European Integration and Geographical Concentration of Swedish Multinationals*

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Abstract:

This paper investigates whether European integration has an effect on the geographical concentration of Swedish multinationals' production inside the European Union. The results indicate that agglomeration and dispersion forces are present, and that the relative strength of these forces has been affected by the EU integration process. In particular, the European integration process has reduced intra-EU transaction costs, and thus the need of R&D intensive multinationals to engage in local production to fully appropriate the return of their assets. The results further suggest that EU integration has led Swedish MNEs to increase dispersion of production inside the European Union.

Keywords: Economic Integration, Multinational Enterprises, Geographical Concentration and Dispersion

JEL Classification: F12, F15, F23

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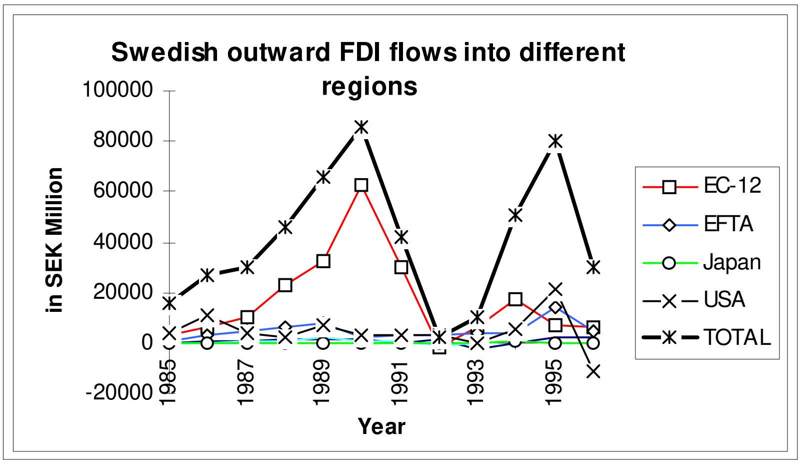
1. Introduction:

Towards the end of the 1980s, Foreign Direct Investment (FDI) flows to the European Union (EU) increased dramatically. Most of these FDI flows came from third countries such as the USA and Japan. Similarly, most of the former EFTA countries experienced unprecedented increases in outward FDI flows which were directed to EU member countries.[1] In fact, Sweden experienced both one of the single largest increases in and highest levels of total FDI outflows relative to GDP of all OECD countries in the period 1985-1994. In 1990, FDI outflows relative to GDP reached an unprecedented 6.31% (OECD, 1996).

Figure 1:



Source: OECD, 1996

However, this was not a solely Swedish phenomenon. Rather, this has to be seen in light of a general trend towards multinational production. There was a world wide FDI boom in the years 1986-1990, which was followed by a world wide FDI recession in the years 1991-1992. Currently, the world is experiencing another FDI boom which started in 1995 (UNCTAD, 1997). These FDI cycles broadly correspond to the Swedish cycle, as shown in table 1. In 1992, Sweden experienced a sharp fall in outward FDI flows, which can be attributed to a deep economic recession and the devaluation of the Swedish Crown.

Empirical evidence suggests that a considerable part of the FDI flows in the 1980s can be regarded as a consequence of the Single European Market (SEM) programme.[2] Other important factors, which contributed to the decision to locate production abroad, include a general worsening of Sweden’s economic performance during the 1980s. Between 1970 and 1991, growth of GDP per person employed has lagged behind the OECD average by 0.6%, while growth of output in the manufacturing sector has grown approximately 0.3% slower.

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1 The USA and EFTA accounted for 33% and 31% respectively of accumulated inward FDI flows into the EU between 1984-93, while Japan accounted for 11% (Eurostat, 1995).

2 See for example UNCTAD (1993) and Dunning (1997a, b) for a review of the evidence.

Reasons contributing to this decline are on one hand the policy induced, low return of human capital and the return on physical capital, which has continuously been rather low when compared to other countries. On the other hand, hourly wage increases permanently exceeded productivity growth, leading to inflation pressure and subsequent devaluations of the Swedish Crown to restore international competitiveness (Lindbeck et al., 1994).

Additionally, it was not until the mid 1980s that Sweden started to liberalise its financial markets. In 1986, the external financing requirement was abolished, and in 1987, the deregulation was extended, to include real estate abroad. From 1989 onwards, this included insurance (OECD, 1996). Unsurprisingly therefore, Swedish banks, real estate and insurance companies increased their investments abroad by 500% in current prices during the years 1987-90 (Andersson & Fredriksson, 1993).[3]

Nevertheless, little is known about geographical aspects, in terms of geographical concentration, of these Foreign Direct Investments, and the effects that European integration has thereupon. Taking the example of American firms, most of the initial response to the SEM programme came from established American multinationals, which responded mainly in restructuring and consolidating existing activities in the EU, rather than seeking major new investment opportunities. Quite differently, formerly exporting firms may be induced to supply the EU market from inside, but will not simultaneously choose to establish production units in different EU locations or member states. In this case, FDI serves as a platform for intra-EU exports. Japanese FDI into the EU may serve as an example for this argument, as most of the investment emerged subsequent to the SEM announcement, and can thus mainly be regarded as import substituting character (UNCTAD, 1993).

This paper makes a first empirical attempt to analyse how geographical concentration of Swedish multinationals' activities has been affected by the EU integration process. The geographical concentration of the activities of multinational enterprises (MNEs) serve as a good indication of the presence and importance of forces leading towards agglomeration or dispersion of industrial activity. These forces are at the heart of research in the geography and trade literature (e.g. Krugman, 1991; Krugman & Venables, 1995, 1996 and Venables, 1995, 1996).

Similarly, these issues are also analysed in some of the new trade and investment models, which typically focus on the simultaneous decision of firms between exporting and producing abroad. Markusen & Venables (1996b) and Markusen, Venables, Konan & Zhang

[3] Prior to these changes, firms wishing to invest abroad had to seek permission of the Bank of Sweden. Permission was generally granted if firms were able to demonstrate that their investment would have positive effects on the Swedish trade balance (e.g. Swedenborg, 1985).

(1996), for example, derive implications for the agglomeration of industrial activity, in cases where multinationals are permitted. A somewhat special case is the model by Motta & Norman (1996) who extend new theoretical trade and investment models in one important aspect; they derive implications of economic integration for the geographical distribution of FDI in a three country setting.[4]

If the European integration process affects the relative strength of these forces, then MNEs can react faster to these institutional changes than national firms. The reason is that MNEs are commonly referred to as being '*footloose*' relative to firms being confined to national markets only, as they have an inherent ability to move production between different locations.[5]

Analysing the changing behaviour of MNEs in light of economic integration may shed some light onto the question of whether European integration has an effect of facilitating the tendency towards more or less agglomeration of industrial activity in the long run. This, in turn yields important policy implications.

