THE RESEARCH INSTITUTE OF INDUSTRIAL ECONOMICS

Working Paper No. 619, 2004

Corporate Restructuring and Labor Productivity Growth

by Katariina Hakkala

IUI, The Research Institute of Industrial Economics
P.O. Box 5501
SE-114 85 Stockholm
Sweden

Corporate Restructuring and Labor Productivity Growth*

Katariina Hakkala†
IUI‡and Stockholm School Economics

February 2004

Abstract

This paper analyzes corporate restructuring and its role in generating labor productivity growth in a sample of large Swedish manufacturing corporations. It is found that external restructuring, including ownership changes, start-ups and closures of plants, accounted for up to 47 percent of the productivity growth of the sample of corporations during the 1986-96 period. The results indicate that the productivity of large multi-plant corporations grew almost twice as fast as that of single-plant firms with the same internal productivity growth, thanks to their organizational flexibility. Divestitures of low productive plants were found to play a particularly important role in the replacement process generating productivity growth. The effect of external restructuring on productivity is to some extent explained by a shift towards a more skill-intensive production.

Keywords: corporate restructuring, labor productivity growth
JEL classification: D24, F23, G34

---

*I thank Ari Kokko, Fredrik Sjöholm, Matthew Slaughter and Jonathan Haskel for helpful comments. Financial support from Tore Browaldh's Foundation is gratefully acknowledged.

†e-mail: KatariinaH@iui.se
‡The Research Institute of Industrial Economics, Box 5501, SE-11485 Stockholm, Sweden

1 Introduction

The productivity studies of the last decade have taught us that, in addition to the productivity growth that occurs within establishments, an important contribution to the overall productivity increases is made by a process of external restructuring whereby incumbents with high productivity grow and gain market shares, while low productivity establishments exit and are replaced by more productive entrants. The importance of external restructuring in generating productivity growth has been examined particularly by the empirical studies analyzing the sources of aggregate productivity in the whole economy or an industry[1], but also by theoretical studies on industry dynamics with heterogenous firms.[2]

However, none of this research focuses on the role of restructuring within multi-plant firms in generating productivity growth. The micro-level studies touch upon issues associated with firm-level restructuring, but leave fundamental questions regarding the sources of corporate productivity growth unanswered. Some more recent findings demonstrate that there is reason to focus on multi-plant firms. For instance, Disney et al (2003) examine productivity growth in the UK manufacturing sector between 1980 and 1992 and find that surviving single-establishment firms had almost zero productivity growth, while surviving establishments that were part of multi-establishment firms accounted for nearly half the overall productivity growth. Including entry and exit, the contribution of multi-plant firms to total productivity growth was 79 percent. This result suggests that multi-plant firms make an important contribution to overall productivity growth.[3] Research on job flows by Schuh and Triest (2000) finds, in turn, evidence of a large share of the job reallocation between plants owned by multi-plant firms occurring within these firms. Aggregating over different types of firms yields that three fourths of the reallocation of jobs between manufacturing plants occur between firms and one fourth within firms. This finding suggests an extensive restructuring within multi-plant firms.

The question this paper aims at answering is how restructuring within multi-plant corporations is associated with labor productivity growth. In addition to "internal" fac-

[1] See e.g. Baldwin and Gorecki, (1991), Baily, Hulten and Campbell, (1992), Baldwin, (1993), Griliches and Regev, (1995), Liu and Tybout, (1996), Olley and Pakes, (1996), Aw, Chen and Roberts, (1997), Foster, Haltiwanger and Krizan, (1998) Levinhson and Petrin, (1999) and Haskel, Heden and Disney (2000).

[2] See e.g. Jovanovic, 1982, Cabral, 1993, Hopenhayn, 1992 and Pakes and Ericson, 1995.

[3] See also Baily et al (1992) who only report small differences in productivity between plants of single- and multi-plant firms. However, plants that were part of a high-productivity firm also had high productivity.

tors, such as technology upgrading and downsizing within the plants that remain part of corporations over longer periods, the labor productivity of a multi-plant corporation may also increase as a result of "external" restructuring, as inefficient plants are sold or closed down and replaced by more productive new or acquired plants. In particular, the role of ownership changes of plants in generating productivity growth of multi-plant corporations has so far not been examined to any considerable extent. Whether multi-plant firms derive their productivity growth from internal or external sources is essential since productivity growth is closely associated with economic growth. It is believed that factors such as intangible assets used as joint inputs and economies of scale and scope may create a competitive advantage and explain the leading position in productivity held by multi-plant firms. These factors generate "real" productivity growth within firms and contribute to the overall productivity growth of industries. However, if the main source of productivity growth of multi-plant firms is organizational change, such as acquisitions of more productive plants and divestitures of misfits, the contribution of multi-plant firms to overall productivity growth may be limited.

