# The relation between domestic and foreign investment revisited
## Does the impact of foreign direct investment differ across industries?

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**Abstract**

Recent analysis of the relationship between domestic and foreign direct investment have found strong sector specific effects. It has been shown that a complementary relationship prevailed in more basic oriented industries, contrasting the pattern of a substitutionary relationship between domestic investment and foreign investment in more R&D-intensive industries. This reflects differences in the ways of organizing industrial production in different industries, and in fixed costs in equipment, machinery and plants. These differences across industries also influence how swift firms can react to exogenous shocks, such as the creation of the European internal market. In this paper we examine whether these industry-specific differences remains as we extend the period of analysis to comprise the latter part of the 1990s. The results confirm a difference between the two sectors, albeit considerably weaker. This indicates that the development in the 1980s and beginning of the 1990s partly can be explained by strategic and "portfolio" reasons.

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## 1. Introduction

In recent analyses of the effect of regional integration on the relationship between foreign and home country investment, it was shown how the effect differs across industries (Braunerhjelm and Oxelheim 1999; 2000).[4] The results also provided an answer to the inconclusive results found in previous studies, where sector-, or industry-specific, effects have been neglected (Herring and Willett 1973, Noorzoy 1980, Stevens and Lipsey 1992, Belderbos 1992). The major part of these studies also suffered from the weakness of being based on a subset of industries or firms. In a more comprehensive analysis, and more comparable to the current study since it was based on total flows of domestic and foreign investment in the US, Feldstein (1994) comes to the conclusion that a one to one dollar relation exists between foreign and domestic investment. In other words, a full substitutionary effect is found.

To our knowledge, except for the referred studies by Braunerhjelm and Oxelheim, there has been no analysis of home country effects of FDI where industry-specific characteristics have explicitly been taken into account. The previous results obtained by Braunerhjelm and Oxelheim will serve as our departure point in the current study. Hence, we hypothesize that a substitutionary relationship prevails between foreign and home country investment in R&D-intensive industries, which we henceforth denote the Schumpeter industry. Likewise, we expect a complementary investment pattern to prevail for industries originating in traditional comparative advantage factors, i.e. the Heckscher-Ohlin industry.

We will use iterative seemingly unrelated regression techniques to analyze the impact of foreign direct investment on domestic investment for the period 1982 to 1999, implementing a data-set cross-tabulated by sectors and countries for Sweden. For Swedish firms, as for other countries firms' that were outsiders to the deepening of the European integration that took off in the late 1980s, the formation of the internal market and the uncertainty about future accession, created a novel situation for these firms which is likely to have influenced their investment strategies. In addition, we would expect the reactions to differ between industries

[4] Previous studies on FDI have focused on the relation between exports and FDI (Swedenborg, 1979; Blomström, Lipsey and Kulchycky, 1988; Kravis and Lipsey, 1988, Pfaffermayr 1996), suggesting a significant and positive relationship. The empirical evidence of a complementary relationship is also supported by theoretical arguments, particularly in the "new" trade theory (Helpman 1984; Helpman & Krugman, 1985 and 1989; Grossman & Helpman 1991; Brainard, 1993), suggesting that FDI and exports increase simultaneously. More recent findings, theoretically as well as empirically, give a more ambiguous picture of the relationship between FDI and exports (Markusen et al. 1996; Svensson 1996; Braunerhjelm,1996). See also Bergsten, et. al. 1978, who claim that the relationship may change over time.

because of their different ways of organizing production, differences as regards fixed and sunk costs, etc. As illustrated in Figure 1, foreign direct investment (FDI) to the European Union has grown at a more rapid pace than FDI to the U.S. Furthermore, FDI is predominantly undertaken by firms in the more R&D-intensive Schumpeter industries, indicating strong sector-specific features in the pattern of investment (Figure 2). Thus, to understand the relationship between FDI and home country investment, it is decisive that the analysis is disaggregated to the industry level.

The rest of the paper is organized as follows. The theoretical rationale for engaging in foreign operations is briefly presented in Section 2. Thereafter Section 3 provides the definitions of the industries, the data set, the econometric specification and the empirical results. The main conclusions are summarized in Section 4.