In the empirical analysis we use plant and firm level data from Swedish multinationals, collected on a quadrennial basis of the Research Institute of Industrial Economics in Stockholm. In doing so, we will restrict ourselves to already existing multinationals.[6] Reasons to use data on Swedish MNEs include firstly, that Sweden has traditionally been home to a relatively large number of multinationals.[7] Secondly, Swedish outward FDI flows increased dramatically as a response to the SEM programme. Thirdly, the EU is Sweden's single most important economic partner. Thus, the implications of the SEM programme significantly affect the Swedish economy as a whole. The SEM programme is arguably of such importance that Sweden became a full EU member in 1995.

The remainder of this paper is organised as follows; Section 2 will explore the theoretical background. This will lead to the formulation of testable hypotheses. Section 3 presents the data and sources, while section 4 derives the econometric specification. Section 5 discusses the empirical results, and the final section concludes.

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4 See for example Markusen (1995) for a review of the new trade literature that incorporates MNEs into the analysis.

5 This '*footlooseness*' is according to the OLI approach (Dunning, 1977, 1981) attributed to ownership, localisation, and internalisation advantages, which are regarded as necessary conditions in order to become a multinational.

6 Hence, we do not attempt to explain how European Integration affected the proximity-concentration trade-off hypothesis between multinational production and exporting (see Brainard, 1993, 1997).

7 Even when compared internationally, Sweden emerges as one of the most 'multinational' countries in the world. In 1991, no other country was home country to a greater number of the world's largest 500 corporations, when compared to the size of the economy (Andersson et al., 1996).

2. Transaction Costs, Market Enlargement and Agglomeration:

a. Transaction Costs

According to the OLI approach developed by Dunning (1977, 1981), multinationals need to possess three advantages, namely ownership, localisation and internalisation advantages. Ownership advantages are associated with intangible assets, i.e. firm specific knowledge, patents, trademarks, etc., which are internationally mobile and would allow the firm to efficiently spread production abroad. These assets are to some degree public goods. Due to information asymmetries about the asset between buyer and seller, it is difficult for firms to fully appropriate the returns of these assets when contracting upon them in the market place (e.g. Williamson, 1981). In order to forgo these transaction costs, the firm may choose to internalise these transactions.[8] As firms have the option, however, to substitute multinational activity and exports, locational advantages are necessary in order to prefer the former to the latter.

In recent years numerous, theoretical models appeared in the literature incorporating ownership and localisation advantages, whilst taking internalisation advantages for given. Common to all of them is that ownership advantages are captured by the idea of introducing firm-specific fixed costs that do not have to be incurred again when setting up a new plant abroad. The limitation of early models is that they do not consider transport costs. In this sense, they provide only a very limited explanation of the trade-off between exporting and multinational production (e.g. Markusen, 1984; Helpman, 1984, Helpman & Krugman, 1985).

Newer general equilibrium approaches overcome this limitation, as they typically incorporate transport costs and/or tariffs and firm- and plant level fixed costs (e.g. Brainard, 1993; Horstmann & Markusen, 1992; Markusen & Venables, 1996a,b, 1998). This also applies to oligopolistic partial equilibrium models (e.g. Horstmann & Markusen, 1987; Motta, 1992). The tension between transport costs and economies of scale allows us to analyse the effects of economic integration on the decision of how to supply the foreign market.

A fairly robust result of these models is that, the larger the firm-specific fixed costs and the trade costs are relative to the fixed plant set up costs, the more likely it is that the MNE

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[8] It should be stressed, however, that this notion is primarily used to explain the existence of horizontal multinationals. Vertical multinationals internalise the costs for intermediate products, thereby foregoing ex ante and ex post contracting costs. For an extensive review of theoretical and empirical contributions see Caves (1996).

alternative is favoured to the exporting choice.[9] This is what Brainard (1993) has referred to as the proximity-concentration trade-off hypothesis.

In empirical studies, Research & Development (R&D) expenditure is a common measure to proxy for the importance of firm specific assets. Results suggest that R&D expenditures are positively related to the presence of multinationals (e.g. Caves, 1996). As firm specific assets give rise to both ownership advantages and internalisation advantages, which is due to its joint input, public goods character, it is also possible to use this measure as a proxy for the importance of transaction costs. Correspondingly, it can be argued that if a third country firm wants to supply a whole region, such as the EU, which in turn is characterised by a high degree of transaction costs between its member states, then the implication of the transaction cost argument is that third country firms tend to produce in both countries inside the region. Thus, multinational production will be relatively dispersed. In other words, segmentation of countries into nationally confined markets will result in dispersion of multinational activity.

Hypothesis1a: *High R&D intensity will result in high dispersion of multinational production.*

The aim of the SEM is to create one unified European market. For this to become true, the measures and steps taken by the European Commission to reduce non-tariff barriers (NTB), such as the harmonisation of the regulatory standards and national laws, will result in reducing transaction costs that firms encounter when operating across national borders. Thus, it is expected that European integration reduces the strength of the relationship between R&D expenditure and the dispersion of multinational activity.

Hypothesis 1b: *European integration reduces the firm's transaction costs, and thus the strength of the positive relationship between R&D intensity and the dispersion of multinationals' activity inside the EU.*

b. Market Enlargement vs. Market Accessibility

Motta & Norman (1996) provide a game-theoretic model that specifically allows us to analyse third country firms' behaviour in the light of European integration. Contrary to the

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[9] Roughly speaking the same results appear in oligopolistic models. These models focus on strategic interaction between firms in order to derive the trade-off between multinational production and exporting. However, for some small range of parameters, results are not as clear cut. Due to firms' interaction with each other, '*perverse*' equilibria can emerge where increases in host country market size, reductions in transport cost, and increases in firm-specific costs lead to a change in equilibrium from exporting to multinational production.

aforementioned models, which only consider two countries, they consider three countries, where two countries engage in the creation of a customs union, whilst the third countries stays outside.[10] This reflects nicely the situation of Sweden in the late 1980s. Furthermore, their model yields some predictions about the concentration contra dispersion of third country, and thus, Swedish firms' activity inside the European Union. Economic integration is modelled in assuming that the trade or export costs are smaller within the union than the export costs that have to be incurred by the third country.[11] Hence, economic integration is modelled via better market accessibility and not via an increase in market size.

Market size and market growth have been shown to be important determinants in the attraction of FDI. Both these variables have frequently and successfully been used in empirical studies testing whether both the formation of the EC and the SEM programme have had significant impacts on the attraction of FDI.[12] These findings are consistent with the predictions of newer theoretical models, where the positive relationship between attraction FDI and absolute country size (Rowthorn, 1992) and relative country size (Markusen & Venables, 1996a,b, 1998) have been demonstrated. Thus, the massive increase in EU directed FDI by third countries seems to be a logical consequence when taking into consideration the 'positive' estimates, and thus expectations, for EU's future growth (Emerson et al., 1988) and growth path (Baldwin, 1989) if the SEM is fully implemented.

