \in \mathfrak{I}; I \neq K; \text{ all } i \in I) \tag{10}$$

Obviously, if firm $i \in I$ wishes to use fdi in K to supply consumers in country K it must incur the set-up costs of establishing an overseas production facility in K. Equation (10) has the further implication that if firm $i \in I$ invests in country K it will supply K from its production base in K.[8]

In characterising equilibrium in this model it is assumed that each firm aims to maximise aggregate profit through its location configuration, supply configuration and its quantity choice. We model the quantity-location game being played by the firms as a two-stage game using the Selten (1975) concept of subgame perfect Nash

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[8]   This is reasonable since, if it does not hold then presumably firm $i \in I$ can supply country K from a cheaper production site elsewhere, but then there is no reason for the firm to establish a production site in K.

equilibrium. In the first stage each firm chooses its location configuration. In the second stage each firm chooses its supply configuration and makes its quantity choice given the market location configuration established in the first stage.

Consider the second stage subgame for firm $i \in I$ and $I \in \vartheta$. With constant marginal production and transfer costs this firm maximises its aggregate profit for any market location configuration l by maximising its profit in each country for that location configuration *ignoring all set-up costs.*[9] Assume that for any country K the market quantity choice $q(l)$ is such that the set $\aleph_K$ of active firms in country K contains N_K firms.[10] It is clear from the structure of the model that if any firm $h \in H$; $H \in \vartheta$ chooses to sell a positive quantity in country K it will do so from its active plant in the market location configuration l with the lowest marginal production plus transfer costs of supplying country K. We denote this unit cost by $c_{K*}^{Hh}(l)$; $h \in \aleph_K$ and the associated quantity supplied to country K by $q_{K*}^{Hh}(l)$; $h \in \aleph_K$. Aggregate supply to consumers in country K given the market location configuration l is then :

$$Q^K(l) = \sum_{h \in \aleph_K} q_{K*}^{Hh}(l) \qquad (K \in \vartheta) \qquad (11)$$

and the profit, *ignoring all set-up costs*, to firm i from country K with market location configuration l and market quantity choice $q(l)$ is :

$$\Pi_K^i(l, q(l)) = \left(a^K - Q^K(l) - c_{K*}^{Ii}(l)\right) q_{K*}^{Ii}(l) \qquad \text{if } i \in \aleph_K;$$
$$= 0 \qquad \text{otherwise} \qquad (12)$$

Aggregate profit to firm i with market location configuration l and market quantity choice $q(l)$ is:

$$\Pi^i(l, q(l)) = \sum_{K \in \vartheta} \Pi_K^i(l, q(l)) - l^{Ii} \times F^{Ii} \qquad (13)$$

Denote by $Q^{Ii}(l^{Ii})$ the set of possible quantity choices for firm i given its location configuration l^{Ii}. The Nash equilibrium for the second stage quantity subgame for any market location configuration l is the market quantity location choice $q^*(l)$ such that for all $i \in I$ and $I \in \vartheta$:

$$\Pi^i(l, q^*(l)) \geq \Pi^i(l, q^{Ii}(l), q^{*,-Ii}(l)) \text{ for all } q^{Ii}(l) \in Q^{Ii}(l^{Ii}) \qquad (14)$$

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[9]   Once the location configuration is established all set-up costs are sunk costs.

[10]   Note that in the two-stage formulation of the quantity-location game the market quantity choice and market supply configuration will be affected by the market location configuration.

Denote by $\Pi^{*i}(I)$ the profit to firm i from the Nash equilibrium market quantity choice corresponding to the market location configuration I (defined by equations 12 - 14). An equilibrium for the first stage location game is a market location configuration I^* such that for all $i \in I$ and $I \in \vartheta$:

$$\Pi^{*i}(I^*) \geq \Pi^{*i}(I^{Ii}, I^{*,-Ii}) \text{ for all } I^{Ii} \in L \tag{15}$$

It is possible to be precise about firm i's quantity choice with respect to any country K for any location configuration I. Assume as before that the set $\aleph_K$ of active firms in country K contains N_K firms (including firm i). The profit maximising quantity choice for firm i is, from familiar Cournot analysis :

$$q_{K*}^{*Ii}(I) = s^K \left(a^K - N_K c_{K*}^{Ii} + \sum_{\substack{h \in \aleph_K \\ h \neq i}} c_{K*}^{Hh} \right) \bigg/ (N_K + 1) \qquad (i \in \aleph_K) \tag{16}$$

the market price in country K is :

$$P^K = \left(a^K + \sum_{h \in \aleph_K} c_{K*}^{Hh} \right) \bigg/ (N_K + 1) \qquad (i \in \aleph_K) \tag{17}$$

and the profits, ignoring set-up costs, to firm i from sales in country K are :

$$\Pi_K^i(I, q^*(I)) = \left(q_{K*}^{*Ii}(I) \right)^2 \bigg/ s^K \qquad (i \in \aleph_K) \tag{18}$$

It follows from equations (16) - (18) that the necessary conditions for firm i to wish to supply consumers in country K are that:

(i)   firm i is able to sell a non-negative quantity in country K and

(ii)   the plant from which firm i wishes to supply K at least covers its set-up costs.

Equations (16) - (18) confirm the importance of market size as a determinant of a firm's market supply mode. The lower are the marginal costs of firm i in supplying market K the greater will firm i's profit from country K be. It is to be expected that the marginal costs of firm i in supplying country K are lowest with fdi in K (mode f_K^{Ii})[11] but in order to be able to use this mode firm i has to incur the set-up costs F_K^{Ii}. Such a strategy is more likely to be justified the greater is market size s^K.

Analysis of the effects of tariff and non-tariff trade barriers is not as straightforward. If trade barriers are increased with respect to *all* non-domestic firms attempting to supply market K then exports to K by firm i will be harmed whereas local

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11   This is likely to be the case unless country K is a particularly high-cost country.

production by firm i in country K will benefit. By contrast, if trade barriers are reduced with respect to one set of firms but increased or at best left unchanged with respect to another, as is characteristic of most processes of economic integration, the effect on trade and investment flows is ambiguous: the profits *both* from exporting to country K *and* from local production in K by a firm in the latter set of firms will be reduced.

3. Equilibria for the Two-Stage Game

The general model presented in section 2 must be simplified in order to make further analysis tractable while retaining the essential features in which we are interested. We confine attention to a market in which there are three countries, denoted U, G and J each containing one domestic firm, denoted u, g and j. We can, therefore, talk interchangeably about "country I " and "firm $i \in I$ " and the superscript "Ii" can be simplified to "i". The countries are assumed to be of equal size and to contain identical consumers. Inverse demand for the homogeneous product in each country is, from equation (2) :

$$P = a - Q/s \tag{2'}$$

Costs of production for the three firms are assumed identical. Without loss of generality, we can normalise marginal production costs by assuming:[12]

$$c^i_{Id'} = 0 \qquad (I = U, G, J; i = u, g, j) \tag{19}$$

We further assume that set-up costs of a non-domestic production facility by firm i are not country- or firm-specific :

$$F^i_K = F \qquad (K = U, G, J; I \neq K; i = u, g, j) \tag{20}$$

Since we are primarily interested in the effects of economic integration on foreign direct investment we shall limit our attention to the case in which a regional bloc is formed by economic integration between countries U and G. We further confine our attention to cases in which firm j exports to or invests in countries U or G but in which firms u and g do not supply consumers in country J.[13] Transfer costs between countries U and G are assumed to be t per unit and between country J and U

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[12]   The assumption of symmetry in market sizes, preferences and technologies is made to emphasise the effects of market integration on the export vs. fdi choice. It would not be difficult, as section 2 shows, to relax symmetry along one or more dimensions but the calculations would become much more messy. It is worth noting that the symmetry assumption is not unrealistic when thinking of industrialised countries at similar levels of development and therefore of tastes, technology and costs.