## 2. The Model

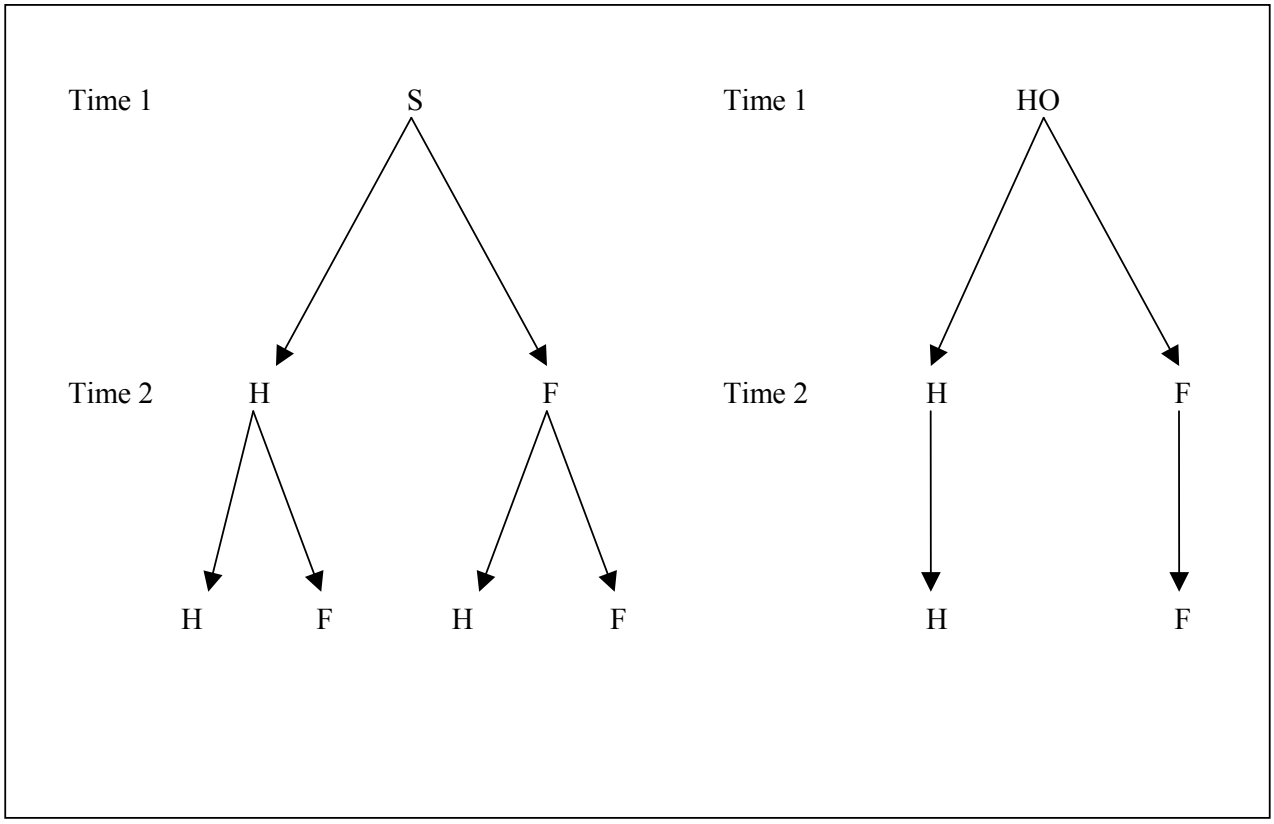
Consider a world that consists of two equally sized countries named home (H) and foreign (F), each hosting a Schumpeterian (S) and a Heckscher-Ohlin (HO) industry. Competitiveness of firms belonging to the former industry is based in R&D-activities, while the latter derives its strength from traditional comparative advantages. In each industry firms operate on markets characterized by imperfect competition, i.e. they are exposed to increasing returns to scale, and firms compete by offering differentiated product variants of either Heckscher-Ohlin or Schumpeter goods.

As always, firms in two industries have features of being both horizontally and vertically integrated.[5] However, the degree of vertical integration is most pronounced in the Heckscher-Ohlin industry, where raw material is extracted and processed in the lower end of the value-added chain and used as input in production of the final goods. In the Schumpeter industry, vertical integration mainly takes the form of transferring headquarter services to identical production units. Thus, firms in the Schumpeter industry is primarily horizontally integrated, where one firm produces identical goods in all its units.

Firms in both industries supply both the home market and the foreign market, either through exports or foreign direct investment (FDI). If the firms chose to invest abroad, monitoring cost (m) of production will be positive, while home country production implies no such costs. On the other hand, exports are always subject to trade costs (t), supposed to be

composed by transportation costs and trade barriers. Even if pure trade costs is zero, transportation costs will always exceed zero.[6]

Assume that a representative firm i in the respective industry stands afore an investment decision. Economies of scale have already been fully exploited in the existing production units. Hence, the firms have to decide whether to erect a new plant in the home country and export goods, or, alternatively, to set up a new plant abroad. The decision problem can be scheduled as follows:




Commencing with the Heckscher-Ohlin industry, production is characterized by being separable into two stages, where the upstream stage (intermediates) is intensively using a production factor in which the home country has a comparative advantage. Hence, production associated with that particular stage is tied to the home country, whereas production of the

[5] See Braunerhjelm (1998) for a description and analysis of vertically and horizontally organized Swedish industries.