However, there is an important tension; Modelling European integration as a market size rather than a market accessibility effect has opposing implications for the geographical distribution of FDI. Motta & Norman (1996) demonstrate that economic integration will induce foreign firms to invest in the customs union in both cases. Importantly though, increased market size favours geographically dispersed FDI, whilst economic integration via better market accessibility is more likely to lead to intra-regional platform FDI. In other words, third country firms will invest inside the customs union and supply the other union members by exporting from the plant located inside the union.

Hence, better market accessibility will not necessarily increase net FDI within the customs union. If the constellation prior to integration is such that intra-regional FDI emerges, it is likely that integration will lead to the rationalisation of FDI via an FDI replacement effect

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10 At present the data set covers observation for the years prior to Sweden being a member of the EU.

11 Only scenarios are considered where the third country supplies the custom union, but not vice versa. This theoretical restriction does not pose any empirical problems, as inward FDI flows into Sweden were negligible until the beginning of the 1990s.

12 For a review whether the formation of the EC had a significant impact on US FDI flows into the EC see UNCTAD (1993). For the impacts of the SEM programme on FDI flows see for example Dunning (1997a,b). Empirical results by Aristotelous & Fountas (1996) also support the Market Enlargement hypothesis.

by third country firms. That is to say that economic integration will lead to centralisation of FDI by third country firms inside the customs union. Furthermore, firms originating from the customs union may be induced to switch from intra-regional FDI to intra-regional exporting. Therefore, Motta & Norman also support the view that, within the EU, intra-EU Foreign Direct Investment would increasingly be displaced by intra-EU trade.[13]

Hypothesis 2a: *Third country MNEs' activities in the EU will tend to be geographically more concentrated, the lower intra-EU trade costs are relative to extra-EU trade costs.*

This model by Motta & Norman accounts for some of the stylised facts, i.e. the rush of third country firms into the EU in the late 1980s. Unfortunately, we will only be able to analyse whether the SEM has affected the concentration of production given that firms produce inside the EU, but not whether the SEM induced Swedish firms to switch from exporting to multinational production.[14]

Furthermore, it is precisely this tension between the market enlargement and the market accessibility hypothesis and their respective implications that is relevant for our study. An empirical study by Svensson (1996) shows, for example, that Swedish MNEs' affiliates in the EU are more export orientated than their affiliates in other parts of the world, and that their exports to third countries have a strong effect of replacing parent exports to third countries. Thus, these affiliates are used as export platforms within the EU.

As mentioned in the introduction, the SEM had a significant impact on FDI flows into the EU. This implies that either formerly exporting firms turned into MNEs, and/or former MNEs increased their level of activity in the integrating region. However, this fact has no implication *per se* with regard to the concentration or dispersion of production within the EU. The firms may increase their production such that the former geographical concentration of their activity is more or less unchanged. Given that the SEM has an additional effect, as implied by the market enlargement and/or market accessibility hypothesis, there will be a change in the geographical concentration of MNEs' activities.

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[13] This is a common result in the theoretical MNE literature, as integration is solely modelled as a reduction of 'iceberg' trade costs. The consequence is that these models predict too much trade relative to FDI as a consequence of integration. A rather nice difference is the approach by Sanna-Randaccio (1996) who derives effects where increased regional integration can lead to increased intra-regional FDI flows. The underlying reason for this result is the argument that different NTBs can have different implications with regard to FDI. Some NTBs may affect the foreign supplier regardless of the chosen supply mode, i.e. both foreign exporters and foreign multinationals, while other NTBs may only affect the exporter, but not the foreign owned, domestically producing multinational, i.e. these NTBs act solely as trade barriers.

[14] This is as the IUI database contains existing multinationals only.

Hypothesis 2b: *If the EU integration process is equivalent to a market size effect, then MNEs' activities within the EU will tend be more dispersed.*

Hypothesis 2c: *If the EU integration process is equivalent to a market accessibility effect, then MNEs' activities within the EU will tend be more concentrated.*

c. Economies of Scale

The starting point when analysing agglomeration forces is the insight into larger countries being able to sustain a higher equilibrium wage rate in imperfectly competitive industries if trade costs are present (e.g. Krugman, 1980; Mathä, 1997). If the production costs were the same in both countries, firms would always want to locate near the larger market, thus minimising transport costs. Both economies of scale and transport costs give rise to the incentive to locate production where the relative demand is highest.

Relaxing the assumption that labour is immobile between countries, as in Krugman (1991), has the effect of the larger country attracting labour inflow, as it pays the relatively higher real wage. As labour responds to the wage differences, the market will be further enlarged. Thus, there exists a tension between the proportion of labour that is mobile between locations and the transport costs that have to be incurred to reach remote customers. As trade costs are reduced beyond a critical level, economic activity will concentrate in one single location.[15] Larger levels of economies of scale have the effect of facilitating the sustainability of the core-periphery pattern. Therefore, the agglomeration forces are larger for industries with large economies of scale.

However, in these models multinationals are excluded by default. As already mentioned earlier in the paper, we are restricted to focus on geographical concentration of production, given that Swedish firms are already engaged in multinational production inside the EU. This is due to the nature of the data. For the predictions of the concentration of multinational production within the EU it will thus be sufficient to review the predictions of 2x2 trade and in-

[15] A different approach emphasises the importance of demand and cost linkages between firms. Thus, agglomeration forces emerge without the necessity to assume the mobility of factors of production (Krugman & Venables, 1995, 1996; Venables, 1995, 1996). Demand and cost linkages emerge due to the introduction of intermediate goods as well as final goods. The intuition of this approach is as follows. Intermediate goods provide a link between upstream and downstream market, as downstream firms consider intermediate goods as a factor of production, while upstream firms consider downstream firms as their final consumers. Driven by market access considerations, downstream firms want to locate where there are relatively many upstream firms, i.e. where supply is relatively high, and vice versa. Together with economies of scale at the firm level, these cost and demand linkages create centripetal forces towards agglomeration. Pulling into opposite direc-

vestment models. For our context, an exporting equilibrium corresponds to a concentrated outcome, whilst a multinational equilibrium corresponds to a dispersed equilibrium.

A rather general result in these models is that the larger plant-specific economies of scale are relative to firm-specific economies of scale and trade costs the more likely it is that exporting is favoured to multinational production (e.g. Brainard, 1993; Markusen & Venables, 1996a,b, 1998). Hence, larger economies of scale on the plant level have the tendency to increase concentration of activity.

Hypothesis 3a: *MNEs operating in industries with large plant-level economies of scale will have more concentrated operations within the EU.*

This tendency will be reinforced if EU integration significantly reduces trade costs between EU member states.

Hypothesis 3b: *European integration will increase the tendency of MNEs with large plant-level economies of scale to concentrate their production.*

However, Markusen & Venables (1996b) and Ekholm & Forslid (1998) demonstrate that allowing multinationals to enter reduces the strength of the agglomeration forces compared to cases where multinationals are exogenously excluded, i.e. as in the model by Krugman (1991). The reason is the general equilibrium constraint that determines relative wages in the two countries. If, for example, two countries only differ in size, then the larger country will have a higher real price of capital in the differentiated product industry. This is assuming that production of the differentiated product is relatively capital intensive. In this case, multinational production has two cost advantages over exporting; saving on transport costs and lower real prices of capital.