[13]   This involves no loss of generality with only three countries given our assumption of constant marginal production costs. The strategy of firm u (g) with respect to country G (U) is not affected by its strategy with respect to country J. Of course, with non-constant marginal costs there would be feed-back between markets. An alternative approach would be to assume that transfer costs to J from U or G and set-up costs for firms u and g in J are prohibitive.

or G to be μ per unit. In other words, marginal production costs by each exporting supply mode are :

$$c^i_{Ke^i_K} = c^j_{I f^j_K e^K_I} = t \qquad (I, K = U, G; I \neq K)$$

$$c^j_{Ke^j_K} = \mu \qquad (K = U, G) \qquad (21)$$

We further assume that

$$\mu > t \qquad (22)$$

in which case, if firm j establishes an overseas production facility in country U (G) then if it decides to export to consumers in country G (U) it will do so from the overseas plant. An overview of this market structure is given in Figure 1.
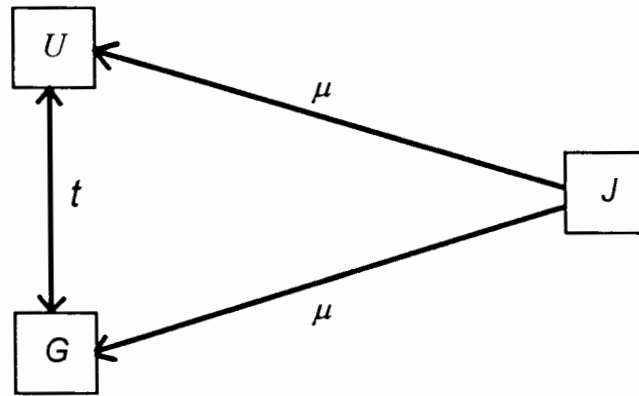
Figure 1 : Market Structure

The possible location configurations, feasible supply configurations and associated quantity choices for each firm are illustrated in Table 2 (recall our discussion of the implications of equation (10)). Since $l^i_I = 1$ $(I = U, G, J)$ by assumption and firms u and g are assumed to supply domestic demand from their domestic plant we can simplify the market location and market supply configurations to the four-component sets :

$$l = \left\{ l^u_G, l^g_U, l^j_U, l^j_G \right\}$$

$$s = \left\{ s^u_G, s^g_U, s^j_U, s^j_G \right\} \qquad (23)$$

where $s^i_K = e^i_K, f^i_K, \text{or } \phi^i_K$ and $s^j_K = e^j_K, f^j_K, \phi^j_K, \text{or } f^j_I e^I_K$ $(I, K = U, G; I \neq K)$. Firms u and g each have three possible supply configurations and firm j has nine, giving a total of 81 possible supply configurations. The pay-offs for each location and supply configuration of the three firms are given in Table 3. Note that in Table 3 we do not include the profits to firm j from sales to consumers in J (given the structure of the model, these profits will be $\Pi^j_J(\ ) = sa^2/4$ no matter the location configurations of

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the three firms). The first term for each firm in each cell (for asymmetric location configurations) is profit from sales to consumers in country U and the second term is profit from sales to consumers in Country G.

Table 2 : Location Configuration and Supply Configuration

Firm	Location Configuration $(l_U^\bullet, l_G^\bullet)$	Supply Configuration $(s_U^\bullet, s_G^\bullet)$
u	(1,0)	$\left(d_U^u, e_G^u\right)$ or $\left(d_U^u, \phi_G^u\right)$
	(1,1)	$\left(d_U^u, f_G^u\right)$
g	(0,1)	$\left(d_G^g, e_U^g\right)$ or $\left(d_G^g, \phi_U^g\right)$
	(1,1)	$\left(d_G^g, f_U^g\right)$
j	(0,0)	$\left(e_U^j, e_G^j\right), \left(e_U^j, \phi_G^j\right), \left(\phi_U^j, e_G^j\right)$ or $\left(\phi_U^j, \phi_G^j\right)$
	(1,0)	$\left(f_U^j, f_U^j e_G^U\right)$ or $\left(f_U^j, \phi_G^j\right)$
	(0,1)	$\left(f_G^j e_U^G, f_G^j\right)$ or $\left(\phi_U^j, f_G^j\right)$
	(1,1)	$\left(f_U^j, f_G^j\right)$

The shaded cells in Table 3 are location and supply configurations that cannot be equilibria of the two-stage quantity/location game. Table 4 details the binding parameter constraints that must be satisfied for each of the remaining location and supply configurations to be Nash equilibria: other parameter constraints which characterise the Nash equilibria are omitted since they are made redundant by those we indicate [14]

Discussion of all of these calculations would be excessively tedious, but some points of interest emerge. First, note that for each symmetric supply configuration of firm j -- $\left(e_U^j, e_G^j\right), \left(\phi_U^j, \phi_G^j\right)$ or $\left(f_U^j, f_G^j\right)$ -- the feasible supply configurations of firms u and g are also symmetric. The converse result is true so long as firms u and g both either invest or do not supply the other regional market but is not necessarily true if they both export: the market supply configuration $\left\{f_G^u, f_U^g, f_U^j, f_U^j e_G^U\right\}$, for example, is not an equilibrium to the two-stage game since, if firm g prefers fdi to exporting in

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[14] An outline of the calculations that generate these results is given in the Mathematical Appendix. Further details can be obtained from the authors on request.