[6] Trade costs can however be expected to differ across industries and products. The more intangible goods are, the lower the trade costs. Consequently, head-quarter services in the Schumpeterian industry can be exchanged internationally without inferring any trade costs, whereas intermediates used in the Heckscher-Ohlin industry is always exposed to trade costs. Bulky products and inputs originating lower down in the value-added chain implies higher trade cost. These differences across industries and products will influence the location decision – i.e. whether investment will take place in the home country or abroad.

final good may take place either in the home country or abroad. However, an increase in the final stage production by necessity implies an increase in production in the home country intermediate stage (see appendix).

The profit maximization problem for a representative firm in the Heckscher-Ohlin industry (HO) can be described in the following way. First, consider production in the final stage, [7]

$$\pi_{HO} = q_{HO}(p_{HO} - t\lambda) - q_{HO}c_{HO} - m\lambda q_{HO} - F_{HO} \tag{1}$$

$$0 < \lambda < 1$$

where p equals the unit price of a Heckscher-Ohlin variant, t is the trade costs associated with exporting the final goods and λ represents the share of production that take place in the home country. Costs consist of unit variable production costs c, together with monitoring costs (m) if the firm has production in both countries. A lower degree of internationalization, that is, inexperience in multinational production, is indicated by a large λ and assumed to increase monitoring costs.[8] Finally, the firm also incurs fixed cost (F). The first order condition is then,

$$\frac{\partial \pi}{\partial q_{HO}} = p_{HO} - t\lambda - c_{HO} - m\lambda = 0 \tag{2}$$

$$p_{HO} = c_{HO} + m\lambda + t\lambda \tag{3}$$

In the upstream production stage, where production of intermediates takes place, the corresponding profit maximizing expression is

$$\pi_{IP} = q_{IP}(p_{IP} - \tau\xi) - q_{IP}c_{IP} - m\lambda q_{IP} - F_{IP} \tag{4}$$

$$0 < \tau < 1, \quad 0 < \xi < 1$$

[7] We drop the country indices, since **??? ???** are exactly the same in the two countries.
[8] λ can alternatively be interpreted as distance, or knowledge, about foreign markets. The larger λ, the larger is the costs to supply foreign markets.

where τ denotes trade costs associated with exporting intermediates and ξ symbolizes the share of intermediates that are exported for the ith firms producing intermediate goods (IP). Hence, first order condition equals,

$$\frac{\partial \pi_{IP}}{\partial q_{IP}} = p_{IP} - \tau\xi - c_{IP} - m\lambda = 0 \tag{5}$$

$$p_{IP} = c_{IP} + \tau\xi + m\lambda \tag{6}$$

Even though this stage of production is tied to the home country, monitoring costs may appear at the firm level since exports of the intermediate means a multinational production structure, and, consequently, positive monitoring costs.

If the firm chose to invest in a new plant in the home country, profit maximization then yields, then from expression (3)

$$p_{HO} = 1 + \lambda t \tag{7}$$

assuming that costs are set to unity. If the firm decide to engage in foreign production, then profit maximization implies

$$p_{IP} = 1 + \tau\xi + m\lambda \tag{8}$$

Profit maximization across the potential locations applies when marginal profit of increased investment in production capacity at home, equals profits of an increase in production capacity abroad. Hence, equalizing these two expressions yields

$$\lambda t = \tau\xi + m\lambda \tag{9}$$

or

$$\lambda(t - m) = \tau\xi \tag{10}$$

The choice of strategy will then be determined by the relation between costs associated with foreign production and costs of exports. More precisely,

$$\left.\begin{array}{l}\lambda(t-m)=\tau\xi, \text{ the firm is indifferent about production site}\\ \lambda(\text{t - m})>\tau\xi, \text{ the firm will choose an FDI - strategy}\\ \lambda(\text{t - m})<\tau\xi, \text{ the firm will choose an export stratgy}\end{array}\right\} \quad (11)$$

Hence, if the costs of exporting the final good, minus the increased costs of monitoring a multi-national production structure, exceeds the costs of exporting the home country intermediates to a foreign production unit, then the firm will invest in abroad to expand production of the final good. Investment in the home country will be limited to production of intermediates (see appendix). If the relative costs of FDI and exports go the other way, then the firm will chose an export strategy and investments will increase in both stages in the home country. Finally, if costs are identical for these two alternatives, the firm will be indifferent whether to export or set up a foreign unit.