Allowing multinationals to enter raises the demand and price for capital in the smaller country. In this sense, multinationals reduce the divergence of factor price differences, which in turn reduces the tendency for agglomeration of activity. Thus, the forces towards agglomeration of activity are weaker than in models the where option of multinational production is excluded. To the contrary, however, capital mobility between countries increases the divergence of the two countries, and thus increases the forces leading towards agglomeration.

d. Vertical Integration

The theoretical trade and investment literature focuses almost exclusively on horizontal MNEs. And indeed stylised facts point towards most FDI being of horizontal nature (e.g.

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tion are the location of immobile factors of production and final consumer demand. The relative strength of

Markusen, 1995). In the Swedish case, however, the relationship of Swedish parents to their EU subsidiaries is predominantly of vertical nature. Overall the share of intermediates in total parent exports to the EU increased from 12% in 1986 to 18% in 1990. For the engineering industries and chemicals the share increased from 12% and 10% in 1986 to 33% and 19% in 1990, respectively, while there was a reduction in the share from 5% to 3% in basic industries. A similar picture emerges for the share of intermediates in parent exports to EU affiliates. This share increased for the engineering industries and chemicals from 50% and 61% in 1986 to 75% and 81% in 1990. Again, the exception is basic industries, for which the share fell from 79% to 65% in the same period (Andersson et al., 1996)

Vertical multinationals are commonly associated with exploiting country differences in relative factor endowments, which is in stark contrast to horizontal multinationals. An early approach by Helpman (1984) and Helpman & Krugman (1985, Ch. 12) allow the geographical separation of headquarters and production of the final product. Multinationals arise so as to exploit differences in factor prices. Multinationals exploit these factor price differences in fragmenting production geographically.[16] Capital intensive headquarter services are located in the capital abundant country, while labour intensive production of the final product is located in the labour abundant country. Allowing multinationals to enter increases the factor price equalisation set, as demand for capital and labour are increased in the capital and labour abundant countries, respectively. However, these models suffer from two limitations; Firstly, firms establish only one manufacturing plant, regardless of being an exporter or a multinational. Secondly, transport costs are not incorporated. Thus, predictions for the effects of economic integration cannot be derived.

The first limitation is overcome by Helpman & Krugman (1985, Ch.13) who separate production into three stages: headquarter services, production of a intermediate product and production of a final product. Headquarter services are assumed to be capital intensive, while production of the intermediate product is assumed to be moderately capital intensive. Production of the final product uses the intermediate product as a production factor, and is assumed to be labour intensive. Firstly, multinationals operate two plants, one in each country. Secondly, not only does intra-firm trade consist of headquarter services as in Helpman (1984) but also of intermediate products.

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these opposing forces depend entirely on these industry characteristics.

[16] Factor prices fail to equalise internationally as the factor intensities are such that from a given endowment point the integrated equilibrium cannot be replicated.

The second limitation has been overcome by Zhang & Markusen (1996) and Markusen, Venables, Konan & Zhang (1996). Both models demonstrate that vertical multinationals tend to emerge if trade barriers are moderate to low and if countries differ significantly with respect to relative factor endowments. In Zhang & Markusen (1996), a large host country size favours multinational production relative to exporting as a smaller fraction of output is shipped back to the home country, thus total trade costs are reduced.

We expect the production of vertical multinationals to be geographically more concentrated than that of horizontal multinationals. This is as vertical multinationals locate production abroad to exploit availability of industry specific skills and technologies, as well as cheap production factors, which are not uniformly distributed within the EU. Thus, efficient production can only take place in some few member states. Furthermore, as vertical multinationals engage in intra-firm trade in intermediates, economies of scale in the transport technology should facilitate the tendency towards concentration of production.

Hypothesis 4a: *Vertically integrated MNEs have more concentrated activities within the EU than horizontally integrated MNEs.*

A few remarks have to be made with regard to the effects of European integration on the geographical concentration of Swedish affiliates. Firstly, as illustrated above, the presence of vertical multinationals is facilitated if trade barriers are low. Thus, European integration is unlikely to achieve a reduction in trade barriers to the extent that the geographical concentration of vertical multinationals is affected. Secondly, in the case of vertical multinationals, we are concerned with the effects of economic integration between Sweden and the EU rather than EU integration *per se*. It was not until the beginning of the 1990s that Sweden attempted to tighten its links with the EU. Thus, up to this point trade barriers between Sweden and the EU remained virtually unchanged. If anything, there was a fear that the EU would turn into a fortress Europe. In 1991, Sweden formally applied for EU membership. The economic relationship between Sweden and the EU changed first in 1993, when the European Economic Area was established, giving EFTA country firms virtually the same access to the internal market as firms from EU member states. Thus, trade barriers between Sweden and the EU started to dismantle in the beginning of the 1990s. Hence, it is unlikely that integration between Sweden and the EU is stark enough to significantly affect trade costs between Sweden and the EU.

The aforementioned theoretical models assume that the final product is either consumed in the country of production or exported back to Sweden. However, as shown by Svensson

(1996), European affiliates export a significant portion of its production to other EU member states. It can thus be argued that if European integration achieves a significant reduction of trade barriers, we should expect an increase in the geographical concentration of affiliate activity. This is as production at less efficient locations is protected by trade barriers within the EU. European integration may reduce trade barriers to such an extent that the benefits from relocation of production more than outweigh the trade costs that need to be incurred after relocation. Therefore, if European integration significantly reduces trade costs, then vertical multinationals are expected to concentrate their activities further.

Hypothesis 4b: *European integration will increase the tendency of vertically integrated MNEs to concentrate their production.*

3. Data

The data is taken from the database at the Research Institute of Industrial Economics in Stockholm. This database contains information about individual Swedish multinationals and their foreign operations in the whole world.[17] We will, however, restrict ourselves to the producing subsidiaries inside the EU. The variables are defined in million SEK and 1990 prices, and are first aggregated to the respective country levels for each EU member state. The resulting variable is further aggregated to the EU level. The analysis covers the years 1970, 1974, 1978, 1986, 1990 and 1994.[18]

As some firms are included only once and others up to six times, we pool the data set over these years. This allows a distinction between pre-integration and integration periods. Interaction variables are used to test for structural effects. A dummy variable that has been assigned the value of 1 for the years 1986, 1990 and 1994 will interact with other variables, such as R&D and production size inside the EU.

The Swedish home market has been excluded for two reasons; Firstly, we focus on Swedish multinational operations within the EU, and secondly Sweden was not a EU member until 1995.

4. Econometric Specification and Hypothesis

The econometric specification of the regressions, and the variables and proxies that are expected to capture the agglomeration and dispersion forces are as follows:

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17 For a complete documentation of the database see Andersson et al. (1996).