Table 3 : Pay-Off Matrix and Feasible Equilibria for the Second Stage Subgame

Firm u	Firm g	(e^j_U, e^j_G)	(f^j_U, f^j_G)	(ϕ^j_U, ϕ^j_G)	(e^j_U, ϕ^j_G)	(ϕ^j_U, e^j_G)	(f^j_U, ϕ^j_G)	(ϕ^j_U, f^j_G)	$(f^j_U, f^j_U e^U_G)$	$(f^j_G e^j_U, f^j_G)$
						Firm j				
e^u_G	e^g_U	u:[(a+μ+t)²+(a+μ-3t)²]s/16 g:[(a+μ-3t)²+(a+μ+t)²]s/16 j:(a+t-3μ)²s/8	u:[(a+t)²+(a-3t)²]s/16 g:[(a-3t)²+(a+t)²]s/16 j:(a+t)²s/8-2F	u:[(a+t)²+(a-2t)²]s/9 g:[(a-2t)²+(a+t)²]s/9 j:0	u:(a+μ+t)²s/16b+ (a+μ-3t)²s/9 g:(a-3t)²s/16 j:(a+t+3μ)²s/16	u:(a+t)²s/9+ (a+μ-3t)²s/16 g:(a-3t)²s/9+ (a+μ+t)²s/16b j:(a+t+3μ)²s/16	u:(a+t)²s/16+ (a-2t)²s/9 g:(a-3t)²s/16+ (a+t)²s/9 j:(a+t)²s/16-F	u:(a+t)²s/9+ (a-3t)²s/16 g:(a-2t)²s/9+ (a+t)²s/16 j:(a+t)²s/16-F	u:[(a+t)²+ (a-2t)²]s/16 g:[(a-3t)²+ (a-2t)²]s/16 j:[(a+t)²+ (a-2t)²]s/16-F	u:[(a+2t)²+ (a-3t)²]s/16 g:[(a-2t)²+ (a+t)²]s/16 j:[(a-2t)²+ (a+t)²]s/16-F
	f^g_U	u:[(a+μ)²+ (a+μ-3t)²]s/16 g:[(a+μ-3t)²+ (a+μ)²]s/16 j:[(a+t+3μ)²+ (a-3μ)²]s/8	u:[a²+ (a-3t)²]s/16 g:[a²+(a+t)²]s/16-F j:[(a+t)²+ (a+t)²]s/16-2F	u:[a²+ (a-2t)²]s/9 g:[a²+(a+t)²]s/9-F j:0	u:(a+μ)²s/16+ (a-2t)²s/9 g:a²s/9+ a²s/16-F j:0	u:a²s/9+ (a+μ-3t)²s/16 g:a²s/9+ (a+μ)²s/16 j:(a-3μ)²s/16	u:a²s/16+ (a-2t)²s/9 g:a²s/16+ (a+t)²s/9-F j:a²s/16-F	u:a²s/9+ (a-3t)²s/16 g:a²s/16+ a²s/16 j:a²s/16-F	u:a²+ (a-2t)²s/16 g:[a²+ (a-3t)²]s/16 j:a²s/16-F	u:[(a+t)²+ (a-3t)²]s/16 g:(a+t)²s/8-F j:[(a-3t)²+ (a+t)²]s/16-F
	ϕ^g_U	u:(a+μ)²s/9+ (a+μ-3t)²s/16 g:(a-3t)²s/16 j:(a-2μ)²s/9+ (a+t+3μ)²s/16	u:a²s/9+ g:(a-3t)²s/16 j:a²s/9+a²s/16 -2F	u:a²s/4+ (a-2t)²s/9 g:(a+t)²s/9 j:0	u:a²s/4+ (a-3t)²s/16 g:(a+μ+t)²s/16 j:(a+t+3μ)²s/16	u:a²s/4+ (a-3t)²s/16 g:(a+t)²s/9 j:(a-3μ)²s/9	u:[a²+ (a-2t)²]s/9 g:(a+t)²s/9 j:a²s/9-F	u:a²s/4+ (a-3t)²s/16 g:(a+t)²s/9+ j:(a+t)²s/16-F	u:a²s/9+ (a-2t)²s/16 g:(a+t)²s/9+ j:a²s/9	u:(a+t)²s/9+ (a-3t)²s/16 g:(a+t)²s/9+ j:(a-2t)²s/9+ (a+t)²s/16-F
f^u_G	e^g_U	u:[(a+μ+t)²+ (a+μ)²]s/16-F g:[(a+μ)²+ (a+μ-3t)²]s/16 j:[(a+t+3μ)²+ (a-3μ)²]s/16	u:[(a+t)²+a²]s/16- F g:[(a-3t)²+a²]s/16 j:[(a+t)²+a²]s/16- 2F	u:[(a+t)²+a²]s/9- F g:[(a-2t)²+a²]s/9 j:0	u:(a+t)²s/9+ a²s/16-F g:(a-2t)²s/9+ a²s/9 j:(a-3μ)²s/16	u:(a+t)²s/16+ a²s/9 g:(a-3t)²s/16+ a²s/9 j:(a-3μ)²s/16	u:(a+t)²s/16+ a²s/9 g:(a-2t)²s/16+ a²s/9 j:a²s/9	u:(a+t)²s/9+ a²s/16-F g:(a-2t)²s/9+ a²s/16 j:a²s/16-F	u:(a+t)²s/8-F g:[(a-3t)²+ (a+t)²]s/16 j:(a+t)²s/16 j:(a-2t)²s/16-F	u:[(a+2t)²+ a²]s/16-F g:[(a-2t)²+ a²s/9 j:(a-2t)²s/16-F
	f^g_U	u:(a+μ+t)²s/16 g:(a+μ-3t)²s/16+ a²s/9 j:(a+t+3μ)²s/16+a²s/9 -2F	u:a²s/16 g:a²s/16+a²s/9 -F j:a²s/16+a²s/9 -2F	u:[(a+t)²+a²]s/9 -F g:[(a-2t)²+a²]s/9 -F j:0	u:[(a+t)²+a²]s/9- F g:a²s/9 j:(a-3μ)²s/16	u:a²s/9+ (a+μ)²s/16-F g:a²s/9+ a²s/16 j:a²s/16-F	u:a²s/16+ a²s/9-F g:a²s/16+ a²s/9-F j:a²s/16-F	u:a²s/9+ a²s/16-F g:a²s/9+ a²s/16-F j:a²s/16-F	u:a²+ (a+t)²s/16-F g:[a²+ a²]s/16-F j:[a²+ (a+t)²]s/16-F	u:[(a+t)²+ a²s/16-F g:[a²+ a²s/16 j:[(a+t)²+ a²s/16-F
	ϕ^g_U	u:(a+μ)²s/16 g:(a+μ)²s/16+ (a+μ+t)²s/16-F j:(a-2μ)²s/16	u:a²s/8-F g:a²s/16+a²s/16 -F j:a²s/8-2F	u:a²s/4+a²s/9 -F g:a²s/9 j:0	u:[(a+μ)²+a²]s/9- F g:a²s/9 j:(a-3μ)²s/16	u:a²s/4+ (a+μ)²s/16-F g:a²s/9 j:(a-3μ)²s/16	u:2a²s/9-F g:a²s/9 j:a²s/9-F	u:a²s/4+ a²s/16-F g:a²s/9+ a²s/16 j:a²s/16-F	u:a²s/9+ (a+t)²s/16-F g:(a+t)²s/16 j:(a+t)²s/16-F	u:a²s/9+ g:(a+t)²s/16-F j:(a-2t)²s/9+ a²s/16-F
ϕ^u_G	e^g_U	u:(a+μ)²s/9 g:(a+μ)²s/16+ (a+μ+t)²s/16+ (a-3μ²)s/9 j:(a-3μ)²s/9	u:a²s/9 g:a²s/9 j:2a²s/9-2F	u:a²s/4 g:a²s/4 j:0	u:(a+t)²s/9 g:[(a-2t)²+ a²s/4 j:0	u:a²s/4+ g:[a²+ (a+μ+t)²]s/4-F j:(a-2μ)²s/9	u:a²s/16 g:a²s/16+ a²s/4-F j:a²s/16-F	u:a²s/9 g:2a²s/16+ j:a²s/9-F	u:a²s/16 g:(a+t)²s/16+ (a+t)²s/16+ j:(a+t)²s/16-F	u:(a+2t)²s/16 g:(a+t)²s/16+ a²s/9-F j:(a-3t)²s/16+ a²s/9-F
	f^g_U	u:(a+μ)²s/16 g:(a+μ)²s/16 j:2(a-2μ)²s/9	u:a²s/9 g:a²s/9 j:0	u:a²s/4 g:a²s/4 j:0	u:a²s/4 g:[a²+ (a+μ)²]s/4 j:(a-2μ)²s/9	u:a²s/9 g:a²s/9+ a²s/4 j:(a-2μ)²s/9		u:a²s/9 g:2a²s/9-F j:a²s/9-F	u:a²s/9 g:(a+t)²s/9-F j:(a-2t)²s/9-F	u:(a+t)²s/9 g:(a+t)²s/9-F j:(a-3t)²s/16-F
	ϕ^g_U	u:(a+μ)²s/9 g:(a+μ)²s/9 j:2(a-2μ)²s/9	u:a²s/9 g:a²s/9 j:0	u:a²s/4 g:a²s/4 j:0	u:a²s/9 g:a²s/4 j:(a-2μ)²s/9	u:(a+μ)²s/9 g:a²s/4 j:(a-2μ)²s/9	u:a²s/9 g:a²s/4 j:(a-2μ)²s/9	u:a²s/4 g:a²s/4 j:(a-2μ)²s/9	u:a²s/9 g:a²s/9 j:(a-2t)²s/9-F	u:(a+t)²s/9 g:[(a-2t)²+ a²s/9-F j:a²s/9-F

supplying U then firm j will also prefer fdi in U. By contrast, the market supply

configuration $\left\{e_G^u, e_U^g, f_U^j, f_U^j e_G^U\right\}$ is an equilibrium for some parameter values.

Table 4 : Parameter Constraints, Market Location and Supply Configurations

	l and s	N^{ug}	Binding Parameter Constraints	
I	$\{0,0,0,0\}$ $\left\{e_G^u, e_U^g, e_U^j, e_G^j\right\}$	2	$a+t-3\mu > 0$ $(a+t)^2 + (a-2t)^2 - 2(a+t-3\mu)^2 < 16F/s$ $(a+\mu)^2 - (a+\mu-3t)^2 < 16F/s$	1a 2a 3a
II	$\{0,0,1,1\}$ $\left\{e_G^u, e_U^g, f_U^j, f_G^j\right\}$	4	$a-3t > 0$ $a^2 - (a-3t)^2 < 16F/s$ $(a+t)^2 - (a-2t)^2 > 16F/s$	4a 5a 6a
III	$\{0,0,0,0\}$ $\left\{e_G^u, e_U^g, \phi_U^j, \phi_G^j\right\}$	2	$a+t-3\mu < 0$ $a-2t > 0$ $(a+t)^2 + (a-2t)^2 < 16F/s$	1b 7a 8a
IV	$\{0,0,1,0\}$ $\left\{e_G^u, e_U^g, f_U^j, f_U^j e_G^U\right\}$	3	$a-3t > 0$ $(a+t)^2 + (a-2t)^2 - 2(a+t-3\mu)^2 > 16F/s$ if $a+t-3\mu \geq 0$ $(a+t)^2 + (a-2t)^2 > 16F/s$ if $a+t-3\mu < 0$ $(a+t)^2 - (a-2t)^2 < 16F/s$	4a 2b 8b 6b
V	$\{0,1,0,1\}$ $\left\{f_G^u, e_U^g, f_U^j, f_U^j e_G^U\right\}$	4	$a-3t > 0$ $a^2 - (a-3t)^2 < 16F/s$ $(a+t)^2 - (a-2t)^2 > 16F/s$	4a 5a 6a
VI	$\{1,1,0,0\}$ $\left\{f_G^u, f_U^g, e_U^j, e_G^j\right\}$	4	$a-3\mu > 0$ $(a+\mu)^2 - (a+\mu-3t)^2 > 16F/s$ $a^2 + (a-3t)^2 - 2(a-3\mu)^2 < 16F/s$	9a 3b 10
VII	$\{1,1,1,1\}$ $\left\{f_G^u, f_U^g, f_U^j, f_G^j\right\}$	6	$a^2 - (a-3t)^2 > 16F/s$ if $a-3t \geq 0$ $a^2 > 16F/s$ if $a-3t < 0$	5b 11a
VIII	$\{1,1,0,0\}$ $\left\{f_G^u, f_U^g, \phi_U^j, \phi_G^j\right\}$	4	$a-3\mu < 0$ $a^2 - (a-2t)^2 > 9F/s$ if $a-2t \geq 0$ $a^2 > 9F/s$ if $a-2t < 0$ $a^2 + (a-3t)^2 < 16F/s$ if $a-3t \geq 0$ $a^2 < 16F/s$ if $a-3t < 0$	9b 12 13a 14 11b
IX	$\{1,0,1,0\}$ $\left\{f_G^u, \phi_U^g, f_U^j, \phi_G^j\right\}$	4	$a-3t < 0$ $a^2 - (a-2t)^2 > 9F/s$ if $a-2t \geq 0$ $a^2 > 9F/s$ if $a-2t < 0$ $a^2 < 16F/s$	4b 12 13a 11b
X	$\{0,0,1,1\}$ $\left\{\phi_G^u, \phi_U^g, f_U^j, f_G^j\right\}$	4	$a-3t < 0$ $a^2 - (a-2t)^2 > 9F/s$ if $a-2t \geq 0$ $a^2 > 9F/s$ if $a-2t < 0$ $a^2 < 16F/s$	4b 12 13a 11b
XI	$\{0,0,0,0\}$ $\left\{\phi_G^u, \phi_U^g, \phi_U^j, \phi_G^j\right\}$	2	$a-2t < 0$ $a^2 < 9F/s$	7b 13b