By examining the sources of productivity growth at the level of corporation, this study extends both the micro-level productivity studies that analyze internal determinants of firm productivity growth and the industry level studies that examine the importance of external restructuring. The analysis of this study has been made possible by the access to unique plant-level data on the thirty largest multinational manufacturing corporations in Sweden. Rather than examining the sources of aggregate productivity growth, this study focuses on the labor productivity growth of a sample of large multi-plant manufacturing corporations. To distinguish the sources of productivity growth at the corporation level, this paper uses information for all plants in Swedish manufacturing sector that are controlled directly or indirectly through affiliate firms by the corporations. The sample does not claim to be representative for the manufacturing sector or for multi-plant firms in general. However, the sample corporations are representative for large multinational corporations that play an important role in several industrialized economies and in particular, in small open economies such as Sweden. For instance, the thirty corporations account for about 70 percent of aggregate Swedish industrial R&D in 1999.[4] This should be compared with their share of total manufacturing employment, which was about 30 percent during the period of study.[5]

[4]Own calculations based on data provided by Statistics Sweden. The share was 65 percent in 1993.

[5]In the US, the multinational parent firms account for 52.1 percent of manufacturing employment and 69.1 percent of industrial R&D in 1999 (Source: BEA, Bureau of Labor Statistics and National Science

The main finding of the paper is that external restructuring at corporation level contributes almost as much to long-term labor productivity growth of the multi-plant corporations as internal sources. Particularly important is the contribution of ownership changes of plants. The relative importance of external and internal sources of productivity growth varies substantially with the business cycle at the corporation level. The findings are in line with the results of industry-level studies showing the within plant component to be large and positive in periods of robust productivity growth and negative in periods of modest productivity growth.[6] The external restructuring thus seems to compensate for low or even negative productivity growth within the continuing operations of the corporations. By using data for educational level of the employees, it is also found that corporations sold and closed plants that were less skill-intensive than the plants stayed with the corporations and that new, but not the acquired plants, were more skill-intensive than the continuing plants of the corporations. These findings suggest that external restructuring and divestitures, in particular, led to productivity increases through a shift towards a more skill-intensive production. During the period of high productivity growth, when productivity growth was found to stem mainly internally through productivity increases within plants that stayed with the corporations, the initial skill intensity is not found to explain productivity growth of these plants. It suggests that other factors than a skill-based technological change explain productivity increases of the continuing plants during the period.

The structure of the paper is as follows: Section 2 further discusses the specifics of multi-plant corporations, Section 3 describes the data, Section 4 presents the methods and results of productivity decompositions, Section 5 examines the relationship between skill intensity and labor productivity growth and Section 6 concludes.

2 Restructuring within Multi-Plant Firms

In the literature on industry dynamics, a firm's life is described as a cycle. In Jovanovic's (1982) model of passive learning, for instance, firms enter an industry when they see a business opportunity, employ labor and other inputs.[7] As the firms operate, they learn

Foundation).

[6] Baily, Hulten and Campbell, 1992, Baily, Bartelsman and Haltiwanger, 1996a and 1996b, and Haltiwanger, 1997.

[7] See Hopenhayn (1992), Cabral (1993), and Pakes and Ericson (1998) for other theoretical models on industry dynamics with heterogenous firms.

about their productivity. Productive firms grow larger and gain market shares, while unproductive ones contract, and eventually shut down. A general feature in most models of industry dynamics is that firms evolve and grow organically by hiring more production factors and expanding their current operations if finding it profitable.

Profit maximization in multi-plant firms involves decisions regarding several plants, perhaps even in several industries. At one extreme, each plant can be an independent unit producing a distinct product, and can essentially be run without interaction with other units. At the other extreme, all plants are involved in the production of a single final good. To describe a firm's life becomes considerably more complex when a firm owns more than one plant. Changes in demand, factor prices and technology at any stage of the production process will then affect all plants of the firm. Although plants in the same firm may share common characteristics or joint-inputs such as R&D results, management and brand names, plants of multi-plant firms are likely to differ in terms of productivity, even in the same industry. For instance, new plants tend to be less productive than incumbents, but exhibit substantial productivity growth due to learning effects. Vintage effects may, on the other hand, explain why some older plants are less productive than new ones.

