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# Foreign acquisitions of Swedish companies – effects on R&D and productivity

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# Foreign acquisitions of Swedish companies – effects on R&D and productivity

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**Abstract**

This paper studies relative productivity and R&D expenditures as determinants of foreign acquisitions of Swedish manufacturing firms, as well as, the productivity and R&D performance of these firms after the acquisitions. The results are that foreign owned firms have a higher productivity and use a more capital-intensive technology than domestic ones. The relative labor productivity improves after the acquisition, while the development of relative total factor productivity is more uncertain. We find no evidence of any reduction of R&D-spending of foreign firms. R&D-spending does not seem to explain which domestic firms are acquired, however, foreign ownership has increased the most in R&D-intensive industries.

## 1 Introduction

Multinational firms (MNFs) are characterized by having production plants in more than one country. The alternative to becoming an MNF, is to concentrate production in one country, and export its products to other countries. The existence of MNFs has been explained within the so called OLI-framework (see Dunning, 1977) by acquired, firm-specific, advantages. These advantages may be expressed in form of patents and or brand names, but may also be in form of knowledge which is not generally available to other firms. In the case of patents, licensing is an option that are sometimes used, but it has the disadvantage that knowledge is transferred to the licensee that may become a future competitor, once the patent has expired. The firm specific advantages may be of different types (and extents) and if one, reasonably, assumes that it is always an extra cost of entering a new market

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(due to unfamiliarity with local culture, laws, customs etc.), such advantages may be required to successfully enter a foreign market.

The theory of MNFs often implicitly assumes that FDIs take place by establishing a new plant in the host country; a so called "greenfield entry." However, FDIs increasingly take place through acquisitions of local firms[1]. It may therefore be fruitful to consider FDIs within the theory of ownership change in general. This seems particularly compelling since the trend toward increasing FDI flows has gone on in tandem with an increased frequency of ownership change through mergers and acquisition in many countries, especially during the 1980s (see e.g., Braunerhjelm et al., 1996; Graham & Krugman, 1993 and UNCTAD, 1997).

## 1.1 Motives behind FDIs

An often used taxonomy of broad motives behind FDIs are the following (see Dunning 1993, )

1. resource seeking,
2. market seeking,
3. efficiency seeking,
4. strategic asset or capability seeking.

*Resource seeking* firms invest abroad if they are dependent on a specific natural resource, which is only available abroad (or is in plentiful supply where). By integrating backwards they can control the supply of this resource. Minerals, raw materials, and agricultural products are the most common examples, however, other factor or products which are in abundant supply in a foreign country can be assigned to this category of FDI motives. The MNF will usually export most of the production from the subsidiaries established abroad due to this motive.

*Market seeking* firms establish production abroad if this is cheaper than exporting to these markets. Firms with products with high transport cost due to their innate characteristics (e.g. low value per weight unit), or with products that are protected by high tariff barriers in the foreign market, are likely to be motivated by market seeking. Other reasons behind this motive is the need to be in close communication with the local market and adapt

[1]For example, in the sample we use in our empirical studies we had no (0), greenfield entry during the time period studied (1980-94). However, several foreign owned firms in the sample had entered as greenfields before 1980.

the products to local tastes. Most of the production is sold locally and not exported.

*Efficiency seeking* firms try to take advantage of gains from division of labor within a vertically integrated MNF. Economies of scale and positive spill-overs may lead to extensive specialization of certain stages in a production process, and a concentration into one, or a few, geographical locations. This will lead to lower total production cost. Most of the production of such intermediate products will be sold within the MNF.

*Strategic asset seeking* firms may acquire assets as a move to pre-empt competitors to gain any advantage. This motive is particularly important in oligopolistic markets there firms watch over each other closely. If the acquired strategic assets are vested within a corporate form, FDI will be undertaken by a takeover, or acquisition, of a local corporation.

As already noted, an increasing fraction of FDI flows has been in the form of takeovers and acquisitions, instead of greenfield investment. The driving force behind this observed trend may have been increased global competition, particularly within oligopolistic industries there the strategic asset seeking motive is particularly strong. However, the other motives may also result in takeover and acquisitions instead of greenfields. Lowered trade- and international investment barriers, as well as communication costs, may motivate both market-seeking and efficiency-seeking FDIs. In addition, as it becomes easier to acquire foreign firms, it becomes more profitable to acquire foreign firms and instigate cost reducing measures, in line with tacit knowledge that the acquiror has in both the organization of production and marketing. This latter motive is closely connected to the motives for ownership change that has been discussed within the theories of mergers and acquisitions in general.

## 1.2 Theories of ownership change

Several theories of ownership change have been suggested. One theory, proposed by Meade (1968), expounds a mechanism with a Darwinist flavor; efficient owners survive, unfit (inefficient) owners disappear. This process can be more or less continuous if the economy, or industry, is subjected to minor but frequent shocks. In this case ownership change may be a slow and gradual process. However, if a large shock occurs, restructuring and ownership change may be quite dramatic.[2] Even if no such severe shocks occur, an industry may nevertheless be disturbed from its equilibrium ownership pattern if the pool of potential owners is suddenly enlarged. During the latter

[2]Mithcell & Mulherin (1996) find that, even though aggregate takeover activity clusters in time, there is also a significant cross-sectional variation which indicates the importance of industry specific shocks.

part of the 1980s a there was a, more or less, worldwide trend toward lowering barriers to FDIs, this trend also extended to Sweden and these lowered barriers increased the number of potential owners.

A slightly different theory of ownership change has been suggested by Lichtenberg (1992), who in turns build on Jovanovic's (1982) job-matching theory. In this theory the employer does not know the hired workers true productivity, but learn more about this over time. This learning process results in workers moving between employers and staying for longer or shorter spells at the same employer according to the quality of the match.

The matching theory of ownership change suggests that some owners have comparative advantages in owning certain types of firms (or plants). The source of a particular owner's comparative advantage can be found in its previous experience. This is thus very much in line with the OLI framework, applied specifically to acquisitions. According to this matching theory firms and owners are constantly evaluating its match. If it is found to be a poor one, the owner may decide to divest the firm. This could be done by liquidating the firm and sell its assets separately, or it can sell the entire firm to a new owner. Transaction costs and strategic considerations will influence this choice.

Other theories of ownership change have been developed in line with the managerial theory advanced by, for example Baumol (1967), Manne (1965) and Marris (1964) among others. In these theories managers pursue, with impunity, non-value maximizing growth strategies. The threat of takeover may be a check on such empire-building ambitions, and force managers to be (reasonably) efficient.

We will focus on the matching theory in this paper; if this theory is correct one would expect to observe that a firm, or plant, that changes ownership have had a poor productivity performance before the ownership change, and show an improvement afterwards. We will also compare the performance of domestic and foreign acquirors. If firms acquired by foreign MNFs show a bigger increase in relative productivity than those acquired by domestic firms, this would be evidence in line with the specific advantage explanation for FDIs. If all firms (foreign or domestic) show an improved productivity performance, this will be in support of the matching theory in general.

## 1.3 R&D and FDIs

In the debate about the effects of the increased FDI activity and foreign ownership, much attention has been focused on its effect on the R&D activity of the acquired domestic firms. If the primary motive for an FDI is strategic asset seeking, it is possible that R&D will be reduced or moved abroad to

be integrated with the acquiror's R&D activities in its home country. The argument behind this fear is that R&D is often associated with economies of scale and it is therefore common that an MNF concentrates its R&D efforts in one geographical place (often adjacent to the group head office). R&D becomes a separate activity and the fruits of the R&D-branch's efforts are sold to the other branches within the multi-national group. The acquired domestic firm may have performed some R&D, which becomes unnecessary after its incorporation into the MNF. The required R&D services may now be bought from the MNFs R&D branch. This outcome is more likely to occur the more similar the R&D efforts of the two companies are. This may indeed be a driving force behind the acquisition in the first place, to avoid duplication of efforts and therefore reduce average cost and raise profit margins in the acquired company.

If the two companies pursue different R&D programs the acquisition may be motivated by market-oriented strategies, e.g. to cover a broader spectrum of the product-characteristic space. In this case it is more uncertain if there are any gains in concentrating R&D. Incentive reasons, plus the likely adjustment costs involved in relocating an already functioning activity, may compel the new owner to leave the R&D activity intact, or even to provide it with more funds if, which is often the case, it has a broader world market coverage than the previous owner.