Notes : (i) By symmetry, three further market location and supply configurations exist and can be identified by exchanging $U(u)$ and $G(g)$ in the configurations **IV**, **V** and **IX**.

    (ii) N^{ug} is the number of plants operating in Countries U and G.

Now consider the market supply configuration $\left\{e_G^u, f_U^g, s_U^j, s_G^j\right\}$.[15] For such a configuration to be an equilibrium for firms u and g it is necessary that firm j adopts an asymmetric supply configuration (as noted above): any symmetric configuration by firm j gives rise to contradictory conditions for firms u and g. Also, firm j will wish to supply both countries U and G. For example, if it is profitable for firm g to invest in U then firm j will find it more profitable to invest in G and export to U rather than not supply U. Finally, if firm g invests and firm u exports, firm j will prefer to invest in G and export to U rather than invest in U and export to G. The higher profits obtained from investing in the host country market with fewer local competitors more than offsets the lower profits from exporting to the other market.

No market supply configuration in which firm u exports to G but firm g does not supply U (or vice versa) can be an equilibrium. If firm j adopts a symmetric supply configuration then so will u and g. All other supply configurations lead to contradictory conditions for firms g and j. If firm j supplies only one country it will prefer to supply U since this is less competitive but then it will also be profitable for g to supply U. If it is profitable for j to supply both countries then it will also be profitable for g to supply U.

By contrast, there is an equilibrium in which firm u invests in G but firm g does not supply U (and vice versa): the market supply configuration $\left\{f_G^u, \phi_U^g, f_U^j, \phi_G^j\right\}$ in which firm j invests in U. This requires that trade barriers between U and G are sufficiently high as to preclude firm g from being able to export to U. The investment by j then makes it unprofitable for g to invest in U. This equilibrium is, however, not unique. Exactly the same parameter constraints will generate the equilibrium market supply configuration $\left\{\phi_G^u, \phi_U^g, f_U^j, f_G^j\right\}$ (see Table 4) with the same configuration of active plants.

4. Economic Integration, Market Size and External Trade Barriers

Equilibrium in the two-stage game is determined by the interaction of five parameters, a, t, μ, F and s. The last two always appear as the ratio F/s (see Table 4) which is a measure of the interaction between economies of scale, as measured by set-

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[15] The following comments also apply, of course, to the market supply configuration $\left\{f_G^u, e_U^g, s_U^j, s_G^j\right\}$.

up costs, and market size. We treat the demand parameter a as fixed. Equilibrium is thus determined by the interaction between the three parameters t, μ, F/s.[16]

In order to illustrate this interaction we divide the parameter space into three regions : $\mu \leq a/3$; $a/3 < \mu \leq a/2$; $\mu > a/2$. The results are presented in Figure 2. In constructing this figure we have assumed $a = 10$. Roman numbers refer to the equilibria and Arabic numbers to the parameter constraints in Table 4.

4.1 Market Size (F/s) and External Barriers to Trade (μ)

We begin with the "traditional" analysis that investigates the effects on fdi of market size and external trade barriers.

A change in the external trade barrier μ will affect the Nash equilibrium *only if firm j is currently exporting to Countries U and G*, a condition that will be satisfied only if $\mu < a/2$: from equation (22) and parameter constraint 1. This result has a simple intuition. If firm j has chosen to invest in the U-G region then j is effectively a regional insider. All three firms will then be unaffected by any changes in the region's external trade barriers.[17]

If firm j is an exporter to the regional bloc (equilibrium **I**), i.e. if the pre-integration value of μ is less than $a/2$, the effect of an increase in μ will depend upon the magnitude of the change (with economic integration this is unlikely to be a marginal change), the intra-regional trade barrier t and market size F/s. Provided that the post-integration value of $\mu < a/3$ *or* that market size is "large enough" -- such that $F/s \leq 9a^2/80$ (the maximum value of F/s for which constraint 8 can be satisfied) -- an increase in μ changes the Nash equilibrium from **I** to **IV**, i.e. from $\left\{ e_G^u, e_U^g, e_U^j, e_G^j \right\}$ to

$\left\{ e_G^u, e_U^g, f_U^j, f_U^j e_G^U \right\}$. Firm j will prefer to invest in U (or G) and export from U to G (or G to U), a form of fdi that has been referred to by some authors as "building the aircraft carrier" (Balasubramanyam and Greenaway (op. cit.)). For smaller market sizes (or higher set-up costs), however, such that $F/s > a^2/8$, an increase in μ will either have no effect (if μ remains less than $a/3$) or will lead to firm j choosing not to supply the regional bloc: equilibrium **III**. In no circumstances do we find an increase in the external trade barrier leading to a dispersed "sheltering behind the harbour wall" form of fdi by firm j -- a switch from either **I** or **IV** to **II** or **VII** with firm j investing in both intra-regional countries.

An increase in market size affects the equilibrium no matter the initial supply configuration. Consider first the case in which $\mu \leq a/3$. At small market sizes (high

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[16] An alternative approach is to conduct the subsequent analysis in terms of the demand adjusted parameters F/sa^2, t/a and μ/a (see Rowthorn (op. cit.)).

[17] A similar result holds if there is more than one firm in country J : a change in μ will affect the Nash equilibrium only if at least one of these firms is exporting to U and/or G.
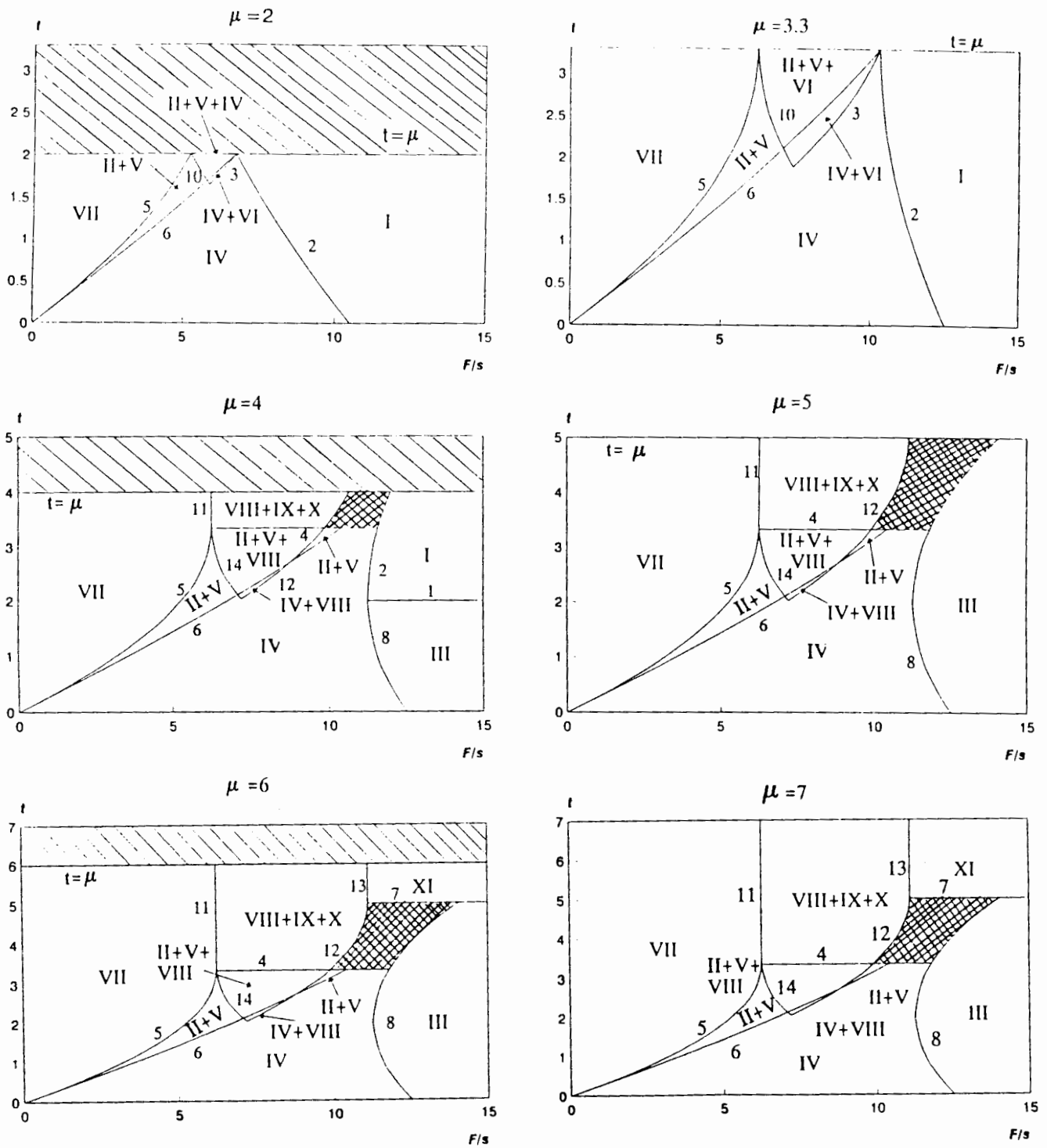
Figure 2 : Economic Integration and Market Equilibrium I