Now consider the horizontally integrated firms in the Schumpeter (S) industry. Similarly to the Heckscher-Ohlin firms they can either choose an FDI or an export strategy. However, in the Schumpeter industry there is no link between the different stages in production. Hence, the decision where to expand production capacity depends on the relation between trade cost (t) and monitoring costs (m), given identical production technologies in the respective country. Profit ($\pi$) maximization of a representative firm in the Schumpeter industry (S) can be described as,

$$\pi_S = q_S(p_S - t\lambda) - q_S c_S - m\lambda q_S - F_S \quad (12)$$

$$0 < \lambda < 1$$

where p equals the unit price, c is variable costs and F is fixed cost. Differentiating with respect to q yields the first order conditions,

$$\frac{\partial \pi_S}{\partial q_S} = p_S - t\lambda - c_S - m\lambda = 0 \quad (13)$$

Hence, an export strategy implies that the following condition has to be satisfied,

$$p_S - t\lambda = 1 \tag{14}$$

and the alternative FDI-strategy,

$$p_S - m\lambda = 1 \tag{15}$$

Just as in the Heckscher-Ohlin industry, comparing the increase in profits of retaining production at home with profits generated by undertaking FDI, clearly demonstrate that the relation between t and m will determine which strategy the firm chooses. Thus,

$$\left.\begin{array}{l} t = m, \text{ the firm is indifferent about production site} \\ t > m, \text{ the firm will choose an FDI - strategy} \\ t < m, \text{ the firm will choose an export stratgy} \end{array}\right\} \tag{16}$$

The simple model outlined above generates the following hypotheses as regards the relation between FDI and home country investment in the respective industry:

First, when FDI takes place in the Heckscher-Ohlin industry, it is likely to have a complementary and positive impact on home country investments due to its vertical production structure where one stage is tied to the home country. In addition, we expect a lower degree of foreign production for the Heckscher-Ohlin industry, since λ tend to be large in this industry and monitoring costs high.

Second, the Schumpeter industry, displaying more of a horizontal structure, can be expected to choose one possible investment location at the expense of alternative investment locations. Therefore, a substitutionary relationship between FDI and home country investment is expected in the Schumpeter industry. In addition, since λ tends to be lower in the Schumpeter industry, as is the dependence on trade in tangible intermediates, we expect a higher degree of foreign investment and production in the Schumpeter industry.

## 3. Empirical model, data and empirical results

The Swedish manufacturing sector has been classified into three types of industries denoted Heckscher–Ohlin (HO), Schumpeter (SCH) and Other, based on the respective industry's R&D intensity (Table 1). The Heckscher–Ohlin industries comprise ISIC 32 (textile, wearing apparel and leather), 33 (wood and wood products), 34 (paper and pulp), and 37 (basic metal industries), while the Schumpeter industries comprise ISIC 35 (chemicals) and 38 (fabricated metal products, machinery and equipment). The two sub industries ISIC 31 (food, beverage and tobacco) and ISIC 36 (non-metallic mineral products) constitute Other industries, since these industries are characterized more by differences then similarities to the two other industries. In particular, they have a history of heavy protection that justifies a separate classification. Further specification in the composition of these aggregates is hindered by the lack of data.

*Econometric model*

An exogenous chock, such as an integration process in Europe, can be expected to affect the three industries in a similar manner, implying that there is reason to believe that the residuals are correlated between the industries. We will therefore implement Zellner´s iterated seemingly unrelated regression technique in the estimations. Because we do not know the exact nature of the relationship between the foreign direct investment and the domestic investment, and theory give little guidance, we will use three different variable specifications.[9] The first specification is simply expressed in absolute (real) levels, while the second equation captures the change between two consecutive years. Finally, we also run regression on the percentage change in the variables between two consecutive years. More precisely, the estimated regressions are as follows:

[9] The trade-based theory suggests a complementary relationship (Helpman 1984; Helpman & Krugman, 1985 and 1989; Grossman & Helpman 1991; Brainard, 1993). See also Bergsten, et al 1978, who claim that the relationship may change over time.