Research of R&D activity in MNFs has found that R&D in foreign affiliates is mainly adaptive in nature. I.e., it is geared toward adapting technologies to local conditions and regulations. R&D performed by the MNF in it's home country is more basic and long-term in character (Caves, 1996; Fors, 1996 and 1997). Håkansson and Nobel (1993) suggest that R&D by foreign affiliates of Swedish MNFs is mostly adaptive and done to facilitate technology transfers from the parent company to its affiliates.

## 1.4 Welfare consequences

The matching theory of ownership change predicts that productivity improvements will result in the acquired firms. These productivity gains may be beneficial to the host country in various ways. For example, it could lead to lower prices (since the average unit cost will decrease), which is beneficial to the host country's consumers. However, it may also reduce the profits of locally owned firms and lead to a monopolization of the industry, with higher prices and the monopoly profits going into the hands of foreign citizens. From a nationalistic welfare point of view it is therefore not unambiguously true

that foreign entry with improved productivity is beneficial.[3]

However, an acquired firm, active in industries which are either exposed to intensive import competition or which compete mainly on the world market, may not have the leeway to raise prices even if it becomes the only domestic producer. An acquisition is, in this case, likely to benefit local input owners, and maybe also the state through increased tax revenues, and is therefore beneficial from a nationalistic point of view.

R&D activities are of special importance, from a welfare point of view, since it has public good characteristics. An individual firm may not be able to completely appropriate the fruits of its R&D efforts, which, partly, spills-over to other firms. This externality drives a wedge between the private- and social return to R&D. As a consequence, an acquisition of an R&D intensive domestic firm which leads to a re-locating of R&D activity abroad, may be negative for the host country. This is more likely the more geographically limited R&D-spillovers are.

In addition to the reasons an MNF can have for conducting R&D in a foreign affiliate that were discussed in the previous section it has been suggested recently that such R&D is also undertaken to gain access to knowledge in foreign "centers of excellence," and to benefit from localized R&D spillovers. The nationalistic welfare consequences of these types of FDIs are ambiguous. However, since all foreign FDIs in our sample were acquisitions of existing firms this explanation seem à priori not to be the most likely one. This indicates more of an interest in direct acquisitions of knowledge vested in the acquired firm than a wish to pick up knowledge spillovers from domestically owned firms. Since the previous domestic owners can be presumed not to sell valuable assets cheaply, and since these owners should be counted in the national welfare calculation, it cannot be assumed that national welfare has decreased due to the change in ownership.

## 1.5 Purpose and outline

This paper has two main purposes. The first is to investigate, empirically, the extent of productivity improvements in Swedish manufacturing firms that have been acquired by foreign MNFs during the period 1980-1994. The second main purpose is to find out how R&D activity has changed after the acquisition.

[3]The nationalistic cost-benefit calculation should also take into account the tax revenue that the state can raise through taxation of the monopoly profits and maybe also through taxation of dividend repatriation to the parent company by the subsidiary. However, if the local tax is too high multinational firms have ample opportunities, for example through internal pricing schemes, to shift reported profits from high tax, to low tax countries.

We start in section 2 with an overview of the development of foreign ownership within the Swedish manufacturing industry. A brief analysis of the cross-sectional pattern of foreign ownership is also given. In section 3 we look at the productivity performance of domestic and foreign firms, with a special emphasis on the changes in productivity after a foreign acquisition of a domestic firm. Section 4 deals with the R&D activities among domestic and foreign firms, where we in particular focus on the behavior after the acquisition. The more technical aspects of different measures of productivity are relegated to an appendix, which also contain some description of the data set used in the empirical studies.

# 2 Foreign ownership in the manufacturing sector

When discussing the consequences of FDIs it is common to start by presenting diagrams or tables showing the development of FDIs over time. However, the FDI statistics come from the Balance of Payments accounts and show financial flows. These may, but need not, correspond to actual investments in real assets. For this reason we show instead, in Table 1, the extent of foreign ownership in subindustries of the Swedish manufacturing industry 1980, 1985, 1990 and 1994. This, we believe, gives a more accurate picture of the importance of foreign ownership and -governance of productive assets located in Sweden, than the Balance of Payments statistics.

From Table 1 we can conclude that, even though there are differences across subindustries, it is apparent that there have been an acceleration of the foreign ownership share since 1980. The subindustries showing the biggest increase in the foreign share are *Food, Beverages & Tobacco, Chemicals, Plastics, Non-Metallic Mineral Products, Non-Electrical Machinery & Computers* and *Professional Goods.* The only subindustries, at this level of aggregation, showing virtually unchanged or declining shares are *Wood Products & Furniture, Rubber* and to some extent *Electrical Machinery.*

The general trend is that the foreign influence has been strongest over the entire period in the chemical industries, while it has been weak in industries based on forest products and iron. A possible explanation for this is that industries based on raw materials with which Sweden is relatively well endowed is also dominated by domestic companies (wood products, paper & pulp, iron and metal products). The worldwide chemical industry was early on dominated by American, British and German companies (see Dunning, 1993), a pattern which is reflected in the foreign ownership of companies in

Table 1: Foreign owned companies' shares of total employment in various manufacturing industries 1980, 1990 and 1994.

| Industrial sector | Foreign share of total employment, (%) 1980 | 1985 | 1990 | 1994 |
|---|---|---|---|---|
| Food, Beverage & Tobacco | 7.8 | 14.1 | 19.6 | 20.3 |
| Textiles, Apparel & Leather | 6.5 | 5.1 | 7.0 | 17.5 |
| Wood products | 0.1 | 0.6 | 1.5 | 0.5 |
| Paper, Pulp & Paper products | 1.8 | 4.0 | 10.4 | 8.2 |
| Printing & publishing | 4.4 | 4.8 | 4.1 | 7.9 |
| Basic Chemicals & Fertilizers | 9.1 | 26.2 | 26.2 | 65.9 |
| Other Chemicals incl. drugs | 35.2 | 30.0 | 38.1 | 52.1 |
| Petroleum refineries | 46.6 | 44.4 | 34.1 | 46.0 |
| Rubber products | 9.1 | 1.7 | 4.8 | 7.4 |
| Plastics products | 5.3 | 13.1 | 37.6 | 18.3 |
| Non-metallic mineral products | 8.3 | 15.9 | 36.5 | 38.0 |
| Iron, Steel & Non-ferrous metals | 3.1 | 4.0 | 7.7 | 14.1 |
| Iron & Steel | 2.4 | 3.3 | 2.2 | 12.7 |
| Non-ferrous metals | 6.0 | 6.3 | 24.5 | 18.5 |
| Metal products | 5.2 | 8.7 | 11.7 | 11.7 |
| Non-electrical machinery | 6.6 | 10.6 | 24.1 | 20.6 |
| Electrical machinery | 9.5 | 10.6 | 15.5 | 9.9 |
| Transport equipment | 1.9 | 3.1 | 4.4 | 4.1 |
| Professional goods | 12.3 | 9.7 | 14.7 | 27.4 |
| Other manufacturing | 12.0 | 12.8 | 27.8 | 34.7 |
| Total manufacturing | 6.2 | 8.8 | 14.6 | 15.1 |

*Source*: Statistics Sweden.

these sectors.

The factor-proportion theory of international trade predicts that a country will export goods that use intensively factors of production with which the country is relatively well endowed. The specific-advantage theory of MNFs suggests that these firms establish plants in several countries to exploit the specific advantages that gives it an edge over local competitors. The choice between exporting from one location in the home country or starting multinational production, depends on the fixed costs at the plant and firm levels, the level of transport costs, as well as on barriers to international investment. A possible link between the theory of international trade and specialization and the theory of MNFs is that specialization in an early stage of industrial development is conducive to the development of firm-specific assets, which at a later stage can be exploited in the form of FDIs. It is therefore possible that as barriers to FDI are gradually lowered, the inflow of foreign owned

firms are highest in sectors in which the host country has a comparative disadvantage, and vice versa. Of course, if the comparative disadvantage of the host country is very large it would not be attractive as a production location. However, if there are trade barriers so that exports to this country is restricted, the market seeking motive will be sufficient to perform either a greenfield, or an acquisition of a local firm, after investment liberalization. If trade- and investment liberalization occur at the same time the local firms may not be able to compete with foreign firms import. Foreign firms may in this case anyway be interested in acquiring a local firm and integrate it in its multinational vertical production structure. This requires that the foreign multinational firm has some superior technological knowledge and that the comparative disadvantage of the host country is not too large. However, if fixed costs on the plant level is high (high scale economies) it would be more attractive to concentrate production in one place and export to the host country.