F/s) such that constraint 2a holds, **I** is the Nash equilibrium: intra-industry trade within the regional bloc and exports to the bloc from J. At intermediate market sizes (such that constraints 2b and 6b hold) **IV** is an equilibrium: firm j chooses to invest in one country and export to the other while both intra-regional firms choose to export.[18] At

[18] Note that for some parameter combinations **VI** could also be an equilibrium : intra-regional, intra-industry investment and inter-regional exports.

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greater market sizes such that constraints 5a and 6a hold there are two possibilities: **II** or **V**. These are effectively equivalent apart from the ownership of the plants with the same aggregate profit and the same total outputs in U and G. Some intra-regional exports are displaced by intra-regional investment. Finally at large market sizes such that constraint 5b holds, **VII** is the equilibrium and intra-regional trade is replaced by intra-regional investment.

For $\mu > a/3$ market size will have the same effect provided that constraints 1a and 4a hold. If, however, the intra-regional trade barrier t is relatively high -- $t > a/3$ -- somewhat different results can emerge. As Figures 2b and c indicate, there is a part of the parameter space for which there exists no equilibrium to the two-stage game : the cross-hatched area. This area is delimited by four mutually contradictory constraints:

(i) constraint 8b : firm j finds supply strategy $f_U^j e_G^U$ profitable if there is intra-regional trade;

(ii) constraint 4b : firm g cannot export to U if j has adopted supply strategy $f_U^j e_G^U$;

(iii) constraint 12 not holding : intra-regional fdi is not profitable if firm j does not supply the region;

(iv) constraint 7a : intra-regional exports are profitable if firm j does not supply the region

At greater market sizes such that constraints 11b and 12 hold there are three possible equilibria **VIII**, **IX** and **X**. As with equilibria **II** and **V**, these are effectively equivalent Market size is large enough to justify fdi but intra-regional trade barriers are sufficiently high to prevent intra-regional trade. Finally, provided market size is sufficiently high that $F/s < a^2/16$ then **VII** is the equilibrium with trade being replaced by fdi for all three firms.

4.2 Market Size (F/s) and Market Accessibility (t)

Market size and market accessibility have sharply contrasting roles. We have already seen that the larger is market size the more likely we are to see equilibrium **VII** -- dispersed locations by all three firms. By contrast, the lower are the intra-regional trade barriers the more likely is it that we shall see equilibrium **IV** -- intra-regional intra-industry trade and concentrated fdi by the non-regional firm.

Of particular interest is the effect of a change in intra-regional trade barriers when external trade barriers are relatively high and when market size is relatively small (or set-up costs high). Take the case where $a/3 < \mu < a/2$ and constraint 8a is satisfied [19] A reduction in intra-regional trade barriers i.e. an improvement in intra-

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[19] If $\mu > a/2$ and constraint 8a is satisfied then firm j will not supply the regional bloc no matter the value of t

regional market accessibility, can lead to firm j choosing not to supply U or G, a change from equilibrium **I** with firm j exporting to the regional bloc, to **III** with firm j not supplying the regional bloc: this will certainly be the case if $F/s > a^2/8$. When all three firms are exporters intra-regional trade barriers protect the exports of firm j from the intra-regional exports of firms u and g. Reducing these barriers improves the intra-regional competitiveness of firms u and g and may result in them becoming sufficiently competitive as to be able to keep firm j out of the market.

For market sizes in the range $a^2/8 > F/s > 9a^2/80$ we can have the same effect. Alternatively, a change in intra-regional trade barriers may cause a change in the market equilibrium from **I** or **III** to equilibrium **IV** (fdi by firm j plus intra-regional exports). Note, however, that this change in the equilibrium can result either from a decrease in intra-regional trade barriers *or from an increase in these barriers*. The reason for this apparently surprising result can be identified from firm j's profit with the market supply configuration $\left\{ e_G^u, e_U^g, f_U^j, f_U^j e_G^U \right\}$ of equilibrium **IV** (Table 3).

$$\Pi^j(\ ) = \left[(a+t)^2 + (a-2t)^2 \right] s / 16 - F \qquad (24)$$

Profit falls with an increase in t for $t \le a/5$ and rises with an increase in t for $t > a/5$. To see why note that an increase in intra-regional trade barriers has two effects on firm j: an export cost effect and an import protection effect. The former reduces firm j's profits by making exporting to country G more expensive (the second term in equation (24)), while the latter makes sales in country U more profitable by affording firm j additional protection from firm g (the first term in equation (24)). With high values of t firm j's exports to G are small relative to its sales in U, the import protection effect is dominant and an *increase* in internal trade barriers will encourage firm j to invest in U. When t is low, by contrast, firm j's exports to G are more nearly equal to its sales in U, the export cost effect dominates and a *decrease* in the internal trade barriers will encourage firm j to invest in U.

Now consider the cases where $F/s < 9a^2/80$. An increase in market size will eventually lead to dispersed fdi by all firms (equilibrium **VII**) whereas an improvement in market accessibility is more likely to lead to equilibrium **IV**, intra-regional intra-industry trade and concentrated fdi by the non-regional firm. That a reduction in t leads to less fdi is not surprising. For the market sizes we are considering all three firms are regional insiders and the intra-regional trade barriers act just like any other barriers to trade in the "standard" analysis. We know that fdi is favoured by high barriers to trade and exporting by low barriers.