18 In 1982, no survey was conducted.

<u>Dependent variable:</u> *NCON*

The extent of concentration of multinational production within the EU is defined as the sum of squared shares of a MNE's output in each member state.

$GEOCON_i = \sum_k (PROD_{ik} / PROD_i)^2$, where $PROD_{ik}$ is firm i's production in member state k. Production in the member state k is defined as:

$PROD_k =$ *EU sales by all subsidiaries in member state k - total imports of final products from Sweden to k.*

Final products are defined as products that are not used in the production process by the subsidiary. Thus, we make an attempt to separate the sales of subsidiaries from their actual production. In doing so, we hope to get a more accurate measure of the 'true' extent of multinational activity. This is especially true as many affiliates comprise both production and sales activities.

The variable *GEOCON* is bound between 1/12 and 1. A logistic transformation of *GEOCON* would remove this bound, but would generate too many missing values, as the data set contains many MNEs operating in one EU member state only. This can be seen from table 1. Thus, we use the number equivalent form of *GEOCON* instead, where $NGEOCON_i = GEOCON^{-1}$. We will use a logarithmic transformation of *NGEOCON* as dependent variable: *NCON= log(NGEOCON).*

As shown in table 1, for more than 50% of all observations *NGEOCON* equals 1. In other words, the majority of Swedish MNEs produce in one country only inside the EU. Such a distribution of the dependent variable *NGEOCON* corresponds to a censoring of the dependent variable. Commonly censoring of the dependent variable refers to a sample where some observations of the dependent variable are not observed, while the independent variables are observed (e.g. Maddala, 1983; Greene, 1993). However, in our sample censoring is not related to the observability of dependent variables, but rather to the fact that values in a certain range are transformed to a single value; the volume of Swedish MNEs' production in EU member states is transformed into a single value if MNEs produce in one member state only.

<u>Table 1: MNEs operating in more than 1 EU country</u>

	All	1970	1974	1978	1986	1990	1994
NO. OBS	446	66	69	78	70	84	79
NO. OBS. NGEOCON>1	215	34	32	36	36	36	41
SHARE OF POS. OBS. IN %	48.2	51.5	46.4	46.2	51.4	42.9	51.9

This poses a problem in so far as estimation of the dependent variable by ordinary least squares (OLS) will result in biased coefficient estimates. This problem can be avoided by formulating a Tobit regression model, which takes the following form:[19]

$y_i^* = \beta' x_i + \mu_i$, where y_i^* is the real observed variable and

$y_i = y_i^*$ if $y_i^* > 0$

$y_i = 0$ if $y_i^* \leq 0$

The consequence of such separation of the dependent variable is that a change in x_i affects both the conditional mean of y_i^* in the positive part of the distribution, and the probability that the observation falls within that part of the distribution (e.g. Greene, 1993).[20]

Explanatory variables

Research & Development: *RD*

The R&D to sales ratio is commonly used to explain the existence of multinationals. It is thought to catch the arguments forwarded by the transaction cost approach. In industries with higher R&D expenditure, competition is more dependent on the exploitation of firm-specific assets. Hence, the higher the R&D to sales ratio, the lower the geographical concentration of multinational production inside the EU is expected to be. This variable is defined as: *RD = The ratio of total R&D expenditure to total sales by the parent company*.

Furthermore, we expect European integration to reduce transaction costs inside the EU, and thus the size of the coefficient of *RD*. To test this, we include an interaction variable called *DRD* to analyse whether there was a structural shift due to the EU integration process. We expect the coefficient of this interaction variable to be negative.

It may be argued that R&D intensity should be regarded as an endogenous rather than exogenous sunk cost. One major difference between exogeneity and engogeneity of sunk costs results from the optimal response of firms as the relevant market size is increased (Sutton, 1991). The EU integration process can be regarded as such an increase in market size if firms start to compete on a European rather than national level. Firms, which operate in industries with a high degree of competition in endogenous sunk costs, may respond in increasing the level of sunk costs to deter entry of other firms, and thus prevent dilution of market concentration and market power.[21]

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19 There is no indication of censoring at the upper limit.

20 The regressions are carried out in LIMDEP 7.0.

21 An empirical application to the industrial structure of the EU in 1987 can be found in Davies & Lyons, 1996.

Nevertheless, even when admitting that R&D expenditures are endogenously determined by the competition process in an industry, R&D intensity is not endogenous to our analysis. Even if EU integration has the effect of MNEs increasing their R&D intensity, the negative relationship between R&D intensity and geographical concentration of production inside the EU should not be affected, unless the EU integration process has reduced intra-EU transaction costs. Thus, R&D is exogenous to our problem.

<u>EU production:</u> *LPROD*

The variable *LPROD* takes account of subsidiaries often being both production sites as well as sales outlets. The variable is defined as:

PROD = *Total EU sales by subsidiaries - total imports of final products from Sweden*
LPROD = *log(PROD)*

There are a few good reasons why *LPROD* is included as exogenous variable. Firstly, as Sweden is a relatively small country, firms become domestically constrained at an early stage. Thus, further expansion has to take place abroad. This argument is consistent with Andersson et al. (1996) who show that Swedish MNEs' internationalisation process between 1970 and 1990 was characterised by expansion through foreign affiliates.[22] This also means, that most of the Swedish MNEs are too small to actually supply the whole EU market with their goods. As we implicitly assume that this is the case, we will have to account and correct for this by including *LPROD* as an exogenous variable.

Secondly, Sweden is also home country to some very large MNEs, which surely adopt regional strategies. Market segmentation prior to the SEM may have constrained Swedish MNEs' growth within single European member states. This argument has also been forwarded by Davies & Lyons (1996) who argue and demonstrate for the EC in 1987 that the size of a MNE favours spatial dispersion of multinational activity, if multinational production as such is motivated by domestic market constraints.

Thirdly, we need to account for the fact that affiliate production by Swedish MNEs in the EU has increased naturally over time, and has been fuelled by the announcement of the internal market programme. Not including *LPROD* would bias the other coefficient estimates as a natural increase in affiliates' production and thus a probable increase in dispersion is not reflected by any other variable. We are, however, not interested in the question whether

[22] The share of home market sales to total sales fell from 41% in 1970 to 23% in 1990. The home country work force shrank from 64% in 1970 to 40% in 1990.

Swedish MNEs increased their production volume in the EU, but whether the SEM had an effect on geographical concentration. Thus, in order to control for different firm sizes, we need to include affiliates' production volume in the EU as an exogenous variable.

Furthermore, we include an interaction variable called *DLPROD* to examine whether there is a structural effect of *LPROD* from 1986 onwards. The variable *DLPROD* is the result of an interaction between *LPROD* and a dummy variable called *DSEM*, which takes the value of zero for the years 1970, 1974 and 1978 and the value of one for the years 1986, 1990 and 1994. The dummy variable *DSEM* is expected to reflect institutional changes brought about by the SEM. A negative significant coefficient would give some support for the FDI rationalisation hypothesis, as the impact of the SEM can be seen to reduce the expected positive relationship between firm size and geographical concentration of production. Contrarily, a positive significant sign would indicate that the SEM strengthened the relationship between size and dispersion. This could be seen as evidence of the market enlargement hypothesis.