A longer theoretical treatment of motive and driving forces behind FDIs is beyond the scope of this paper[4], but the limited discussion above suggest that FDIs should be positively related to tariff barriers and transport costs (trade costs in general), as well as to industries in which firm-specific advantages are important. It should be negatively related to industries where the host country has strong comparative advantages, and where scale economies on the plant level is important. The following regression equation, on a pooled cross-section time series of 20 three-digit manufacturing industries, captures some of these aspects (t-values in parentheses):

$$\begin{aligned} \ln FDI_i &= \underset{(-0.66)}{-1.45} + \underset{(3.36)}{0.28} \ln Tariff_i + \underset{(3.60)}{1.11} \ln K/L_i + \underset{(4.03)}{0.50} \ln R\&D_i \\ &\quad - \underset{(-2.87)}{0.35} \ln Forest_i - \underset{(-0.72)}{0.18} \ln Electric_i - \underset{(-1.85)}{0.54} \ln Scale_i \\ \bar{R}^2 &= 0.48, \quad F = 9.91 \end{aligned}$$

The dependent variable is here (the natural log of) the share of foreign employment in industry $i$, $Tariff$ is tariff revenue in percent of the total import value in industry $i$, $K/L$ is the ratio of the physical capital stock and employment, $R\&D$ is expenditure on R&D, *Forest* and *Electric* are the use of forest products and electric energy, respectively, in percent of total expenditure on intermediate goods. *Scale* is a measure of scale-economies defined

[4] A longer discussion is furnished in Modén (1997) .

as total industry sales divided by the number of plants. The coefficient on the tariff variable supports a market seeking motive for FDIs, while the coefficients on the measures of capital- and research-intensity, indicates that FDIs are more prevalent in technologically advanced industries. Industries dependent on forest products (a raw material which Sweden is abundantly endowed with) have a relatively low foreign share, while dependence on electricity (again an input which Sweden is well endowed with) has no significant influence. Plant scale-economies has a negative (although only weakly significant) influence on the foreign ownership share. These results are broadly in line with several of the explanations for FDIs outlined above. However, to gain some more insights into whether efficiency- and strategic asset seeking motives are important we now turn to a firm level analysis of productivity and R&D developments after an acquisition by a foreign firm.

# 3 Productivity

In this section we will investigate the productivity developments within foreign owned firms. We are primarily interested in comparing the productivity development in firms that have been acquired by a foreign MNF, with that of the rest of industry. To make such comparisons meaningful it is crucial to use a rather narrow industry classifications. We therefore constructed a sample of 30 industries at the 5-digit ISIC level.[5] The included industries were chosen on the basis that each included firm should not span more than one such industry classification.

Productivity can be defined as output ($Y$) per unit of input ($X$). Partial measures of productivity, for example average labor productivity, is defined as output per unit of input

$$PFP_L = AP_L = Y/X_L \tag{1}$$

If one wants to compare productivity between different firms at the same point in time, such partial measures are potentially misleading because they may be due to differences in the mix of input use. For example, if a company uses more capital per labor than another company, it will have a higher average labor productivity. However, this capital-intensive input-mix may be more expensive than the more labor-intensive alternative and is therefore not optimal.

Different input-mixes can be taken into account by defining a measure of total factor productivity ($TFP$). Output is now divided by an index which

[5] A more thorough description of the construction of the sample is given in the appendix, section 6.3.

includes all inputs

$$TFP = \frac{Y}{h(X_1, .., X_n)} \tag{2}$$

The methodology we use in making $TFP$ comparisons is called the index-number approach. This approach has the advantage that one doesn't have to estimate parameters in a production technology. However, one does have to specify a functional form for the $h(\cdot)$ - function.[6]

## 3.1 Productivity level differences

In table 2 we show, for some selected industries in our sample, in the left hand side panel the average deviation from the average labor productivity of a "hypothetical" industry firm; the middle panel shows the average deviation from the capital-labor ratio, and the right hand side panel shows the average deviation from TFP of the same hypothetical firm for 1985, 1990 and 1994. For each year and each variable we show the average deviations for domestic and foreign firms separately. The last line of the table shows an average for each year over all industries (in the entire sample). Even though there are some differences between industries the overall picture is that foreign owned firms have both a higher labor productivity, a higher capital intensity and higher total factor productivity than domestically owned firms. A simple test of differences of means show that foreign firms had a significantly higher labor productivity (at the 1%-level) for all three years, while they had a significantly higher capital-labor ratio in 1990 and 1994. For the total factor productivity the difference is significant (at the 1%-level of significance) only for 1994. The higher labor- and total factor productivity and capital intensity of foreign firms may be a result of higher than average size (or scale). To test this we ran OLS-regressions on the difference of average labor productivity of company $i$ in industry $j$ at time $t$ from the industry average ($RELALP_{ijt}$) on the natural log of firm sales ($\ln Y_{ijt}$) and a dummy variable which takes the value one if the firm is foreign owned and zero otherwise ($FORDUM$). We also ran a similar regression with the relative total factor productivity ($RELTFP_{ijt}$), as a dependent variable. In Table 3 we show two versions of each of these sets of regressions, the $a-$ variant excludes the sales variable and the $b-$ variant includes it. In all model variants we included a full set of industry dummy variables (not reported in the table). The results verify that the relative labor- and total factor productivity was higher in foreign owned firms. The scale effect was highly significant for both productivity measures; the foreign dummy variable was positive and significant in the relative labor

[6]The index-number approach is further described in the appendix, section 6.1.

Table 2: Percentage deviation from average labor productivity, K/L-ratio and total factor productivity for domestic and foreign owned firms, 1985, 1990 and 1994.

| | Deviation from average labor producitivty (%) | | | | | | Deviation from average K/L-ratio, (%) | | | | | | Deviation from average TFP (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ISIC | 1985 | | 1990 | | 1994 | | 1985 | | 1990 | | 1994 | | 1985 | | 1990 | | 1994 | |
| code | dom. | for. | dom. | for. | dom. | for. | dom. | for. | dom. | for. | dom. | for. | dom. | for. | dom. | for. | dom. | for. |
| 15520 | na | na | 0.0 | 2.3 | -8.7 | 13.0 | na | na | 1.2 | 24.4 | -18.2 | 13.7 | na | na | -24.1 | 93.6 | -36.2 | 53.4 |
| 15821 | -1.3 | 10.6 | -1.4 | 2.8 | 11.2 | -11.2 | 10.2 | -8.4 | -11.8 | 23.6 | -6.9 | 6.9 | -23.0 | 44.7 | -26.3 | 50.0 | -30.0 | 29.4 |
| 15840 | 0.6 | -2.0 | -12.8 | 18.3 | -18.2 | 12.1 | -2.8 | 5.7 | -13.5 | 12.3 | -20.6 | 13.7 | -0.1 | -3.2 | -18.3 | 3.9 | -22.2 | 20.5 |
| 15860 | 19.9 | -15.0 | -3.5 | 5.3 | -18.4 | 18.4 | 2.5 | 11.2 | -29.2 | 43.8 | -58.8 | 58.8 | -16.1 | 47.0 | -14.5 | 20.7 | -15.6 | 14.2 |
| 21211 | na | na | -7.3 | 14.5 | -5.7 | 11.4 | na | na | 7.2 | -14.5 | 4.3 | -8.6 | na | na | 8.8 | -19.0 | 7.8 | -16.2 |
| 28630 | 4.4 | -1.8 | 4.8 | -9.6 | 21.3 | -10.7 | 13.0 | -2.6 | -14.4 | 28.8 | -44.3 | 22.2 | 8.0 | 6.8 | -8.0 | -28.7 | -0.0 | -1.3 |
| 29120 | -0.7 | 2.3 | -3.4 | 6.7 | -4.6 | 11.1 | -4.4 | 14.6 | -3.0 | 9.1 | 7.5 | -10.5 | -17.7 | 40.3 | -17.3 | 24.1 | -24.5 | 5.3 |
| 29550 | na | na | -12.2 | 24.3 | -92.2 | 18.6 | na | na | -10.8 | 21.5 | -1.3 | 0.3 | na | na | -31.3 | 20.2 | -131.6 | 11.7 |
| 31300 | -1.8 | 43.4 | -4.6 | 57.9 | 2.6 | 48.3 | -1.1 | 39.5 | -10.9 | 39.6 | 1.3 | 103.3 | -23.9 | -31.0 | 10.5 | 26.7 | -59.0 | -17.2 |
| 31400 | -29.6 | 21.2 | -36.0 | 12.3 | na | na | 55.4 | -18.5 | 85.2 | -28.4 | na | na | -1.9 | -15.2 | 43.6 | 15.5 | na | na |
| Average | 1.9 | 12.6 | -6.2 | 5.9 | -15.5 | 4.8 | 6.8 | 2.0 | -4.3 | 10.0 | -13.9 | 6.4 | -2.5 | 2.1 | -3.3 | 3.5 | -19.9 | 2.8 |

*Source:* Statistics Sweden and own calculations

*Note:* "na" means that there are either only domestic or foreign owned firms in that industry, which means that the average deviation from the industry average is equal to zero by definition.