4.3 The External Wall (μ) and the Internal Floor (t)

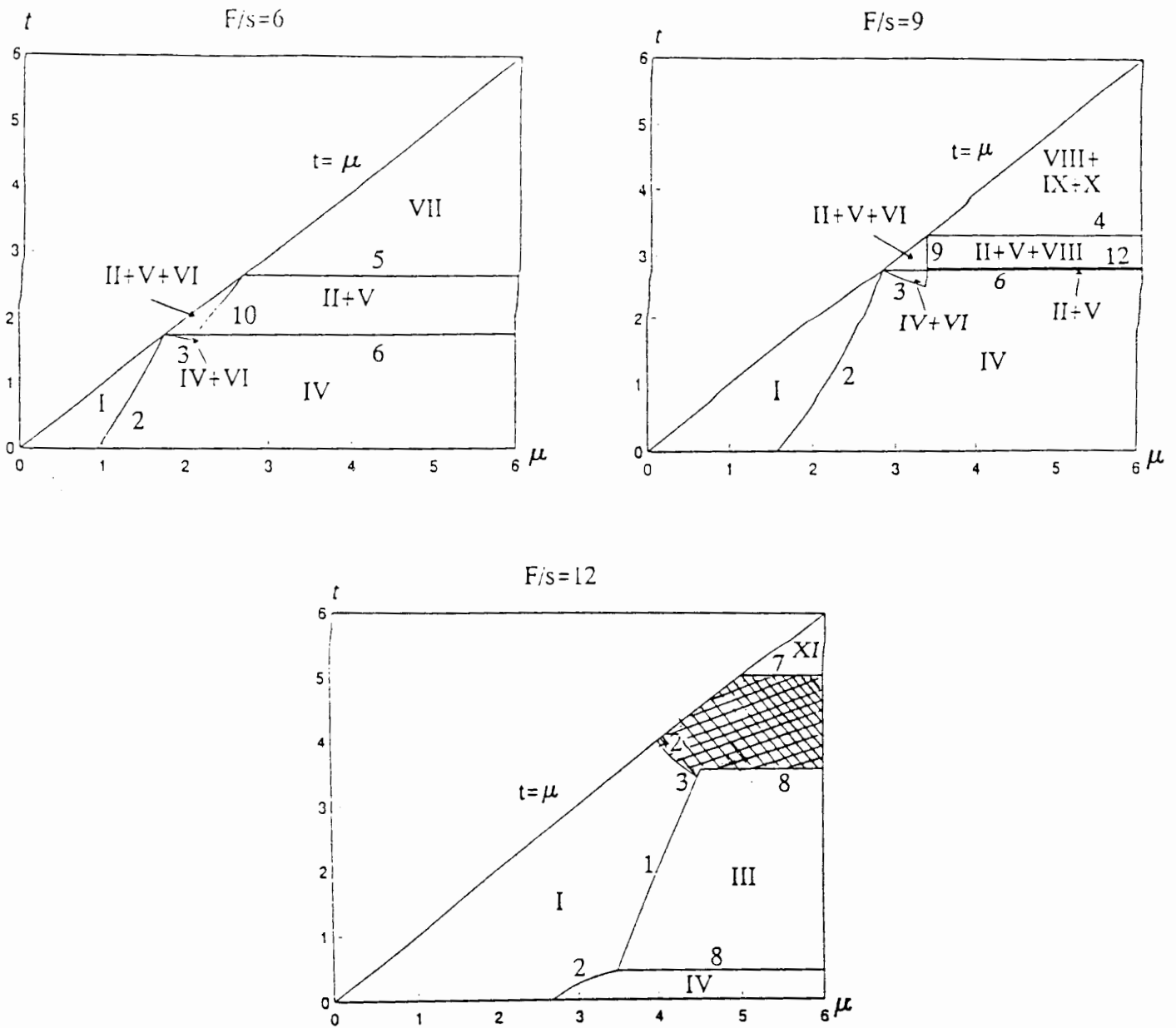Figure 3 makes the discussion in this section clearer.

Figure 3 : Economic Integration and Market Equilibrium II

An increase in external trade barriers will affect the equilibrium *only if firm j exports to the regional bloc prior to the increase in* μ i.e. only if equilibrium **I** or **VI** (export from *J* and intra-regional, intra-industry investment) applies.

If the initial equilibrium is **I** and if the market size is large -- $F/s < 9a^2/80$ -- or is small -- $F/s > a^2/8$ -- an increase in the external tariff and non-tariff wall will have a similar effect to a lowering of the internal tariff and non-tariff floor. There will be a switch from equilibrium **I** to equilibrium **IV** for large market sizes and from **I** to **III** for small market sizes. It would appear, in other words, that for these market sizes it matters little whether "Fortress Europe" raises the extra-regional wall or lowers the intra-regional floor. While this is true with respect to the market location and supply

configurations, however, it is not true of the market quantity choices as we shall show in section 5. Once an increase in the height of the extra-regional tariff and non-tariff wall has caused the equilibrium to switch from **I** to **IV** or **III** further increases will have no effects on the market quantity choices. This is not true of a lowering of the intra-regional tariff and non-tariff floor.

For intermediate market sizes -- $a^2/8 > F/s > 9a^2/80$ -- changes in the external wall and internal floor will have contrasting effects. An increase in μ is likely to lead to equilibrium **III** with firm j being excluded from the regional bloc. By contrast, a reduction in t is more likely to lead to equilibrium **IV**, concentrated fdi and intra-regional exports by firm j.

If the initial equilibrium is **VI** (which will arise only if $\mu < a/3$) we also see contrasting effects. Raising the external wall will, depending upon market size, lead to a switch to equilibrium **II** or **V**, with fdi by firm j replacing at least some fdi by firms u and g, or to **VIII** with firm j being excluded from the regional bloc. Lowering the internal floor, by contrast, leads to equilibrium **IV**; intra-regional, intra-industry investment is replaced by intra-regional trade and the external firm switches from exporting to concentrated fdi.

Now consider cases in which the external and internal trade barriers and market size are such that firm j is a regional insider: equilibria **II, V, VII-XI**. Then the market supply configuration will be unaffected by further changes in the external trade barriers. By contrast, changes in the internal tariff barriers will induce changes in intra-regional trade and investment. We are, for example, likely to see a switch from equilibria with dispersed fdi such as **II, V** or **VII** to equilibrium **IV** in which fdi is rationalised and there are intra-regional intra-industry trade flows.

5. Welfare Impacts in the Integrated Economies

Welfare comparisons in models of the type presented in this paper are usually based upon a consideration of the effects of policy changes on consumer surplus and total surplus. Such a comparison is complicated in this case for at least two reasons. First, we have not specified what proportion of the extra-regional trade barrier consists of tariff rather than non-tariff barriers to trade nor do we assume that an increase in μ is solely an increase in tariffs. Consequently, we are unable to obtain measure of the tariff revenue on imports from Country J. Secondly, it is not clear how the profit to firm j should be treated no matter whether j is an exporter to or investing in the regional bloc.[20] Note that if we were to include tariff revenue on imports from J this would increase total surplus of equilibrium **I** while inclusion of tax revenue

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[20]   If this profit is repatriated to Country J then presumably we should include as regional welfare only the regional tax take on the profit, but this requires that we specify the rate of corporate tax and implicitly assumes that the investment is financed 100% from Country J.

the profits of firm j would increase total surplus for all equilibria in which firm j chooses to supply the regional bloc i.e. all but equilibria **III** and **XI**.

Our primary interest is in the impact of economic integration on welfare in the integrating countries. We concentrate, therefore, upon prices in countries U and G and profits of firms u and g from sales to U and G. Total surplus is measured as the sum of consumer surplus in U and G plus profits to firms u and g from sales to U and G. There is also the problem of how to deal with parameter regions in which there are multiple equilibria. In such regions we consider only the equilibrium that gives firm j the greatest profit. This is not equivalent to giving firm j a first-mover advantage but can, perhaps, be rationalised along similar lines. The equilibria eliminated by this assumption are **V**, **VI** , **VIII** and **IX**. Note that, with respect to prices and consumer surplus, **V** is identical to **II** and **VIII** and **IX** are identical to **X** since these equilibria involve the same distribution of plants and the same supply configurations. Of course, the eliminated equilibria have higher producer surplus than those we retain. We also confine our analysis to a consideration of the effects of changes in the external and internal trade barriers μ and t. A change in market size affects price only if it results in a change in the equilibrium. Increased market size always increases consumer surplus and profit for any given equilibrium.
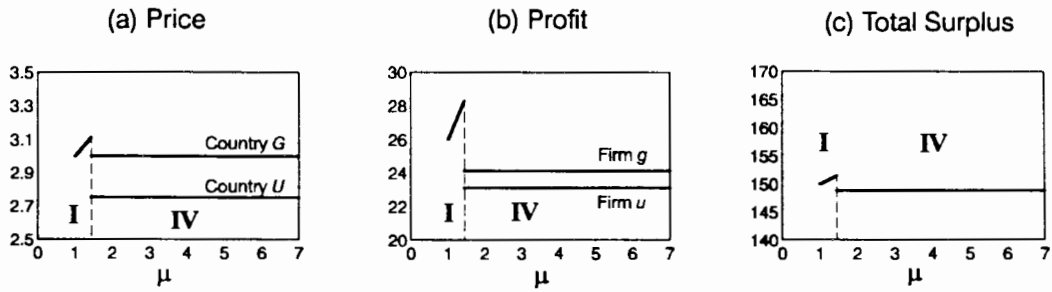
The parameter space can be divided into four main regions with respect to market size : $F/s < a^2/16$; $a^2/16 < F/s < a^2/9$; $9a^2/80 < F/s < a^2/8$; $a^2/8 < F/s$. For purposes of illustration we assume $F = 12$ and consider $F/s = 6$, 9 and 12 (it turns out that the only difference in the welfare properties of the fourth region, e.g. with $F/s = 15$, and the third region, with $F/s = 12$, is that the latter includes equilibrium **IV**). Figures 4 and 5 summarise the main elements of the welfare comparison.