$$GDI_{i,t} = \alpha_{0,i} + \alpha_{1,i} FDIEU_{i,t} + \alpha_{2,i} FDIRW_{i,t} + \alpha_{3,i} EXP_{i,t-1} + \alpha_{4,i} REXR_t + \alpha_{5,i} D + u_{i,t} \qquad (17)$$

$$GDI_{i,t} - GDI_{i,t-1} = \beta_{0,i} + \beta_{1,i}\left(FDIEU_{i,t} - FDIEU_{i,t-1}\right) + \beta_{2,i}\left(FDIRW_{i,t} - FDIRW_{i,t-1}\right) + \beta_{3,i}\left(EXP_{i,t-1} - EXP_{i,t-2}\right) + \beta_{4,i} REXR_t + \beta_{5,i} D' + v_{i,t} \qquad (18)$$

$$\frac{GDI_{i,t} - GDI_{i,t-1}}{GDI_{i,t-1}} = \gamma_{0,i} + \gamma_{1,i} \frac{FDIEU_{i,t} - FDIEU_{i,t-1}}{FDIEU_{i,t-1}} + \gamma_{2,i} \frac{FDIRW_{i,t} - FDIRW_{i,t-1}}{FDIRW_{i,t-1}} + \gamma_{3,i} \frac{EXP_{i,t-1} - EXP_{i,t-2}}{EXP_{i,t-2}} + \gamma_{4,i} REXR_t + \gamma_{5,i} D'' + w_{i,t} \qquad (19)$$

The dependent variable, GDI, is gross domestic investment in Sweden. Among the explanatory variables, FDIEU represents foreign direct investment made by Swedish firms into the EU, whereas the FDIRW is the foreign direct investment made by Swedish firms to the rest of the world and EXP the total export by Swedish firms. Finally, REXR the percentage change in Sweden's real effective exchange rate index. The indexes *i* and *t* denote type of industry and time (year), respectively.

The reason to include the export variable in the regressions is to control for the external demand. A higher demand that is met with increased domestic production leads to a higher degree of capital utilization and, finally, an increase in domestic investment. We therefore expect the export parameter to be positive. The real effective exchange rate is intended to control for differences in relative production costs in Sweden and in foreign countries. Furthermore, D, D' and D'' are time dummy vectors included to capture the effect of the enlargement of the EU in 1986 and 1995.

When the regressions are based on absolute levels, we need to include one time dummy for the period 1986-1999 and one for the period 1995-1999, since the investment flows to the EU is likely to have permanently changed from 1986 and 1995 due to the increasing number of countries in the area. When we look at changes between years, we will also have to include one time dummy for 1986 and one for 1995 to take into account the fact that the number of countries in period *t* and *t-1* are different for these two years. However, as we switch to percentage changes there is no reason to believe that the influence of the enlargement on the variable is permanent. Time dummies are therefore only needed for 1986 and 1995.

Because we only have access to a limited number of observations, we will reduce the number of estimated parameters in the systems, partly by removing the insignificant time dummy variables and partly by imposing constraints on the remaining parameters. This will be done in a backward elimination fashion, where the least significant variable step by step is excluded from the regressions until only the significant time dummies remains.

*Data*

The Swedish Central Bank has provided the data on foreign direct investment, while the data on gross domestic investment and export were obtained from Statistics Sweden. The exchange rate data comes from IMF and the GDP deflator from OECD.

Table 2 shows the simple correlation coefficient between the dependent and the independent variables in the regressions.[10] The most consistent result in table 2 is provided by the lagged export variable, which is positively correlated, with the gross domestic investment irrespective of specification and industry, justifying that this variable is included in the regressions. Moreover, the correlation is also highly significant for both Hecksher–Ohlin and Schumpeter industries, while the other manufacturing industries fail to attain significant correlation. The simple correlation between the real effective exchange rate and the gross domestic investment is positive throughout the table, albeit only significant when we express the variables in absolute levels.[11]

When looking at the foreign direct investment the most striking feature is the lack of significant correlation. However, when the variables are specified as percentage changes the Schumpeter industries show a strong negative correlation for the foreign direct investment in the EU as well as a highly positive correlation for the foreign direct investment elsewhere.

*Results*

The results from the regressions are reported in table 3. The only restriction imposed on the regressions is that the parameter value of the exchange rate index, REXR, is bound to be the same for both the Heckscher–Ohlin and Schumpeter industries in the first set of regressions (absolute levels).

Foreign direct investment in the EU by the Heckscher–Ohlin industry has a positive impact on domestic investment for all variable specifications and is also significant for all

[10] All value variables are deflated with the implicit GDP deflator. The correlation matrix for the independent variables reveals no sign of multicollinearity. The correlation matrixes are available from the authors on request.

specifications except for the percentage change. This result supports our hypotheses of a complementary effect between foreign and domestic investment by the Heckscher–Ohlin industry. The foreign direct investment in the EU made by the Schumpeter industry has a significantly positive impact on domestic investment when we regress the level of FDI on domestic investment. However, it then shifts to a significantly negative impact when the regression is based on percentage changes. Braunerhjelm and Oxelheim (1999, 2000) also find this negative impact in earlier studies. Foreign direct investment to the rest of the world is less significant and gives a more mixed impression.