Table 3: OLS regression results of relative average labor productivity (*RELALP*) and relative total factor productivity (*RELALP*), on a foreign ownership dummy and total sales.

| Explanatory variables | Dependent variable | | | |
|---|---|---|---|---|
| | *RELALP* | | *RELTFP* | |
| | (a) | (b) | (a) | (b) |
| FORDUM | 0.109*** | 0.065*** | 0.128*** | 0.019* |
| | (5.96) | (3.67) | (7.87) | (1.64) |
| $\ln Y$ | . | 0.136*** | . | 0.224*** |
| | . | (18.09) | . | (48.27) |
| No. of observations | 2721 | 2721 | 2546 | 2546 |
| | . | . | . | . |
| $\bar{R}^2$ | 0.04 | 0.14 | 0.17 | 0.57 |
| F | 5.11*** | 17.22*** | 20.69*** | 20.74*** |

productivity case for both model variants, but only marginally significant in the relative TFP case when the scale variable was included.[7]

If one peruse Table 2 carefully one can detect an increasing difference over time in both labor and total factor productivity as well as capital intensity. This may be because foreign firms have acquired domestically owned firms with higher than average labor productivity, and has maintained this higher productivity afterwards, or it may be because foreign firms have been more successful in raising productivity after the acquisition than has domestic firms. To test the hypothesis that foreign firms have acquired higher than average productivity domestic firms we divided the sample into three subperiods, (1980-84, 1985-89 and 1990-94), and estimated probit equations where the dependent variable took the value 1 if a firm was acquired by a foreign owner within each time period, and 0 otherwise. Two model variants were estimated ($a$ and $b$), where in the $a-$ variant, we used $RELALP_{ijT}$, as an explanatory variable and in the $b-$ variant we used $RELTFP_{ijT}$. In both model-variants we included firm $i's$ share of the total production value in industry $j$ at time $T$, ($share_{ijT}$), where $T = 1985, 1990$, i.e., the first year of each separate subperiods[8], as an additional explanatory variable. The

[7] If we drop $\ln Y_{ijt}$ from the regression the foreign dummy increases somewhat (to 0.109), which indicates that scale has some influence on average labor productivity.

[8] The time period $1980 - 84$ was excluded in the estimations due to the small number of foreign acquisitions during that period.

Table 4: Maximum likelihood estimates of probit equations of the probability that a firm was acquired by a foreign owner during the specified periods.

| Explanatory | 1985-89 | | 1990-94 | | 1985-94 | |
|---|---|---|---|---|---|---|
| variables | model a | model b | model a | model b | model a | model b |
| *RELALP* | 0.05 | . | -0.11 | . | -0.04 | . |
| | (0.70) | . | (-1.56) | . | (-0.20) | . |
| *RELTFP* | . | 15.67 | . | 1.32 | . | 4.34 |
| | . | (1.32) | . | (-0.19) | . | (0.81) |
| Share | 0.14 | 0.05 | 0.41** | 1.73* | 0.86* | 0.95 |
| | (0.76) | (0.05) | (2.00) | (1.76) | (1.64) | (1.58) |
| No. of observations | 182 | 181 | 197 | 197 | 379 | 378 |
| | . | . | . | . | . | . |
| No. of acquisitions | 31 | 31 | 44 | 44 | 75 | 75 |

results, given in Table 4, show that in no model variants (and for none of the time periods) could we reject the null-hypothesis that firms that became acquired within the relevant time period had the same productivity level as the industry average. We can also note that firms that subsequently became acquired had a higher than average share of total industry production at the beginning of the period, however, only for the $1990-94$ period was this difference statistically significant.

We can conclude that the acquired firms were not of a higher than average productivity type, using either definition of productivity.

## 3.2 Comparison of domestic and foreign acquisitions

In this section we compare the behavior of firms that have been acquired by foreign and domestic firms. The focus is here on the changes in productivity rather than on its level, we also hope to find out whether there is any significant differences between the behavior of foreign and domestic owners. If we do not find any such difference, we may conclude that the nationality of the owner plays a minor role. If there is a difference it is worthwhile to go on and try to find out the reasons for these differences.

We start by looking at the development of average labor productivity in acquired firms relative to their respective industry averages. This is illustrated in Figure 1. The average labor productivity of firms that subsequently became acquired was lagging behind the industry average, this was true for

both categories of firms. After the acquisition there seems to be a quite different story though. Firms acquired by foreign MNFs show a substantial increase relative to the industry average, while domestic firms stay about the same, or decline somewhat.

An increase in labor productivity could be the result of an increase in the capital-labor ratio, which in the short run would be most expediently accomplished by reducing the labor force, however, it could also be the result of a better utilization of existing resources. For example, the new owner may have access to better marketing and distribution channels which permits it to increase sales on relatively short notice.

Figures 2 and 3 show the development of the relative capital-labor ratio and the relative output-capital ratio of acquired firms (foreign plus domestic acquisitions), before and after acquisition. In foreign acquisitions the capital–labor ratio drops before the acquisition but increases somewhat between years +1 and +4; in domestic acquisitions it is a clear increase in this ratio and a stabilization at a level higher than the industry average. The relative productivity of capital shows a steep increase in foreign acquisitions, but a decline in domestic acquisitions. These patterns could be consistent with foreign firms shrinking the size of the acquired firm, e.g., by selling excess capacity and laying off part of the labor force, but at the same time it makes the acquired firm more efficient. However, it could also be due to increasing sales after the acquisition, in line with the argument mentioned above that a new owner has access to new customers and distribution channels. Figure 4 shows that foreign firms have in fact increased their employment in relative terms. Furthermore, Figure 5, which shows the changes in the average shares of total domestic production, indicates that foreign firms have increased their relative production in the acquired firms. Together this indicates that foreign owners have accomplished a better utilization of resources by increasing their customer base. Domestic owners have increased the capital-labor ratio, but have not been able to increase neither the average labor-, nor the average capital-productivity.

A further perspective on the behavior of foreign and domestic acquirors is provided in Table 5, there we make a simple decomposition of the percentage change in labor productivity according to the following formula

$$\Delta \ln(\frac{Y}{L}) = \Delta \ln(\frac{Y}{K}) + \Delta \ln(\frac{K}{L})$$

where $Y/L$ is average labor productivity, $Y/K$ is the average output-capital ratio and $K/L$ is the average capital-labor ratio.

In addition to the comparisons made above it is also fruitful to look at how the compensation to factors of production change. Since few firms in our

Table 5: Decomposition of the change in average labor productivity in changes in the output-capital and capital-labor ratios, for foreign and domestic acquisitions

| | Foreign acquisitions | | | Domestic acquisitions | | |
|---|---|---|---|---|---|---|
| $t$ | $\Delta \ln(\frac{Y}{L})$ | $\Delta \ln(\frac{Y}{K})$ | $\Delta \ln(\frac{K}{L})$ | $\Delta \ln(\frac{Y}{L})$ | $\Delta \ln(\frac{Y}{K})$ | $\Delta \ln(\frac{K}{L})$ |
| -5 | -4.5 | -9.7 | 5.3 | -4.8 | -2.5 | -2.3 |
| -4 | -3.8 | -9.6 | 5.8 | -3.8 | -1.6 | -2.2 |
| -3 | -3.6 | -5.6 | 1.9 | -3.0 | -1.3 | -1.7 |
| -2 | -4.8 | -5.0 | 0.3 | -3.6 | -1.2 | -2.4 |
| -1 | -6.6 | -1.1 | -5.5 | -4.6 | -4.5 | -0.1 |
| 0 | -5.0 | 3.9 | -8.9 | -4.3 | -6.4 | 2.1 |
| 1 | -0.5 | 11.4 | -11.9 | -3.7 | -9.7 | 6.0 |
| 2 | 3.2 | 12.8 | -9.6 | -3.3 | -11.5 | 8.2 |
| 3 | 3.7 | 10.9 | -7.1 | -5.5 | -15.7 | 10.2 |
| 4 | 4.9 | 8.3 | -3.4 | -6.0 | -14.3 | 8.3 |
| 5 | 5.9 | 9.2 | -3.3 | -7.2 | -13.9 | 6.7 |

sample are stock-market quoted (they are usually subsidiaries to such companies) we cannot analyze how the firms' valuation changes as the ownership change is announced, instead we focus on the compensation to labor. Table 6 shows that the relative wage of both foreign- and domestic firms declines before the acquisition and increases afterwards. However, the increase in the relative wage of foreign firms shows a much steeper increase than does those in domestic firms. It is possible that this reflects a change in the composition of the labor force towards a higher ratio of white-collar to blue-collar workers in foreign firms, unfortunately, we do not have that information.