Consider first the effect of an increase in the external trade barrier μ and assume that the pre-increase equilibrium is **I**: Figures 4(i) and 5(i).
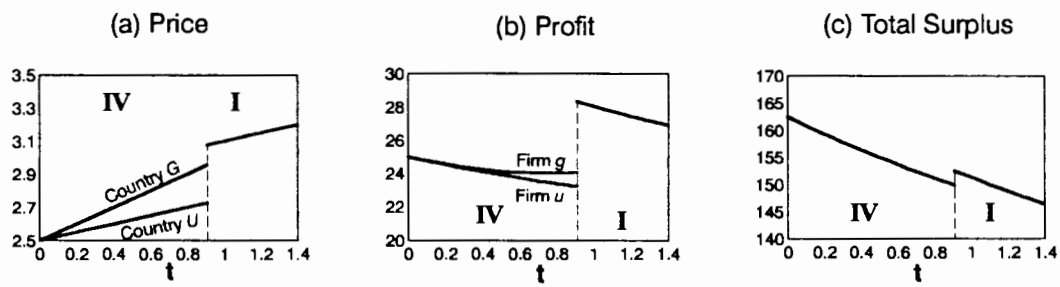
If there is no change in the equilibrium, consumers lose but firms u and g gain with the increased profits being sufficient to offset the loss in consumer surplus. If the increase in μ is sufficient to lead to a change in the equilibrium the resulting welfare effects vary with market size. If market size is sufficiently small for the increase in μ to lead to firm j choosing not to supply the regional bloc (equilibrium **III**) prices and profits are increased with the increase in profits being sufficient to offset the reduction in consumer surplus. By contrast, if market size is large enough for the increase in μ to lead to fdi in the regional bloc by firm j ($F/s < a^2/9$ and equilibrium **IV**) prices and profits are reduced, the reduction in profits is greater than the increase in consumer surplus so that total surplus is reduced. The reduction in price and firm's profit is greater in the country in which firm j invests.

Now consider the effects of a decrease in the internal barriers to trade t: Figures 4(ii)-(iv) and 5(ii). If the equilibrium does not change, a reduction in t reduces
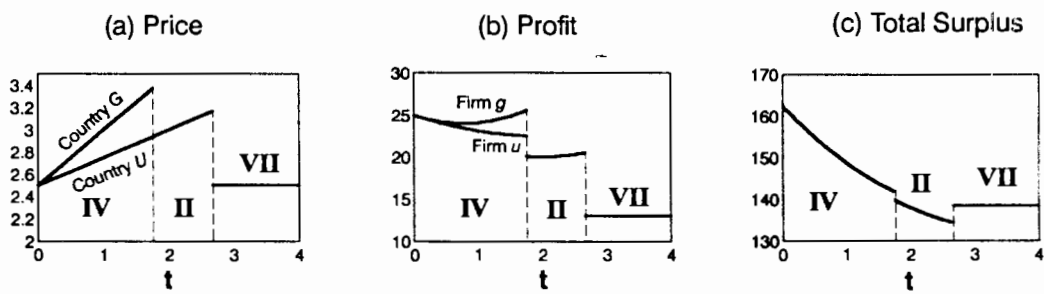
(i) F/s = 6 ; t = 1

(a) Price

(b) Profit

(c) Total Surplus

(ii) F/s = 6 ; μ = 1.4

(a) Price

(b) Profit

(c) Total Surplus

(iii) F/s = 6 ; μ = 4

(a) Price

(b) Profit

(c) Total Surplus

(iv) F/s = 9 ; μ = 4

(a) Price

(b) Profit
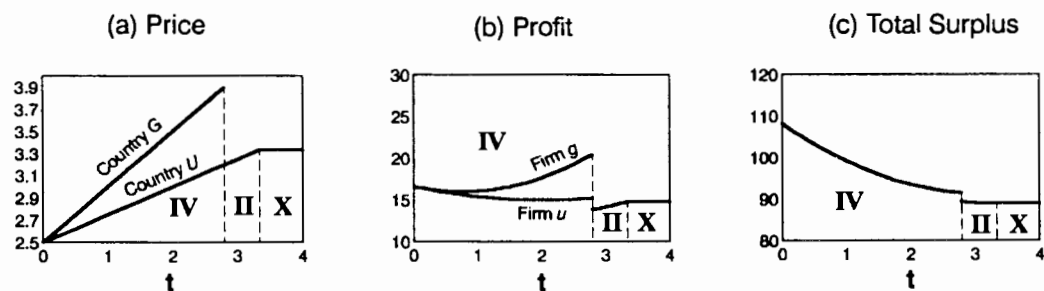
(c) Total Surplus

Figure 4 : Welfare Impact of Changes in Internal and External Trade Barriers :
$$F/s < a^2/9$$

(i) F/s = 12 ; t = 1

(a) Price	(b) Profit	(c) Total Surplus

(ii) F/s = 12 ; μ = 4

(a) Price	(b) Profit	(c) Total Surplus
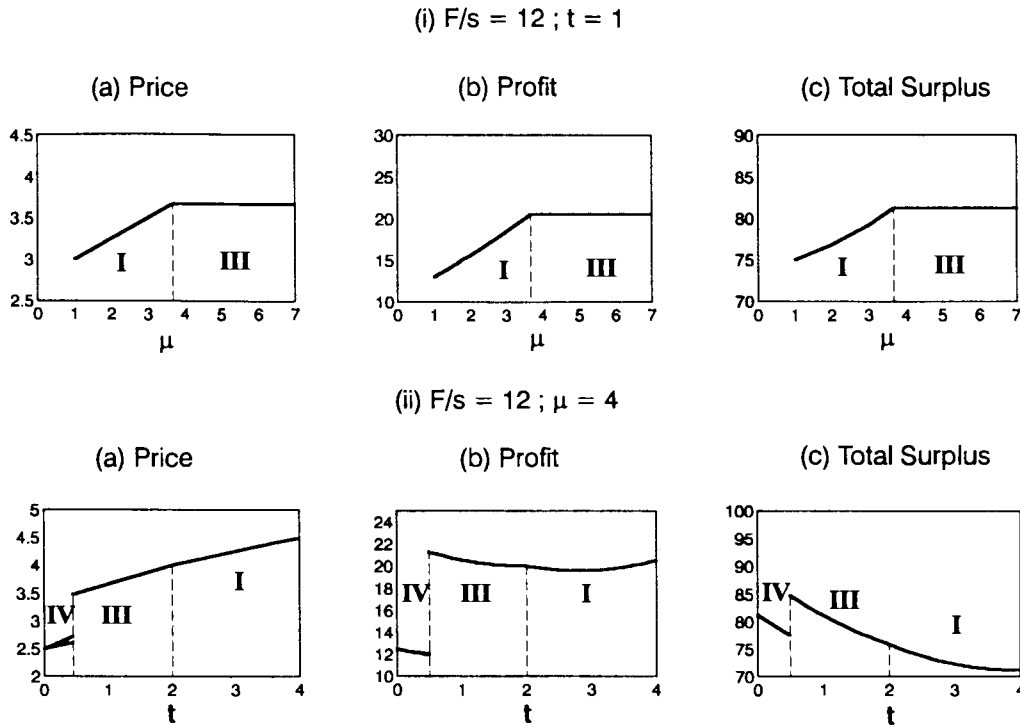
Figure 5 : Welfare Impact of Changes in Internal and External Trade Barriers :
$$9a^2/80 < F/s < a^2/8$$

prices and increases total surplus. The effect on the profits of firms u and g is, however, ambiguous if they are both intra-regional exporters (equilibria I, II and IV): note, for example, the impact on firm g's profits of a reduction in t in equilibrium IV (Figures 3(ii)-(iv)). The explanation lies in the export cost and import protection effects discussed in section 4.2. At high values of t intra-regional exports are low relative to domestic sales and the import protection effect is dominant. At low values of t, by contrast, intra-regional exports are high relative to domestic sales and the export cost effect is dominant.

If the reduction in intra-regional trade barriers causes firm j to change from exporting (equilibrium I) to fdi (equilibrium IV) prices fall, consumer surplus and total surplus rise. Intra-regional firms' profits fall, this fall being greater for the firm with its domestic base in the host country for the fdi. While governments may be keen to attract fdi, it is not clear that domestic firms will share their sentiments. Note also the sharp contrast between these results and the traditional customs union result based upon the trade creation and trade diversion effects of the union. The explanation of this contrast is straightforward. In the traditional customs union literature the formation of the union is normally expected to lead to the exclusion of low-cost world suppliers whereas our model takes explicit account of the possibility that these suppliers may be induced to undertake fdi in the customs union in order to maintain market access.

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There are rather different effects if the reduction in internal trade barriers leads to concentrated fdi (equilibrium **IV**) rather than dispersed fdi (equilibria **II, VII** or **X**). Total surplus will increase but this is primarily a consequence of an increase in profits of firms u and g. Prices will always rise if the pre-increase equilibrium is **VII** with all firms investing in both countries and are likely to rise in other case unless the reduction in t is substantial.