<u>Platform FDI</u> *EDBSH*

As a proxy for the extent to which foreign affiliates are used as export platforms, we use *EDBSH*, which is defined as the ratio of affiliate sales to third countries other than Sweden to total affiliate production inside the EU. Hence, the measure gives an aggregate account of the production for non-local purposes. Unfortunately, the data does not allow to distinguish between different export destinations other than to Sweden. It is, however, conceivable, that most of the exports by EU affiliates are destined to other EU member states. Thus, this limitation in the data is not expected to bias the econometric results.

We will use the interaction variable *DEDBSH* to test whether European integration has had an effect on the relationship between export intensity of affiliates and their agglomeration of activity.

<u>Firm level economies of scale</u> *KL*

The effect of economies of scale at the firm level are captured in using a measure for the capital-labour ratio. The intuition is that more capital intensive firms have higher economies of scale. Capital expenditure can also be regarded as a necessary sunk cost, that has to be borne when setting up another plant. Thus, the larger these initial capital costs are, the larger the potential economies of scale that can be reaped. We expect that this measure is positively related to the concentration of production inside the EU. It is defined as:

KL = *The ratio of KAP to LAB*,

where *KAP* = *The book value of real estate, machinery, etc. in EU subsidiaries*, and *LAB* = *The total number of employees in EU subsidiaries.*

European integration is expected to strengthen the relationship between economies of scale and the concentration of production. We include interaction variable *DKL* to test for this effect.

Industry level economies of scale *LG*

This industry measure of economies of scale is taken from Swedish industry statistics at the 3 and 4 digit level of the ISIC classification. The years in question are 1970, 1975, 1978, 1987, 1990, and 1993, which broadly correspond to the observations for the Swedish MNEs.

The measure *G* is calculated by first summing up the number of employees and number of establishments over the different firm size classes, starting with the upper end of the firm size distribution. The summation is ended when one half of total industry employment is reached. The total number of employees is then divided by the total number of establishments for these firm size classes. In this sense we attempt to ensure that the plants included are operating at or above the Minimum Efficient Scale of production. The final measure is a logarithmic transformation of *G*.

Again, we expect that this measure is positively related to concentration of production inside the EU. The interaction variable *DLG* is used to test for an integration effect. It is expected that European integration strengthens the relationship between economies of scale and concentration.

Vertical forward integration: *VF*

According to Hypothesis 4, we expect that Swedish MNEs' operations in the EU will be more concentrated for MNEs being characterised by a high degree of vertical integration. The variable that is thought to capture the degree of vertical forward integration, *VF,* is defined as:

VF = *The ratio of total imports from Sweden that are used for further processing by the subsidiary to total production of EU subsidiaries.*

Alternatively, this variable may also be seen to correspond to extra-union transport costs in the Motta & Norman (1996) model. According to their analysis, higher extra-EU trade costs relative to intra-EU trade costs will result in multinationals being relatively concentrated in their activities. Thus, these MNEs will have the tendency to use their EU affiliates as export platforms to other EU countries. This discussion should be borne in mind when interpreting this variable in the regressions. We include an interaction variable called *DVF*, which is used to test whether European integration strengthens the relationship between vertical integration and geographical concentration of MNEs.

Trade Costs: *TREMB*

The trade costs are taken from Swedish industry statistics. The years and the level of aggregation correspond to the years for industry level economies of scale measure *LG*. *TREMB* reflects the size of industry transport costs and is expressed as a percentage share in total sales. There is, however, no distance component to this measure.[23]

We expect that this measure is positively related to the concentration of production inside the EU. The reason is outlined in the Motta & Norman (1996) model where the ratio of the intra-EU transport costs to external transport costs is the driving force for platform FDI by third country firms. Again, we use an interaction called *DTREMB* to test for a structural effect after 1986. Though, as mentioned earlier, it was not until the beginning of the 1990s that economic integration between Sweden and the EU started to progress, which is in contrast to EU integration. It is thus unlikely that *DTREMB* will be significant. Furthermore, it is not clear whether to expect a positive or negative coefficient, as the sign of the coefficient depends on how fast economic integration between Sweden and the EU progressed relative to EU integration.

Fixed Effects of EU integration: *DUM70, DUM74, DUM78, DUM86, DUM90, DUM94*

We regard the observations in the 1970s as the pre-integration period, and the observations for the years 1986, 1990, and 1994 as integration period.

We do not have any prior expectation regarding the sign of these dummy variables. Positive and significant coefficients for the year 1986, 1990 and 1994 would lend support to the market enlargement hypothesis, while a negative coefficient would be interpreted as an improvement in market accessibility.

Thus, the general econometric specification of the model can be summarised as follows:

NCON= f(RD LPROD EDBSH VF KL LG TREMB DRD DLPROD

(+) (+) (-) (-) (-) (-) (-) (-) (?)

DEDBSH DVF DKL DLG DTREMB DUM70-78 DUM86-94)

(?) (-) (-) (-) (?) (?) (?)

5. Empirical Results

a. Descriptive Statistics

A rough indication of the changes that occurred from 1970 onwards is given in table 2 and 3 below.[24] Throughout the time period Swedish MNEs increased their presence in the EU. The yearly increase in the average production volume was 4.21%, 6.88% and 5.69% for the years 1970-78, 1978-86, and 1986-94, respectively. To the contrary, there is no clear trend for the median of production volume in the EU.

Table 2: Mean of some key variables

Mean	All	1970	1974	1978	1986	1990	1994
NO. OBS	446	66	69	78	70	84	79
NGEOCON	1.738	1.751	1.672	1.667	1.800	1.748	1.793
PROD in m. SEK	1355.29	642.63	710.24	893.51	1521.25	1782.33	2368.92
EDBSH in %	33.84	28.15	35.76	33.12	37.37	30.64	37.89
VF in %	10.14	12.35	11.33	11.15	9.07	8.33	9.13
KL in %	21.74	16.37	15.43	15.66	19.39	24.49	36.90
RD in %	1.94	1.77	1.66	1.83	2.57	1.82	2.01

Both the mean and the median of *EDBSH*, our measure for the extent to which affiliates are used as export platforms, suggest that exports to EU member states account for an increasing share of total affiliate production.

Average geographical concentration has changed little over the years. To measure geographical concentration we use the number equivalent to the Herfindahl index, which has an intuitive interpretation; a geographical concentration of 1.74 is as *if* a MNE is producing equally as much in 1.74 countries. Notable is that, on average, Swedish MNEs' production in the EU is less geographically concentrated after 1986. The number equivalent to the Herfindahl index, *NGEOCON*, is larger than the average of the total sample for 1986, 1990, and 1994. Here the median reveals some interesting insights. For the total sample and some subperiods the median of *NGEOCON* equals 1.00. In other words, at least 50% of all MNEs in our sample have manufacturing plants in one EU country only.