An implication of a multi-plant organization structure and differences between plants is that firms may continuously restructure their operations. Plants facing decreasing demand or productivity may be contracting and eventually be shut down, as predicted by the models for industry dynamics, but corporations can also try to sell them first and perhaps replace them by acquiring or starting new plants where they see better business opportunities. Maksimovic and Phillips (2002), for instance, find evidence of conglomerate firms becoming more focused when the prospects in their main segments improve by acquiring assets in these segments and selling assets in more peripheral segments. During periods of weak demand in their main business segment, they diversify by acquiring assets in unrelated industries.

A multi-plant firm's response to changes can be quite different from that of a single-plant firm. For instance, multi-plant firms may be more inclined to neglect businesses that do not perform well, as compared to single-plant firms, because closing down some plants is less dramatic when the firm still continues operating in other businesses. Bernard and Jensen (2002) study plant shutdowns and find that unconditionally, multi-plant firms are far less likely to shut down a plant than a single-plant firm. The positive relationship is, however, entirely driven by the better characteristics of plants within multi-unit firms.

Accounting for plant attributes such as age, size, productivity etc., these same firms are actually more likely to close a plant.[8]

Despite the existing evidence of differences between multi-plant and single-plant firms, very few previous studies have analyzed the implications of these differences on productivity growth. This paper sheds light on some of the particular features of multi-plant firms by examining the sources of productivity growth at the corporation level. In comparison with most productivity studies, an important difference is that ownership changes of plants are regarded as an additional source of productivity growth at the corporation level.[9] As an example, corporations are able to attain productivity growth either by improving the productivity of their operations internally, for instance by investments in R&D, or by acquiring plants or firms with high productivity. Firm-level data might not be able to separate these sources and in most studies on industry level productivity using plant-level data, plants changing owners are generally categorized as continuing plants since corporate ownership structures extending to several levels of affiliate firms are difficult to trace. This paper uses data for all plants directly or indirectly controlled by the corporations through affiliate firms and distinguishes the ownership changes of plants as an external source of productivity to a corporation.

3 Data

The data set is a sample consisting of the thirty largest multinational manufacturing company groups with their headquarters in Sweden in 1990. Some of the corporations included in the sample have moved their headquarters from Sweden after 1990, but they were still key employers in Sweden in the 1990s. The sample corporations account for about 30 percent of the total employment in Swedish manufacturing industries during the period in question.[10] Statistics Sweden collects information on inputs and outputs of individual establishments and has constructed the data set from its databases on industrial and financial statistics.

The data set includes information on the manufacturing firms and plants under the control of the thirty corporations during the period 1985-98. In the resulting unbalanced

[8] Audretsch (1994) also found that among new establishments, the likelihood of exit was higher for subsidiaries and branch plants than for independent establishments when controlling for the start-up size.

[9] Baldwin (1993) analyzes the role played by changes in the ownership control of plants for the turnover process and productivity growth in Canadian manufacturing.

[10] The average employment share and sales value share of the sample corporations in total manufacturing was 32.8 and 37.7 percent, respectively, in 1985-96.

panel, the yearly number of plants varies between about 600 and 700. Plants and firms are assigned identifiers remaining with them over their lifetime. This means that plants can be followed over time and ownership changes, plant births and deaths can be identified. The data is described more in detail in the Appendix.

In the analysis of the productivity growth of the corporations, this study considers both gross output and value added based measures of labor productivity. Gross output is measured as sales value of shipments,[11] deflated by industry-specific deflators.[12] Labor input is the total employment of the plant, and the labor productivity using gross output measure is the ratio of the two. Value added is defined as real sales value of shipments less real value of outlays for energy and materials by using average price indices for energy and material inputs in manufacturing. Industry-specific price deflators for materials are not available, which is a possible source of a measurement error. Furthermore, the value added measure is computed without taking into consideration costs for services purchased from other plants within the same corporation or other firms. Due to the limitations of the value added measure the gross output measure of labor productivity is regarded as the main measure. The value added measure is considered as an alternative measure to analyze the sensitivity of the results.[13]

There are other relevant measurement issues involved in the choice of productivity measure. Using labor productivity measure rather than total factor productivity implies certain limitations. One shortcoming of labor productivity as an indicator of productivity performance is that it fails to capture changes in factor intensities, which may be a result of the adoption of new technology or changes in factor prices. For example, productivity growth could be caused by a shift to labor-saving, and more capital intensive, technology. Another problem with labor productivity is that average labor productivity has been found to be procyclical in empirical studies.[14] Total factor productivity (TFP) may be

[11] Shipments of finished goods from other plants within the firm are excluded from the gross value.