The lagged export has a positive effect on domestic investment for both the Heckscher–Ohlin industry and the Schumpeter industry for all specifications and it is also significant for all specifications, except for the Heckscher–Ohlin industry when the variables are defined as changes between two consecutive years. Real effective exchange rate has a positive impact for the Heckscher–Ohlin and Schumpeter industries, but is only significant in the estimation based on absolute levels.

In general, the explanatory power of the regressions is fairly good, especially for the Heckscher–Ohlin and Schumpeter industries with $R^2$ values ranging from 0.54 to 0.82.

## 4. Concluding remarks

We have found that the differences in the investment pattern across industries prevail, even though they diminishes as we extend the period to include the latter part of the 1990s. Moreover, it is shown how the effects differ depending on whether the estimations relate to absolute levels or changes. This is hardly surprising, considering that a given capital-stock in a country needs continuos investments for reasons of maintenance etc., which means that in absolute values a complementary relationship is conceivable. However, this may change to a negative relationship as we look at changes in relative terms. Our belief is that relative changes better capture the shift in investments between the home and foreign countries. If you like, it could be interpreted as the change in the pace of investments (second derivative).

Overall our previous finding of differences across the two industries - a complementary relationship in the Heckscher-Ohlin industry and a substitutionary relationship in the Schumpeter industry – seems to prevail. These differences are explained by structural differences across industries.

[11] The correlation between REXR and EXP lies between -0.08 and 0.52 depending on variable specification and

type of industry.

*Table 1: Research and development expenditures in Swedish multinationals, 1986, 1990, 1994 and 1998, R&D expenditure as percentage of turnover.*

| Industries | ISIC code | 1986 | 1990 | 1994 | 1998 |
|---|---|---|---|---|---|
| Food, beverages and tobacco | 31 | 0.6 | 0.3 | 0.6 | 0.9 |
| Textiles, wearing apparel and leather | 32 | 0.1 | 0.9 | 1.0 | 1.6 |
| Wood and wood products | 33 | 1.9 | 0.3 | 2.2 | 0.3 |
| Paper and pulp | 34 | 0.7 | 0.9 | 0.9 | 0.9 |
| Chemicals | 35 | 6.7 | 6.8 | 9.3 | n.a. |
| Non-metallic mineral products | 36 | 1.0 | 0.5 | 0.5 | 0.4 |
| Basic metal industries | 37 | 1.2 | 0.8 | 0.7 | 0.9 |
| Fabricated metal products, machinery and equipment | 38 | 4.5 | 5.1 | 5.4 | 3.4 |

Source: IUI's databases.

*Table 2: Correlation matrix between Swedish gross domestic investment and Swedish foreign direct investment, export and real effective exchange rate, 1982-1999.*

| Type of industry | FDIEU | FDIRW | EXP | REXR |
|---|---|---|---|---|
| Monetary level | | | | |
| Heckscher–Ohlin | 0.48 | 0.20 | 0.79 | 0.61 |
| | (0.05) | (0.44) | (0.01) | (0.01) |
| Schumpeter | 0.31 | 0.42 | 0.87 | 0.49 |
| | (0.22) | (0.08) | (0.00) | (0.04) |
| Other industries | 0.34 | 0.12 | 0.16 | 0.47 |
| | (0.16) | (0.64) | (0.52) | (0.05) |
| Monetary change | | | | |
| Heckscher–Ohlin | 0.38 | -0.01 | 0.73 | 0.15 |
| | (0.13) | (0.98) | (0.00) | (0.56) |
| Schumpeter | 0.17 | -0.30 | 0.66 | 0.18 |
| | (0.51) | (0.25) | (0.00) | (0.48) |
| Other industries | 0.20 | -0.14 | 0.04 | 0.02 |
| | (0.43) | (0.58) | (0.88) | (0.95) |
| Percentage change | | | | |
| Heckscher–Ohlin | 0.29 | 0.25 | 0.77 | 0.15 |
| | (0.26) | (0.34) | (0.00) | (0.58) |
| Schumpeter | -0.58 | 0.62 | 0.76 | 0.12 |
| | (0.01) | (0.01) | (0.00) | (0.65) |
| Other industries | 0.30 | -0.19 | 0.07 | 0.00 |
| | (0.24) | (0.46) | (0.80) | (0.99) |

**Note:** P-value in parentheses. Shown here is only a fraction of the full correlation matrix, however the complete correlation matrix is available from the authors on request.