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[23] Trade cost differences to individual members of the EU do not need to be included, as we treat the EU as a single regional block.

[24] Note that the MNEs included in the sample are different for different years. All interpretations refer to the sample.

Furthermore, Swedish MNEs seem to become more and more horizontally integrated over time. Both the mean and median of *VF* has shrunk between 1970 and 1994. For the last observation in 1994, the median is actually zero. This indicates that over 50% of Swedish parents did not export any intermediate products to the EU affiliates, which are then used as an input in the downstream production process.[25] This is not surprising, as the internationalisation process of Swedish MNEs in Europe is driven more and more by acquisitions rather than greenfield investments. Acquired affiliates are in turn less dependent on the parent company than affiliates that were established as greenfield investments (Andersson et al., 1996).

Another general observation is that the average capital-labour ratio has increased throughout the years. This indicates that Swedish MNEs' production in the EU has become more and more capital intensive in the last decades. On the contrary, Research & Development intensity has been very stable between 1970 and 1994.

Table 2: Median of various variables

Median	All	1970	1974	1978	1986	1990	1994
NO. OBS	446	66	69	78	70	84	79
NGEOCON	1.000	1.150	1.000	1.000	1.078	1.000	1.153
PROD in m. SEK	138.37	137.22	139.41	133.40	142.57	133.30	157.80
EDBSH in %	24.72	15.27	25.74	26.18	30.48	21.36	29.95
VF in %	1.78	5.05	4.67	3.81	1.82	0.03	0.00
KL in %	14.79	12.07	11.83	12.76	13.36	18.53	25.60
RD in %	1.08	1.04	0.96	1.10	1.10	1.11	1.11

c. Econometric Results

All results are shown in table 4 in the appendix. In the regression (i), which includes the whole sample without the inclusion of interaction variables, results demonstrate that the variables identified in the theoretical literature indeed exert agglomeration and dispersion forces. Both economies of scale at the industry and firm level exert a positive influence on the concentration of production. Both coefficients are significant at the 5% level. Similarly, the coefficient of vertical integration is significant at the 1% level. The coefficient of R&D intensity is positively significant at the 5% level, suggesting that the presence of transaction costs causes spatially dispersed production. The results suggest further, that high industry transport costs have the tendency to increase agglomeration of production inside the EU. This coefficient is significant at the 5% level. In other words, the higher Swedish industry transport costs

[25] This is not a seeming contradiction to the stylised facts presented in section 2d. It has to be borne in mind that the statistics presented on page 10 are weighted averages.

are, the more likely it is that Swedish firms use foreign production as an export platform to third countries.

Moreover, the coefficient of *EDBSH* is negatively significant at the 1% level. This nicely confirms our prediction that, the more export intensive EU affiliates are on aggregate, the more agglomerated their activities are inside the EU.

The volume of EU production, and thus implicitly the size of MNEs, is an overwhelmingly important determinant for the concentration of activities inside the EU. The coefficient of *LPROD* is positive and significant at the 1% level. Thus, the operations of larger MNEs inside the EU are significantly less concentrated. In a sense this result also reflects the huge disparity between the smallest and the largest MNEs included in the sample.[26] The dummy variables for the different years are all insignificant. Thus, the SEM did not appear to have any aggregate fixed effect on geographical concentration of production.

However, if EU integration affects the relative strength of the agglomeration and dispersion forces, then this may be captured either by inclusion of interaction variables or by separate estimations of the two sub-periods 1970-1978 and 1986-94. We will do both. Firstly, we shall discuss the effects of sample separation.

The results for the period 1970-1978, as indicated by regression (ii) in the appendix, show that the size and the R&D intensity of Swedish MNEs were the prime determinants for geographical dispersion of their production within the EU. The coefficient of LPROD is positively significant at the 1% level. Similarly, R&D intensity exerts a significant positive force towards dispersion prior to EU integration. The coefficient *RD* is significant at the 1% level.

The coefficients for the export intensity of EU affiliates and vertical integration between parent and affiliate are negatively significant at the 1% and 10% level, respectively, while economies of scale, neither at firm level, nor at the industry level seem to be significant forces towards more concentration prior to EU integration. Furthermore, industry trade costs exert a positive significant influence on agglomeration of Swedish affiliates in the EU. The coefficient of *TREMB* is negatively significant at the 1% level.

The results for the period 1986-94, as shown by regression (iii), suggest that the European integration process has affected the relative strength of the dispersion and agglomeration forces. These results are not unexpected, as Europe consisted of nationally segmented markets prior to 1986. In the integration period economies of scale both at the firm and industry level

[26] The smallest MNE employs less than 10 people while the largest employs nearly 40000 people in their EU affiliates.

contribute significantly to Swedish MNEs' geographical concentration. This is in contrast to the pre-integration period.

The coefficient of R&D intensity is not significant, while the size of the MNE exerts pressure towards more dispersion of production. Economies of scale at the firm and industry level and vertical integration exert significant forces towards more concentration. These coefficients are significant at the 10%, 1% and 5% level, respectively. Furthermore, the coefficients for the export intensity of EU affiliates and the size of the transport costs are both negatively significant at the 1% level.

There is an alternative, and probably equally intuitive, explanation of why the coefficient of economies of scale is a significant determinant in the integration period, but not in the pre-integration period. From the middle of the 1980s onwards, Sweden started to liberalise its financial markets. In 1986, the external financing requirement was abolished (OECD, 1996). Prior to these changes, firms wishing to invest abroad had to seek permission of the Bank of Sweden. Thus, after 1986 Swedish capital was allowed to move freely. According to the predictions by Markusen & Venables (1996b) and Markusen, Venables, Konan & Zhang (1996), capital mobility between countries is expected to increase the tendency for agglomeration of activity, while capital immobility is expected to weaken this tendency.

An alternative way to separate the sample into a pre integration and an integration period is to include interaction variables. A dummy variable assigns a value of one to the observations for the years 1986, 1990 and 1994, which interacts with *LPROD*, *EDBSH*, *KL*, *VF*, *RD*, *LG* and *TREMB*. The results are indicated by the specification (iv). Both the coefficients of *LPROD* and *EDBSH* are still significant at the 1% level. The coefficient of *DLPROD* is negative, albeit insignificant, while the coefficient of *DEDBSH* is positive, but insignificant. In both cases negative significant coefficients would have lent some support to the market accessibility hypothesis. This is as firms with a given size would have been expected to be relatively more dispersed prior to EU integration. Similarly, a stronger relationship between affiliates' export intensity and the agglomeration of their activities would have been consistent with the market accessibility hypothesis.

Furthermore, there is no sign of a structural effect when letting *KL*, *VF*, and *TREMB* interact with our dummy variable for the SEM programme. This suggests that European integration has failed to reduce trade costs to the extent that the geographical concentration of production would be affected. Only the interaction variable for *DLG* is marginally significant at the 12% level, indicating that multinationals operating in industries with large plant-level economies of scale may concentrate their operations inside the EU as a response to the Single European Market programme. Bearing in mind, though, that the tendency for agglomeration is predicted to be smaller in industries in which multinationals are present, these weak results do not come as a big surprise.