Finally, we will look at the development of total factor productivity, measured by the index number approach (Figure 7), and also at the development of relative cost (Figure 8) before and after an acquisition. The methodology of measuring the relative cost is further explained in the Appendix, section 6.2. The TFP measure show a decline before the acquisition for both type of firms and only a weak tendency to increase afterwards. The measure of total cost is more in line with the previous results, being above the industry average before acquisition and declines afterwards. This, of course signifies an increase in relative cost efficiency. Both foreign and domestic firms show a similar pattern of decline in relative cost.

# 4 Research & Development

Table 6 shows the average R&D intensity (R&D expenditure divided by sales) of a sample of manufacturing industries for two periods; the average of the 1980 to 1985 period and of the 1990 to 1994 period. Overall the R&D intensity has increased between the two periods, for both foreign and domestic firms. However, it has increased more for domestic firms and was for the 1990-94 period more than three times as high as for foreign firms. Looking across industries we find that the pharmaceutical industry has by far the biggest R&D intensity. The domestic pharmaceutical firms have also a much higher R&D intensity than the foreign ones. In a few industries, such as *Metal Products* and *Non-Ferrous Metals*, foreign firms have a higher R&D intensity than domestic ones. Declines in R&D intensity between periods, for foreign firms, have occurred in only two industries, (*Food*) and (*Other Chemicals incl. drugs*); while it occurred in four industries for domestic firms (*Food, Iron & Steel, Non-Ferrous Metals* and *Non-Electrical Machinery*). The importance of the pharmaceutical industry is underscored in the last line of Table 6, where we find that, excluding the pharmaceutical industry, R&D intensity by domestic firms actually dropped between time periods, while it doubled for foreign firms.

The evidence on R&D spending presented in Table 6 does not indicate that foreign firms have decreased R&D spending in general, on the contrary it has often increased compared to domestic firms. The fear that foreign firms acquire domestic ones and reduce (and move it to the home country) R&D activity, does not seem to be vindicated here. It should be noted that in some industries, where the foreign R&D intensity has increased and the domestic has decreased, this may be due to the acquisition of a domestic firm, with a high R&D-intensity, by a foreign MNF.

To further investigate the question of possible differences in R&D activities in foreign and domestic firms we ran OLS regressions of each firm's R&D-intensity on a the foreign owner dummy variable.[9] We also included: $\ln Y$, the natural log of total sales; *expshare*, the share of total sales that are exported; $expaffilshare$, the share of exports going to affiliated firms abroad; $domaffilshare$, the share of domestic sales going to affiliated firms.

Since many firms perform no R&D at all, the dependent variable takes the value zero for many observations. The OLS estimates may be biased in this case, (see e.g. for a discussion) and we therefore also estimated Tobit equations, which correct for this bias. In Table 7 we show the results, there

[9] We have R&D data for seven years; 1980, 1983, 1986, 1989, 1990, 1992 and1994. These data were pooled and time- and industry dummies were used in the estimations.

Table 6: R&D intensities for a sample of industries. Averages for the years 1980 and 1985, and 1990 and 1994.

| Industrial Sector | R&D/Sales (%) | | | |
|---|---|---|---|---|
| | 1980-1985 | | 1990-1994 | |
| | foreign | domestic | foreign | domestic |
| Food, Beverage & Tobacco | 0.47 | 0.43 | 0.38 | 0.16 |
| Textiles | 0.04 | 0.47 | na | na |
| Paper, Pulp & Paper products | 2.21 | 0.56 | 8.03 | na |
| Printing & Publishing | 0.00 | 0.05 | 0.09 | 0.28 |
| Basic Chemicals & Fertilizers | 0.72 | 2.21 | 1.70 | 2.26 |
| Other chemicals incl. drugs | 2.72 | 12.84 | 2.07 | 16.31 |
| Non-metallic mineral products | 0.37 | 1.03 | 0.49 | 1.08 |
| Iron & Steel | 0.10 | 1.83 | 0.54 | 1.28 |
| Non-ferrous metals | na | 0.36 | 0.33 | 0.00 |
| Metal products | 0.44 | 0.94 | 5.85 | 1.23 |
| Non-electrical machinery | 3.28 | 4.05 | 2.63 | 3.06 |
| All | 1.03 | 2.87 | 1.80 | 5.69 |
| All (excl, 352) | 0.84 | 1.91 | 1.78 | 1.17 |

*Source*: Statistics Sweden.

model ($a$) includes pharmaceutical firms and model ($b$) excludes these firms. The foreign dummy variable is negative when including the pharmaceutical firms, however, only the OLS estimates are significant. When pharmaceutical firms are excluded the estimate is close to zero and insignificant. The sales and export variables are positive and highly significant in all variants, which indicates that it is primarily larger, export-oriented firms that perform R&D. The intergroup sales variables are all insignificant and vary in sign. These estimates corroborates the statistics presented in Table 6; if we exclude the pharmaceutical industry we find very little difference between domestically and foreign owned firms.

To complement the analysis of R&D with the previous one on productivity we also estimated probit equations of the same type as those presented in Table 4, but in addition to the variables presented there we also included the R&D-intensity as an additional explanatory variable. This variable turned out to be positive, but insignificant. The only significant variable continued to be the market share, which is also positively correlated with R&D intensity in most industries. The magnitudes and signs of the estimated coefficients of the other variables didn't change materially when we included the R&D-

Table 7: OLS- and maximum likelihood estimates of R&D-intensity in foreign and domestic firms.

| Explanatory variables | Dependent variable: *R&DINT* | | | |
|---|---|---|---|---|
| | *OLS* | | TOBIT | |
| | (a) | (b) | (a) | (b) |
| FORDUM | -0.005** | 0.0005 | -0.004 | 0.0009 |
| | (-2.12) | (0.41) | (-1.25) | (0.57) |
| ln $Y$ | 0.003** | 0.003*** | 0.01*** | 0.006*** |
| | (2.52) | (4.81) | (6.51) | (8.12) |
| expshare | 0.026*** | 0.014*** | 0.038*** | 0.021*** |
| | (5.08) | (6.13) | (5.99) | (6.44) |
| expaffilshare | 0.003 | -0.002 | 0.003 | -0.002 |
| | (0.95) | (-0.92) | (0.55) | (-0.91) |
| domaffilshare | 0.00004 | 0.00004 | 0.00004 | 0.00004 |
| | (0.95) | (1.42) | (0.51) | (1.04) |
| No. of obs. | 1193 | 1140 | 1193 | 1140 |
| $\bar{R}^2$ | 0.38 | 0.20 | . | . |
| Log likelihood | 2,228.88 | 3,012.04 | 1,094.32 | 1,490.24 |
| F | 24.05*** | 8.72*** | . | . |

intensity so we do not report the results here.

# 5 Concluding comments

Between 1980 and 1994 the foreign ownership share of Swedish manufacturing industries increased significantly, a trend which have, if any, accelerated after 1994. On the industry level the FDI inflow over this period was attracted to industries that are sheltered from import competition by trade barriers and industries with a relatively high capital- and R&D-intensity, but not especially attracted to industries in which Swedish owned firms had a strong position on the world market. This pattern give support to resource- and market seeking motives for FDIs. On the firm-level we have found that foreign acquisitions have increased both the labor- and total factor productivity of the acquired firms. Furthermore, foreign acquirors appear to be more successful in implementing productivity improvements than are domestic acquirors. This is more clearly the case for labor productivity than for

total factor productivity. Improving labor productivity by shrinking the labor force has been more common in domestic acquisitions than in foreign, on the contrary, the latter show an increase in relative employment. These results support efficiency seeking motives for FDIs in the form of acquisitions, which is also the prediction of an efficiency based theory of ownership change in general.