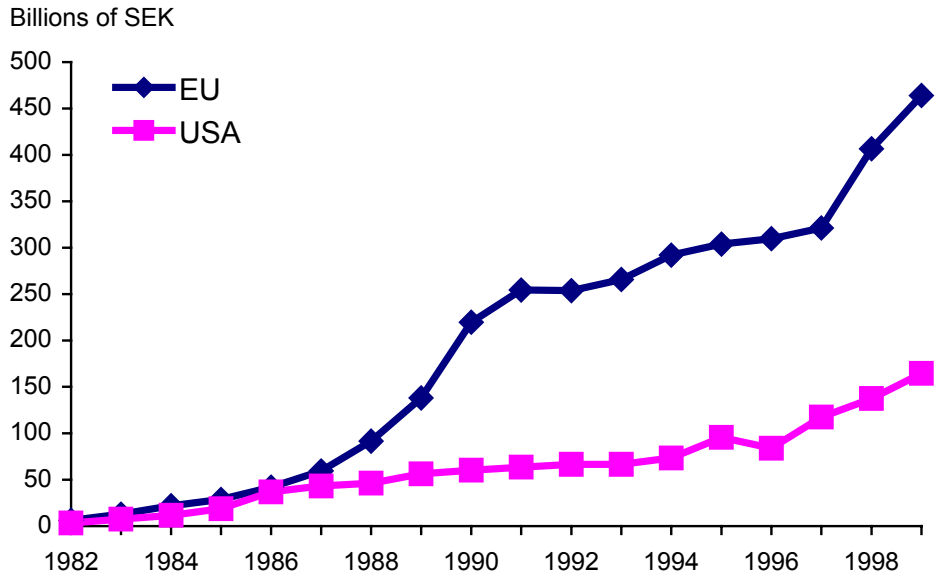
*Table 3: Results from the ITSUR estimation for the period 1982-1999. Dependent variable: Gross Domestic Investment.*

| | Absolute levels | | | Change in levels | | | Percentage change | | |
|---|---|---|---|---|---|---|---|---|---|
| | H–O | SCH | OTHER | H–O | SCH | OTHER | H–O | SCH | OTHER |
| INTERCEPT | 4 402<br>(1.63) | 6 681***<br>(2.78) | 2 295***<br>(2.77) | -113<br>(-0.16) | -126<br>(-0.16) | -65<br>(-0.32) | -3.25<br>(-0.76) | 0.91<br>(0.38) | 1.72<br>(0.61) |
| FDIEU | 0.1155***<br>(6.17) | 0.0863**<br>(2.27) | -0.1850<br>(-1.45) | 0.1088***<br>(3.86) | 0.0450<br>(1.09) | 0.1621<br>(1.45) | 0.0229<br>(1.21) | -0.0310**<br>(-2.65) | 0.0142***<br>(2.98) |
| FDIRW | 0.1603<br>(1.13) | -0.0364<br>(-1.48) | 0.0154<br>(0.27) | -0.0804<br>(-0.31) | -0.0647**<br>(-2.75) | -0.1102*<br>(-1.82) | -0.0026<br>(-0.17) | 0.0238***<br>(3.49) | -0.0200**<br>(-2.52) |
| EXP | 0.0937***<br>(4.76) | 0.0654***<br>(7.40) | 0.1984***<br>(4.27) | 0.0396<br>(0.86) | 0.0551**<br>(2.13) | -0.0555<br>(-0.88) | 1.5259***<br>(3.16) | 0.5478*<br>(2.11) | 0.0964<br>(0.69) |
| REXR | 210**<br>(2.46) | 210**<br>(2.46) | 37<br>(0.98) | 103<br>(1.04) | 19<br>(0.19) | 11<br>(0.41) | -0.1440<br>(-0.27) | 0.1278<br>(0.48) | -0.3187<br>(-0.87) |
| D86-99 | | 1 870*<br>(1.98) | 1 027**<br>(2.68) | | | | | | |
| D95-99 | | | -3 991***<br>(-7.44) | | | 1 061**<br>(2.63) | | | |
| D86 | | | | -3 535***<br>(-3.34) | | | | | |
| D95 | | | | 8 657***<br>(3.68) | 5 837*<br>(2.02) | | 46.49***<br>(2.76) | | 16.11*<br>(1.85) |
| No. of obs. | 54 | 54 | 54 | 51 | 51 | 51 | 51 | 51 | 51 |
| Haessel's [a] $R^2$ | 0.72 | 0.82 | 0.16 | 0.65 | 0.54 | 0.19 | 0.79 | 0.73 | 0.43 |
| Berndt's [a] $R^2$ | | 1.00 | | | 1.00 | | | 1.00 | |

**Note:** t-statistics in parenthesis. *, ** and *** denote statistical significance at the 10, 5 and 1 percentage level respectively. In the case of levels, investment and export figures are expressed as absolute real values, changes refers to regressions based on first differences, while percentage change means that the regressions are based on percentage changes between two consecutive years.