6. Conclusions

The existing literature has identified tariff and non-tariff barriers to trade and market size as important determinants of an international oligopolist's choice between exporting and foreign direct investment. This literature is of limited relevance to the analysis of the growth of Japanese fdi in Europe in response to regime changes such as those incorporated in the Single Europe Act and, more generally, to the effects on the trade/foreign direct investment choice of the emergence of integrated regional trading blocs such as the EC, NAFTA and ASEAN. These regime changes affect market accessibility rather than market size and will lower trade barriers between the integrating economies without necessarily increasing trade barriers with respect to the rest of the world.

We have shown that economic integration, by improving market accessibility, can lead "outside" firms to invest in the integrated regional bloc. But whereas increased market size is likely to lead to dispersed fdi, economic integration is more likely to lead to concentrated fdi with the investing firm supplying the majority of the countries in the regional bloc by intra-regional exports.

It is not easy to identify clear-cut relationships between economic integration and welfare precisely because integration may cause firms from outside the integrated region to invest in the region. The clearest example, and perhaps the most relevant to the EC, NAFTA and ASEAN cases, is where the outside firm exports to the regional bloc prior to economic integration and chooses to invest in the regional bloc as a result of integration. In sharp contrast to the traditional customs union literature this will lead to a reduction in product prices, a reduction in the profits of domestic firms within the integrated economies, and an increase in total surplus.

Our results lend further support to Rowthorn's (1992) conclusion that the growth of regionalism evident in current developments in the world economy will lead to flows of intra-industry foreign direct investment between these blocs, to increased trade within regional blocs, but to only moderate growth of trade between the emergent blocs.

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Mathematical Appendix

This Appendix is not intended to be comprehensive. Rather, we provide below a sample of the calculations that generate Tables 3 and 4.

Denote a strategy set as $\left\{s^u, s^g, s^j\right\}$.

A.1: $\left\{s^u, s^g, s^j\right\} = \left\{e_G^u, e_U^g, s^j\right\}$.

Strategies $s^j = \left(e_U^j, \phi_G^j\right), \left(\phi_U^j, e_G^j\right), \left(f_U^j, \phi_G^j\right)$ and $\left(\phi_U^j, f_G^j\right)$ can all be omitted since each is dominated by a strategy in which firm j supplies both markets.

For $\left\{s^u, s^g, s^j\right\} = \left\{e_G^u, e_U^g, \left(e_U^j, e_G^j\right)\right\}$ to be an equilibrium requires:

(i) $\Pi_u\left(\left\{e_G^u, e_U^g, \left(e_U^j, e_G^j\right)\right\}\right) > \Pi_u\left(\left\{f_G^u, e_U^g, \left(e_U^j, e_G^j\right)\right\}\right)$;

(ii) $q_G^u\left(\left\{e_G^u, e_U^g, \left(e_U^j, e_G^j\right)\right\}\right) > 0$;

(iii) $\Pi_g\left(\left\{e_G^u, e_U^g, \left(e_U^j, e_G^j\right)\right\}\right) > \Pi_g\left(\left\{e_G^u, f_U^g, \left(e_U^j, e_G^j\right)\right\}\right)$;

(iv) $q_t^g\left(\left\{e_G^u, e_U^g, \left(e_U^j, e_G^j\right)\right\}\right) > 0$;

(v) $\Pi_j\left(\left\{e_G^u, e_U^g, \left(e_U^j, e_G^j\right)\right\}\right) > \Pi_j\left(\left\{f_G^u, e_U^g, \left(f_U^j, f_G^j\right)\right\}\right)$;

(vi) $\Pi_j\left(\left\{e_G^u, e_U^g, \left(e_U^j, e_G^j\right)\right\}\right) > \Pi_j\left(\left\{f_G^u, e_U^g, \left(f_U^j, f_U^j e_G^U\right)\right\}\right)$;

(vii) $q_t^j\left(\left\{e_G^u, e_U^g, \left(e_U^j, e_G^j\right)\right\}\right) > 0$; $q_G^j\left(\left\{e_G^u, e_U^g, \left(e_U^j, e_G^j\right)\right\}\right) > 0$.

Constraints (iii) and (iv) are identical to (i) and (ii). Constraint (i) requires:

(A.1) $(a + \mu)^2 - (a + \mu - 3t)^2 < 16F / s$

and (ii) requires

(A.2) $(a + \mu - 3t) > 0$.

Constraint (vii) requires

(A.3) $(a + t - 3\mu) > 0$ which also satisfies (A.2) since $\mu > t$.

Now consider constraint (v). This implies:

(A.4) $(a + t)^2 - (a + t - 3\mu)^2 < 16F / s$

while constraint (vi) implies:

(A.5) $(a + t)^2 + (a - 2t)^2 - 2(a + t - 3\mu)^2 < 16F / s$.

Equation (A.5) incorporates (A.4) since $\mu > t$. Thus equations (A.1), (A.3) and (A.5) define the constraints that must be satisfied for $\left\{e^u_G, e^g_U, \left(e^j_U, e^j_G\right)\right\}$ to be an equilibrium.

A.2: $\left\{s^u, s^g, s^j\right\} = \left\{e^u_G, f^g_U, s^j\right\}$

Strategies $s^j = \left(e^j_U, e^j_G\right), \left(f^j_U, f^j_G\right), \left(\phi^j_U, \phi^j_G\right), \left(e^j_U, \phi^j_G\right), \left(\phi^j_U, e^j_G\right), \left(f^j_U, \phi^j_G\right)$

and $\left(\phi^j_U, f^j_G\right)$ cannot be equilibria since they require mutually contradictory constraints. Consider, for example, $s^j = \left(f^j_U, \phi^j_G\right)$. For this to an equilibrium requires:

(A.6) $a - 3t > 0$ and

(A.7) $(a+t)^2 s / 16 - F > \left[(a-3t)^2 + (a+t)^2\right] s / 16 - F$

which are contradictory.

Strategy $\left(f^j_G e^G_U, f^j_G\right)$ dominates strategy $\left(f^j_U, f^j_U e^U_G\right)$.

Now consider $\left\{s^u, s^g, s^j\right\} = \left\{e^u_G, f^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}$. For this to be an equilibrium requires:

(i) $\Pi_u\left(\left\{e^u_G, f^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}\right) > \Pi_u\left(\left\{f^u_G, f^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}\right)$;

(ii) $q^u_G\left(\left\{e^u_G, f^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}\right) > 0$;

(iii) $\Pi_g\left(\left\{e^u_G, f^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}\right) > \Pi_g\left(\left\{e^u_G, e^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}\right)$;

(iv) $q^g_U\left(\left\{e^u_G, f^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}\right) > 0$;

(v) $\Pi_j\left(\left\{e^u_G, f^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}\right) > \Pi_j\left(\left\{e^u_G, f^g_U, \left(f^j_U, f^j_G\right)\right\}\right)$;

(vi) $\Pi_j\left(\left\{e^u_G, f^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}\right) > \Pi_j\left(\left\{f^u_G, e^g_U, \left(e^j_U, e^j_G\right)\right\}\right)$;

(vii) $\Pi_j\left(\left\{e^u_G, f^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}\right) > \Pi_j\left(\left\{e^u_G, f^g_U, \left(\phi^j_U, e^j_G\right)\right\}\right)$

(viii) $q^j_U\left(\left\{e^u_G, f^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}\right) > 0$; $q^j_G\left(\left\{e^u_G, f^g_U, \left(f^j_G e^G_U, f^j_G\right)\right\}\right) > 0$.

Constraint (i) implies:

(A.8) $a^2 - (a-3t)^2 < 16F / s$

and (ii) implies

(A.9) $a - 3t > 0$.

Constraint (iii) implies:

(A.10) $(a+t)^2 - (a-2t)^2 > 16F/s$

while (iv) is satisfied by (A.9). Constraint (v) is satisfied by (A.8) while (vi) implies:

(A.11) $(a-3t)^2 - (a-3\mu)^2 + (a+t)^2 - (a+t-3\mu)^2 > 16F/s$

which is incorporated in (A.10). Similarly, (vii) implies:

(A.12) $(a-3t)^2 + (a+t)^2 - (a+t-3\mu)^2 > 16F/s$

which is incorporated in (A.10). Constraints (viii) are satisfied by (A.9). Thus equations (A.8), (A.9) and (A.10) define the constraints that must be satisfied for $\left\{ e_G^u, f_U^g, \left(f_G^j e_U^G, f_G^j \right) \right\}$ to be an equilibrium.

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