We cannot find any support for the hypothesis that foreign MNFs are especially attracted to R&D intensive Swedish firms. However, the regression results presented in section 2 on industry data show that foreign ownership has increased the most in R&D-intensive industries. This can be explained in several ways; Sweden may be relatively well endowed with highly-skilled workers in certain areas, which, due to the compressed wage-structure in Sweden, also are relatively cheap from an international perspective. An alternative explanation is that foreign MNFs acquire firms in industries where other Swedish firms (not for sale) have an acquired competitive advantage in R&D, with the hope of catching some spill-overs from these firms. This in turn is likely to require it to maintain, or increase, the R&D activity in the acquired firm. We cannot discriminate between these explanations on the basis of this study, but the results does not support the strategic-asset seeking motive for FDIs if this motive is interpreted as the direct acquisition of firms with acquired firm-specific assets.

To be able to draw any definite conclusions about the welfare effects of liberalizing the laws surrounding foreign direct investment from the results presented in this paper, we have to look closer on the seller-concentration and price-cost margins in industries with increased foreign ownership, which is beyond the scope of this paper. What we can say is that there are indications of increased efficiency in the acquired firms and that there is no evidence of predation on local R&D-knowledge, which may be added on the minus sign in the welfare calculations. Our preliminary assessment is that the increased foreign ownership has contributed to economic efficiency.

# 6 Appendix

## 6.1 The index number approach

If we study the development of a single firm over time it is important to distinguish between changes in partial productivity due to changes in the input-mix from changes due to technological progress. Technological progress implies that the entire production function shifts upwards, which in turn implies that more can be produced with the same input-mix as before. Alternatively, the same output can be produced at with less inputs and therefore, with unchanged input prices, at a lower total cost.

In section 3 we defined total factor productivity as output divided by an index-function of all inputs, $h(X_1, .., X_n)$,

$$TFP = \frac{Y}{h(X_1, .., X_n)} \tag{3}$$

The function $h(\cdot)$ can be defined in different ways; Solow (1957) , for example, used a Cobb-Douglas production function, which in the two input case (labor ($L$) and capital ($K$)) leads to the following definition of $TFP$

$$A = \frac{Y}{X_L^{\alpha} X_K^{1-\alpha}} \tag{4}$$

If the firm minimizes cost, the parameter $\alpha$ shows the costsshare of labor and $1 - \alpha$ that for capital. The growth rate of $TFP$ can now be defined as

$$\dot{TFP} = \dot{A} = \dot{Y} - \left[\alpha \dot{X}_L + (1 - \alpha)\, \dot{X}_K\right] \tag{5}$$

However, the Cobb-Douglas is not a flexible functional form and this means that it does not fulfill the requirement of an ideal index-function (see Diewert 1976). An ideal index is the Törnqvist-Theil quantity index which can be derived from the translog production function. In this case the input index, in the two input case, is defined as

$$\ln x_j^k = 0.5(S_{Lj}+S_{Lk})(\ln X_{Lj}-\ln X_{Lk})+0.5(S_{Kj}+S_{Kk})(\ln X_{Kj}-\ln X_{Kk}) \tag{6}$$

where $S_{ij}$ is the cost share of input $i$ in observation (firm) $j$; $k$ is a reference observation. How to define the reference observation is important and depends on whether one has a timeseries or cross-section dataset.

In the time-series case one often uses the discrete Divisia-index which uses the previous time period as the reference observation

$$\ln x_t^{t-1} = 0.5(S_{L,t}+S_{L,t-1})(\ln X_{L,t}-\ln X_{L,t-1})+0.5(S_{K,t}+S_{K,t-1})(\ln X_{K,t}-\ln X_{K,t-1}) \tag{7}$$

In application it is common to use the initial time period as the reference period, in which case comparisons with following timeperiods can be dome by the summation

$$\ln x_t^1 = \sum_{s=2}^{t} \ln x_s^{s-1} \tag{8}$$

A TFP-index can now be constructed as the difference between the log of the output and the log of the input indices

$$\ln TFP_t = \ln y_t^1 - \ln x_t^1 \tag{9}$$

With cross-section- or panel-data the Divisia index cannot be used since "adjacent" observation doesn't have any apparent meaning. Caves, Christensen and Diewert (1982)[?] suggested a solution to this problem by constructing a hypothetical firm where the cost-share for input $i$ ($\bar{S}_i$), is defined as the arithmetic average of the cost-shares for this input over the individual firms, and the input-quantity for input $i$ is defined as a geometric average for this input over all firms. An individual firm $f$ can now be compared (at a given point in time) with the hypothetical referencefirm by constructing the following index

$$\ln x_f = 0.5(S_{fL}+\bar{S}_L)(\ln X_{fL}-\ln \bar{X}_L)+0.5(S_{fK}+\bar{S}_K)(\ln X_{fK}-\ln \bar{X}_K) \tag{10}$$

With paneldata a hypothetical firm can be constructed for each cross-section and when chained together over time. Firm $f$ at time $t$ can now be compared with the hypothetical firm at, for example, the initial time period ($t = 1$)

$$\begin{aligned} \ln x_{f,t}^1 \;=\; & \Big[0.5(S_{fL,t} + \bar{S}_{L,t})(\ln X_{fL,t} - \ln \bar{X}_{L,t}) \\ & +0.5(S_{fK,t} + \bar{S}_{K,t})(\ln X_{fK,t} - \ln \bar{X}_{K,t})\Big] \\ & \div \Big[\sum_{s=2}^{t} 0.5(\bar{S}_{L,s} + \bar{S}_{L,s-1})(\ln \bar{X}_{L,s} - \ln \bar{X}_{L,s-1}) + \\ & 0.5(\bar{S}_{K,s} + \bar{S}_{K,s-1})(\ln \bar{X}_{K,s} - \ln \bar{X}_{K,s-1})\Big] \end{aligned} \tag{11}$$

By constructing an analogous output index a measure of $TFP$ for firm $f$ at time $t$ relative to a reference time period can be constructed in line with equation 9.

## 6.2 Translog restricted cost function

The typical firm's technology could be represented by a production function, or alternatively by a cost function. We have data for three inputs, material,

labor and capital; the two first inputs are viewed as variable factors while capital is considered to be quasi-fixed. In this situation we may define a restricted cost function which specifies the minimum expenditure on variable factors necessary to produce $y_t$ given the levels of the quasi-fixed factor. The restricted cost function is in our case given by

$$c(y_t, p_{m,t}, w_t, X_{K,t}, t) \tag{12}$$

where $p_{m,t}$ is the price of materials and $w_t$ is the price of labor, $c(\cdot)$ is increasing and concave in $p_{m,t}$ and $w_t$, but decreasing and convex in $X_{K,t}$. Static factor demand functions for materials and labor is derived by applying Shepard's lemma to the cost function. The capital stock cannot be adjusted to its desired level instantaneously, but is adjusted gradually according to some adjustment cost function. A convenient form to use is a quadratic adjustment cost function of the form

$$c_K(I_t) = \frac{\alpha I_t^2}{2} \tag{13}$$

where the parameter $\alpha$ determines the speed of adjustment. The dynamic factor demand for capital is then determined from the firm's problem of minimizing the present discounted cost of fulfilling the optimal production plan, and the associated investment plan (the optimal path for the capital stock). The first-order condition for a minimum is a so called Euler equation, which shows the expected evolution of the quasi-fixed factor.

We specify the restricted cost function as a translog function of the form

$$\begin{aligned} \ln c_{it} &= a_0 + b_L \ln w_t^* + \alpha_y \ln y_{it} + b_K \ln X_{K,it} + b_t t \\ &\quad + \frac{1}{2} b_{LL} (\ln w_t^*)^2 + b_{LK} \ln w_t^* \ln X_{Kt} + b_{Ly} \ln w_t^* \ln y_t \\ &\quad + \frac{1}{2} b_{KK} (\ln X_{K,it})^2 + b_{Ky} \ln X_{Kt} \ln y_t + \frac{1}{2} b_{yy} (\ln y_t)^2 \end{aligned} \tag{14}$$

where $w_t^*$ is the wage rate normalized by the price of materials, $t$ captures independent technological process. This cost function, together with factor share equations for variable factors and the Euler equation for the quasi-fixed factors, gives a system of equation which is estimated y $3SLS$.[10]

We estimate the system of equations separately for each industry, using firm level data and using firm specific dummy variables. For each firm we then calculate the residual from the average industry cost function. The residuals are summed over all firms that was acquired, for five years preceding the acquisition, up to five years afterwards. The summation was done across industries and separately for foreign and domestic acquisitions.