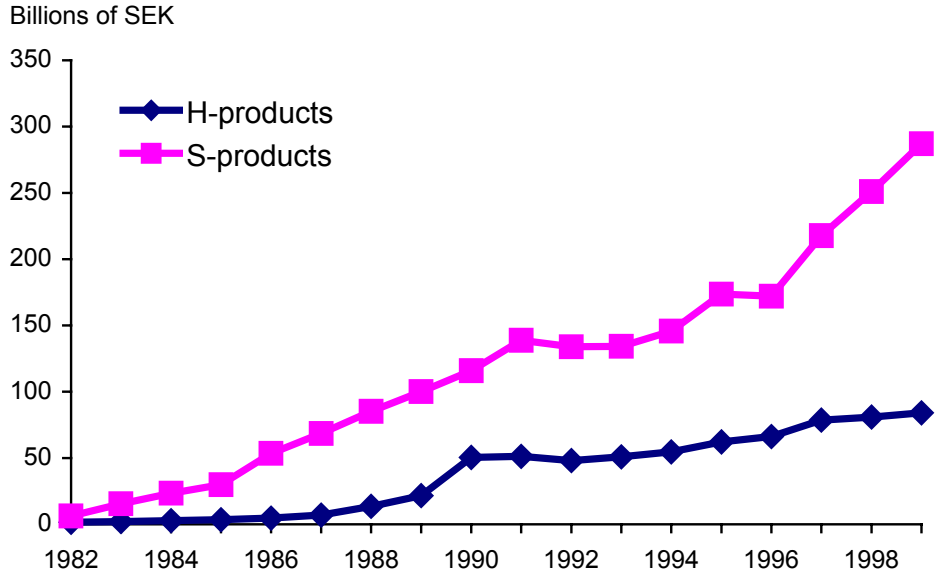
[a] See Haessel (1978) and Berndt and Khaled (1979).

*Figure 1: Accumulated Swedish FDI in the EU and the United States 1982-1999, 1999 years prices.*




**Note:** The European Union consists of 14 countries for all years in the figure.
**Source:** Own calculations based on data from the Swedish Central Bank and OECD.

*Figure 2: Accumulated total Swedish FDI in Heckscher–Ohlin industries and Schumpeter industries 1982-1999, 1999 years prices.*




**Source:** Own calculations based on data from the Swedish Central Bank and OECD.

**Appendix**

Assume a Cobb-Douglas technology where firms in the HO-sector use capital, labor and intermediate products. The production function is separable into two additive subfunctions, V and Q. V combines capital, labor and a technology factor, while Q concerns of intermediate products (IP),

$$Q_{HO}^{j} = V^{j} Q_{IP}\left(V^{H}, Q_{HO}\right) \qquad j = H, F \tag{A1}$$

totally differentiate

$$dQ_{HO}^{j} = dV^{j} Q_{IP} + \left(\frac{\partial Q_{IP}}{\partial V^{H}}\right) dV^{H} + \left(\frac{\partial Q_{IP}}{\partial Q_{HO}}\right) dQ_{HO} V^{H} \tag{A2}$$

assuming $dV^{j} = 0$

$$dQ_{HO}^{j} = dV^{j} Q_{IP} + \left(\frac{\partial Q_{IP}}{\partial Q_{HO}}\right) dQ_{HO} V^{H} \tag{A3}$$

then

$$dQ_{HO}^{j}\left(1 - \left(\frac{\partial Q_{IP}}{\partial Q_{HO}}\right) V^{H}\right) = dV^{H} Q_{IP} \tag{A4}$$

In order to demonstrate the relationship between $Q_{HO}$ and $Q_{IP}$, assume that also $dV^{H} = 0$,

$$dQ_{HO}^{j} = dQ_{IP} V^{H} \tag{A5}$$

and

$$dQ_{IP} = \frac{dQ_{HO}^{j}}{V^{H}} \tag{A6}$$

Hence, an increase in production of $Q_{IP}$ is dependent of an increase in $Q_{HO}$. Thus irrespective of whether production of the final stage is locate in the home or the foreign country, home country production of the intermediate stage production must increase in the home country.

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