There is, however, a significant structural break for *RD*, when including *DRD*. The coefficient of *RD* is significant positive at the 1% level, while the coefficient of *DRD* is negatively significant at the 5% level. Thus, the results suggest that the European integration process has significantly reduced intra-EU transaction costs. Reasons may include the harmonisation of national laws and regulatory standards. Moreover, European integration may have increased the enforceability of contracts. In return, these institutional changes have reduced the need of MNEs to produce locally to fully appropriate the return of their assets.

Finally, there is a significant positive fixed effect for the years 1986, 1990, and 1994. This indicates that Swedish MNEs have a tendency to have more dispersed production inside the EU after 1986. This behaviour of MNEs is consistent with the predictions of the market enlargement hypothesis. This suggests that the creation of the Single European Market has indeed the effect of replacing nationally segmented markets with one large, unified European market, which is the relevant market in terms of competition between firms.

6. Concluding Remarks

In this paper we test empirically as to whether the concentration of MNEs' activity inside the EU is characterised by agglomeration and dispersion forces, and to what extent the European integration process has affected the relative strength of these forces. Firstly, we find empirical support for the presence of agglomeration and dispersion forces. Forces leading to more concentration of activity are economies of scale and vertical integration between parent and subsidiary. Similarly, the forces working in the opposite direction are R&D intensity and the size of the MNE.

Moreover, EU integration has affected the relative strength of these forces. Prior to EU integration, geographical concentration of multinationals' activities was determined by both dispersion and agglomeration forces. One of the main reasons for this result may be that, due to segmentation of markets, competition between firms was confined to national markets only. European integration changed this picture significantly. During the integration period, agglomeration forces have become more important than dispersion forces in explaining the geographical concentration of Swedish multinationals' production inside the EU.

The results suggest in particular that the SEM programme has significantly reduced intra-EU transaction costs. Prior to the SEM programme, high R&D intensities corresponded to large dispersion of EU production. In contrast, there is no evidence that the SEM has reduced trade barriers to such an extent that the geographical concentration of production is affected. This may not be surprising as the tendency towards more agglomeration is reduced in industries where multinationals play a significant role.

Rather to the contrary, there is some evidence of a fixed effect towards more dispersion of Swedish MNEs' activities inside the EU after 1986. This is consistent with the predictions of the market enlargement hypothesis. Taken together, these two results may shed some light onto the issue as to whether European integration is likely to lead to more specialisation of countries in the long-run.

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Table 4: TOBIT Estimates

TOBIT Estimates	Whole sample without interaction variables (i)	Sample for year 1970-1978 (ii)	Sample for year 1986-1994 (iii)	Whole sample with interaction variables (iv)
Dep. Var.	NCON	NCON	NCON	NCON
No. of obs.	446	213	233	446
Log likelihood function	-289.9	-125.9	-155.5	-283.1
Threshold values	Lower=0, Upper=+Infinity	Lower=0, Upper=+Infinity	Lower=0, Upper=+Infinity	Lower=0, Upper=+Infinity

Variable	Coeff.	Std.err	t-stat	Prob.	Sign.	Coeff.	Std.err	t-stat.	Prob.	Sign.	Coeff.	t-stat.	Std.Er	Prob.	Sign.	Coeff.	Std.err	t-stat.	Prob.	Sign.
Constant	-0.579	0.245	-2.369	0.018	**	-1.048	0.352	-2.975	0.003	***	-0.004	0.361	-0.011	0.991		-1.156	0.394	-2.938	0.003	***
LPROD	0.325	0.022	14.554	0.000	***	0.320	0.031	10.237	0.000	***	0.329	0.031	10.738	0.000	***	0.334	0.034	9.746	0.000	***
EDBSH	-0.653	0.147	-4.440	0.000	***	-0.643	0.212	-3.038	0.002	***	-0.701	0.217	-3.227	0.001	***	-0.718	0.230	-3.122	0.002	***
VF	-1.165	0.387	-3.012	0.003	***	-1.081	0.571	-1.891	0.059	*	-1.120	0.522	-2.147	0.032	**	-0.975	0.542	-1.798	0.072	*
KL	-0.331	0.157	-2.117	0.034	**	-0.117	0.292	-0.400	0.689		-0.331	0.194	-1.704	0.088	*	-0.059	0.329	-0.179	0.858	
RD	2.746	1.142	2.405	0.016	**	6.645	1.693	3.926	0.000	***	1.166	1.766	0.660	0.509		6.691	2.007	3.333	0.001	***
TREMB	-0.070	0.020	-3.515	0.000	***	-0.073	0.025	-2.986	0.003	***	-0.076	0.033	-2.277	0.023	**	-0.071	0.029	-2.486	0.013	**
LG	-0.088	0.044	-2.018	0.044	**	-0.021	0.058	-0.369	0.712		-0.178	0.069	-2.589	0.010	***	-0.024	0.066	-0.355	0.722	
PERIOD74	-0.029	0.126	-0.229	0.819		-0.044	0.112	-0.395	0.693							-0.037	0.127	-0.293	0.770	
PERIOD78	-0.064	0.123	-0.523	0.601		-0.056	0.108	-0.521	0.602							-0.049	0.123	-0.396	0.692	
PERIOD86	0.019	0.122	0.153	0.879												1.127	0.505	2.231	0.026	**
PERIOD90	-0.104	0.110	-0.950	0.342							-0.169	0.120	-1.410	0.159		0.971	0.488	1.990	0.047	**
PERIOD94	0.001	0.118	0.008	0.994							-0.062	0.125	-0.493	0.622		1.067	0.490	2.175	0.030	**
DLPROD																-0.013	0.042	-0.305	0.761	
DEDBSH																0.083	0.294	0.281	0.779	
DVF																-0.227	0.653	-0.347	0.729	
DKL																-0.261	0.377	-0.693	0.488	
DRD																-5.467	2.530	-2.161	0.031	**
DTREMB																-0.004	0.041	-0.099	0.921	
DLG																-0.141	0.090	-1.573	0.116	(*)
LPRODhet	-0.080	0.032	-2.457	0.014	**	-0.080	0.067	-1.202	0.229		-0.121	0.045	-2.690	0.007	***	-0.103	0.034	-3.050	0.002	***
VFhet	0.919	0.445	2.067	0.039	**	1.226	0.662	1.853	0.064	*	0.464	0.559	0.831	0.406		0.774	0.422	1.836	0.066	*
Sigma	0.856	0.187	4.580	0.000	***	0.749	0.298	2.517	0.012	**	1.191	0.384	3.102	0.002	***	0.975	0.224	4.353	0.000	***

*, **, *** denote significance at the 10%, 5%, and 1% level, respectively. Estimates for LPRODhet and VFhet 23 are for heteroskedastic term.