[10] For further details about specification of this system and its estimation, see e.g. Good, Nadiri and Sickles (1996) or Morrison (1993).

## 6.3 Description of data and sample

The data used for constructing TFP indices is accounting data from a sample of individual firms with at least 50 employees drawn from Statistics Sweden's company register (CFAR). This dataset was complemented with data from Statistics Sweden's register of foreign owned firms and confidential data for all firms from a special survey conducted by Statistics Sweden. The latter source gives information about research & development expenditures, inter-group sales and more, which are not provided in the regular accounting data given in firms annual reports. Data for the following years were acquired from these sources: 1980, 1983, 1986, 1989, 1990, 1992 and 1994. Data for intermediate years were acquired from annual reports, for the variables which are in the public domain. This gives us a possibility to construct panel data sets for each industry, with yearly observations on each cross-section. .

The sampling procedure was not random. Instead two criteria were used: *i*) the industry definition should be robust to changes in the change from the industrial classification system used between 1980 and 1991 (ISIC revision 2) and the currently used classification (ISIC revision 3); *ii*) the included firms should be homogeneous with respect to their product program, i.e., firms should not span several industry classifications at the aggregation level chosen (5-digit level). This procedure resulted in 34 industries. Due to cost constraints we had to limit the number of included industries somewhat, by excluding some of the industries with the largest number of firms. The sample was further reduced by the need to maintain confidentiality with respect to the R&D variable, hence industries with less than four firms were not included. The total number of industries used in this paper is therefore 30.

The accounting data gives total revenue, cost of goods sold, wage cost, changes in inventories, net investment and measures of capital stocks. Output prices were collected from Statistics Sweden's industry statistics at a level of aggregation most suitable for the industry definition we used for identifying the industries' firms. The consumption of intermediate goods and services was calculated as: total revenue minus profits before depreciation allowances minus wage costs. The price of labor was calculated as total wage bill (including payroll taxes) divided by the total number of employees, the price of intermediate goods was taken from the national accounts at the closest possible ISIC level. A price index for capital services (rental cost of capital) was constructed from measurements of depreciation rates[11] for 22 three digit

[11] These depreciation rates are taken from a separate study by Johansson and Modén [9], and are based on direct assessments of remaining economic lives from a broad sample of manufacturing firms.

ISIC industries, and estimated capital gains on each type of equipment. The total rental cost of capital is then equal to the rental cost of capital per unit of capital times the quantity of capital employed.

The number of acquisitions studied was 170 of which 90 was done by foreign acquirors and 80 by domestic acquirors.

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Figure 1: Development of relative average labor productivity in firms acquired by a foreign MNF (—) and domestic firm (- - -), before and after the acquisition

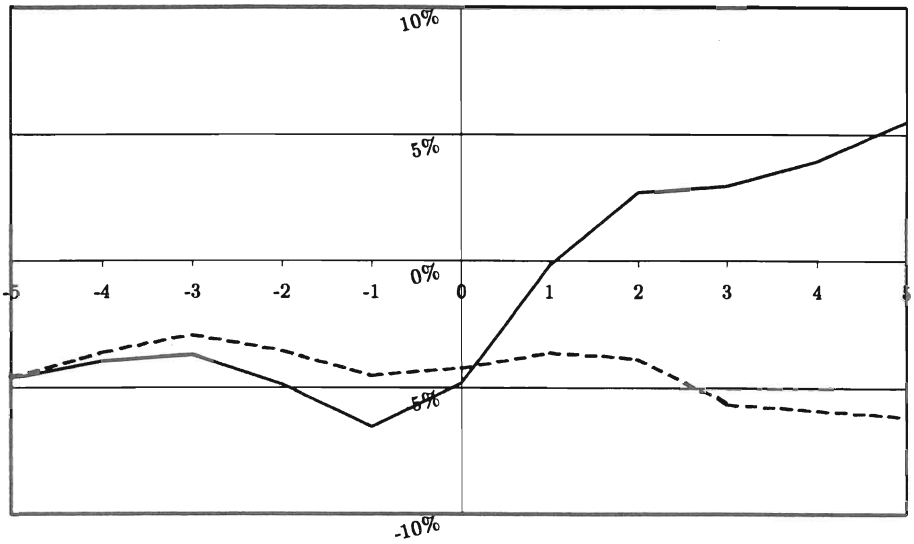



Figure 2: Development of relative average capital-labor ratio in firms acquired by a foreign MNF (—) and domestic firm (- - -), before and after the acquisition

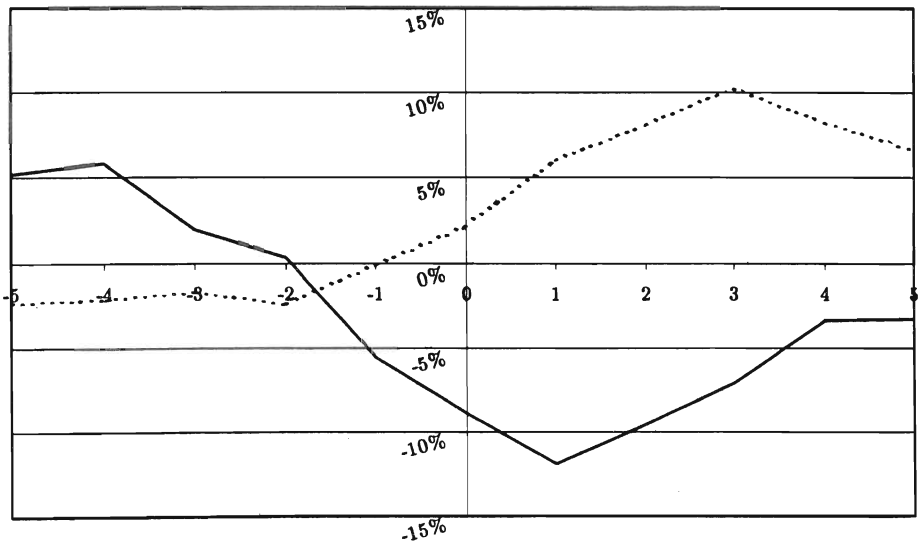


Figure 3: Development of relative average output-capital ratio in firms acquired by a foreign MNF (—) and domestic firm (- - -), before and after the acquisition

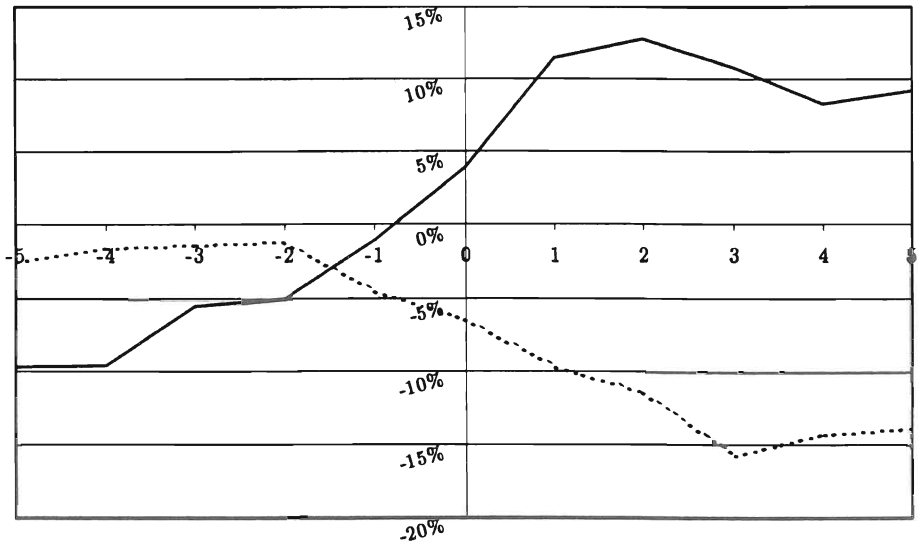



Figure 4: Development of changes in relative employment in firms acquired by a foreign MNF (—) and domestic firm (- - -), before and after the acquisition

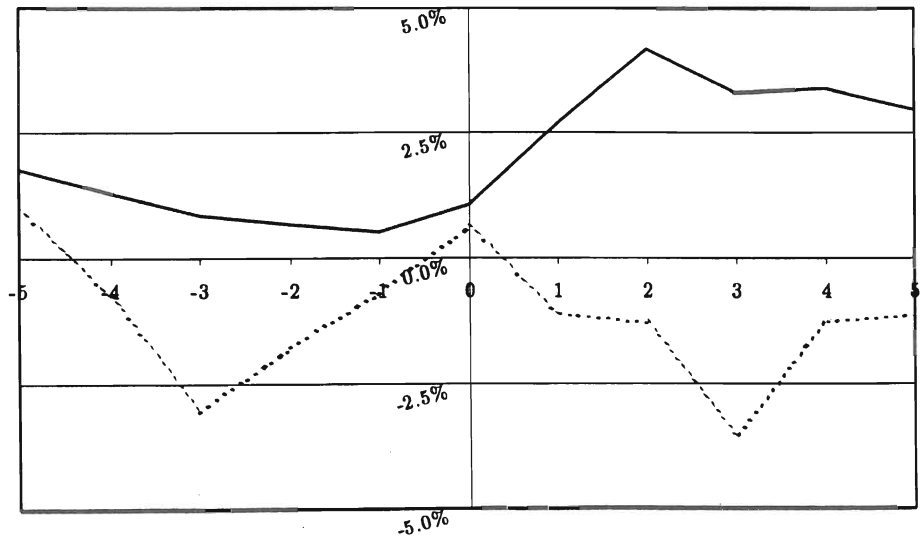


Figure 5: Development of the average relative share of total domestic production of firms acquired by a foreign MNF (—) and domestic firm (- - -), before and after the acquisition

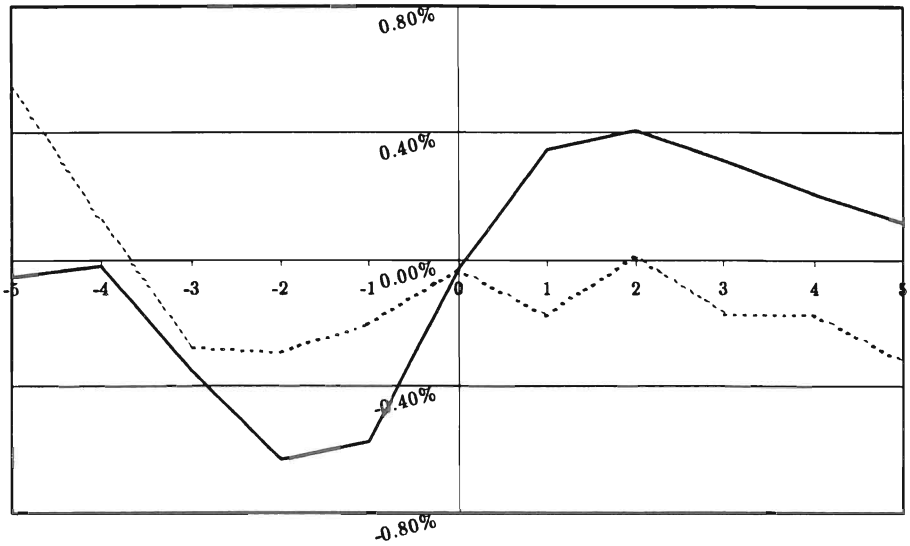



Figure 6: Development of changes in relative wage levels in firms acquired by a foreign MNF (—) and domestic firm (- - -), before and after the acquisition

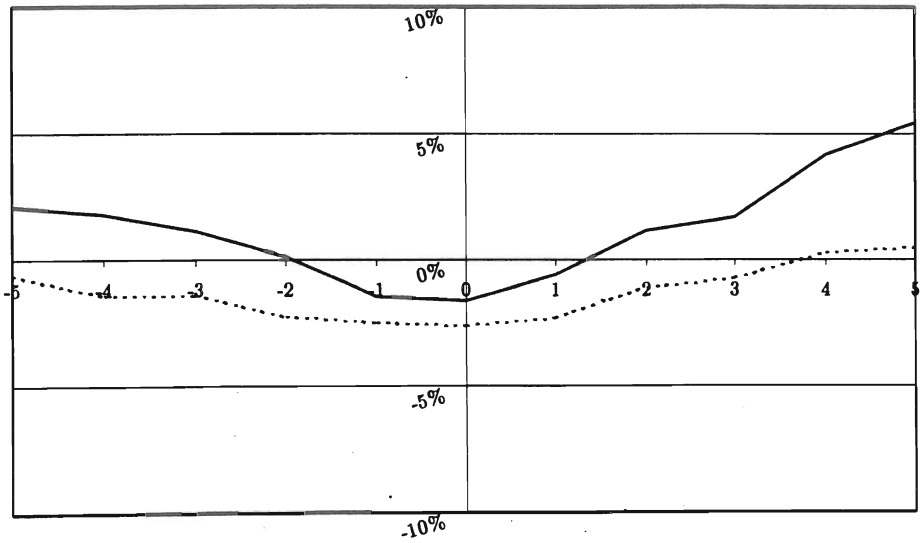


Figure 7: Development of changes in relative total factor productivity in firms acquired by a foreign MNF (—) and domestic firm (- - -), before and after the acquisition

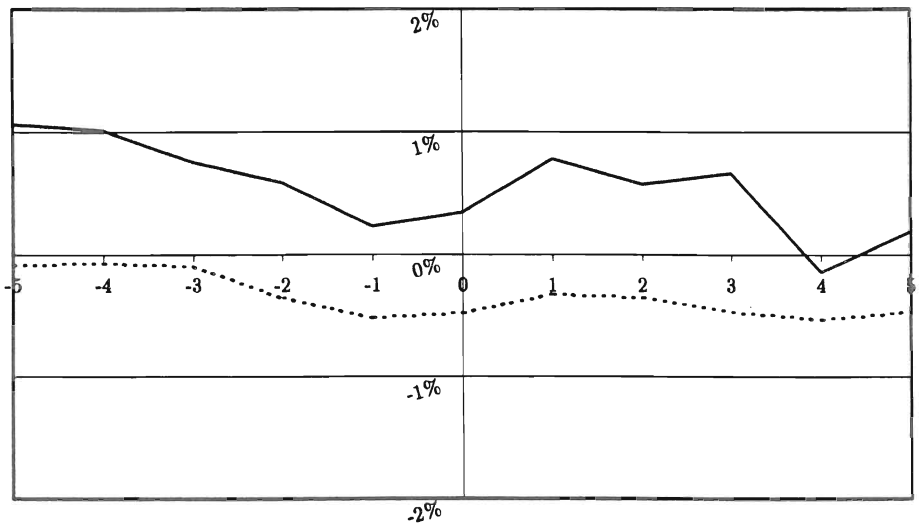
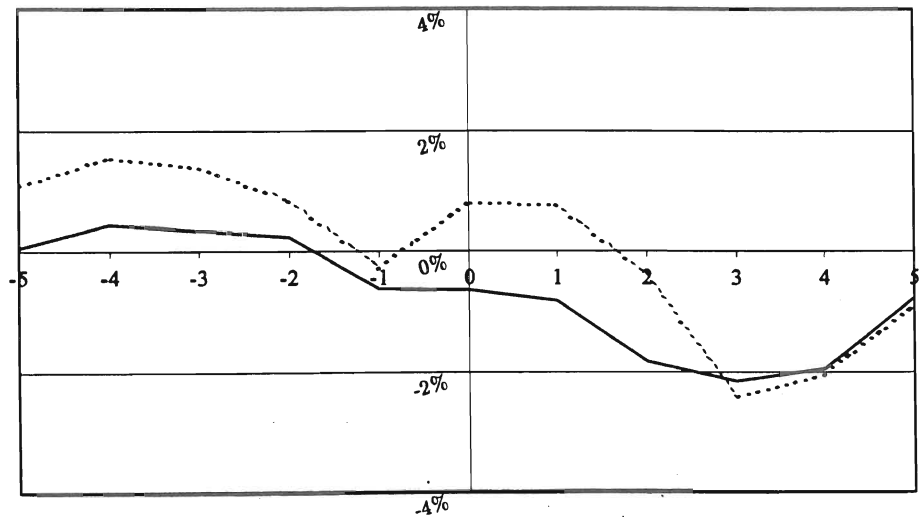



Figure 8: Development of changes in relative total cost in firms acquired by a foreign MNF (—) and domestic firm (- - -), before and after the acquisition



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