[12] A majority of deflators are assigned at the three-digit level of the Swedish standard for industry classification (SNI69 and SNI92). Some industries with an important share of total manufacturing production are given deflators at a more disaggregated level, while industries with smaller shares have deflators at the two-digit level.

[13] Foster et al (1998) used sales value per unit of labor (man-hours and employees) as their main measure of plant-level labor productivity, but also performed decompositions of labor productivity growth using value added per unit of labor. They report the results to be very similar for the two measures.

[14] Baily, Bartelsman and Haltiwanger (1996b) test different hypotheses that may explain the procyclical productivity growth that is not driven by technological shocks. Among the explanations studied are plant-level increasing returns to scale, labor hoarding or a contemporaneous productivity penalty induced by changing the scale of operations. They find that plants permanently downsizing disproportionately account for procyclical productivity, and interpret the results to favor an adjustment cost model involving

a more appropriate measure of productivity, at least theoretically, because it takes into account all inputs, not only labor. In practice, the estimation of labor productivity can give better accuracy than TFP, because estimating the value of capital stocks often implies a large error. Despite the problems associated with labor productivity measures, they have been found to be highly correlated with other productivity measures.[15] This study uses only labor productivity measures because the investment data needed for computing TFP (total factor productivity) are not available at the plant level. It is recognized that the focus on labor productivity sets some limitations for the interpretation of the results.

Figure 1 shows the number of employees and the real sales value of production in the sample corporations and the rest of the Swedish manufacturing sector.[16] In the period 1985-96, Sweden experienced a strong economic boom during the late 1980's and a severe recession in the early 1990's. The figure clearly shows the impact of the economic crisis in 1991-93 on the manufacturing sector. It seems that the sample corporations were not as profoundly hit by the crisis as the rest of the manufacturing sector. After the severe recession, the manufacturing sector recovered both in terms of employment and production. It is remarkable that the production of the sample corporations increased rapidly after the economic crisis, while their employment decreased continuously after the peak year of 1988.

In order to trace patterns of structural change in the sample, Figure 2 shows the allocation of employment for the corporations in 1985, 1990, and 1996 according to an OECD taxonomy of industry groups.[17] The figure shows that in the 1990's, jobs became increasingly concentrated in science-based industries where R&D expenditures are the highest. All other industry groups decreased in employment during the period. Despite the decrease in employment, scale-intensive industries kept their position as the most important sector for the sample corporations, while the science-based industries overtook the differentiated goods industries and become the second most important sector.

The structural changes observable in the data do not necessarily mean that the overall production profile of the sample corporations was changed. Operations contracting in Sweden may have been relocated to other countries. Fors and Kokko (1999) studied the international operations of seventeen of the corporations included in the sample and

a productivity penalty for downsizing as the largest source of procyclical productivity.

[15] For instance, the results of Foster et al. (1998) for productivity decompositions are similar for both measures of productivity.

[16] Continuing corporations (26 of 30) are included. The real sales value is PPI-deflated (1990=100).

[17] For definitions, see the Appendix.

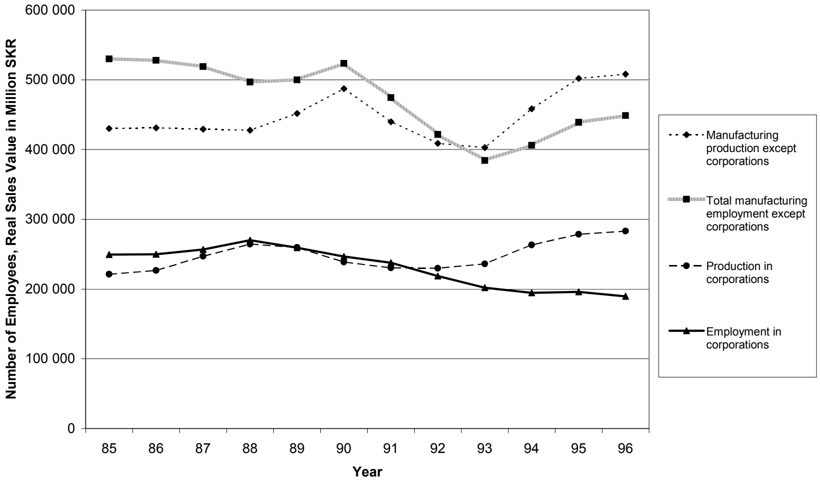

Figure 1: Employment and production in the sample corporations and the rest of the manufacturing sector

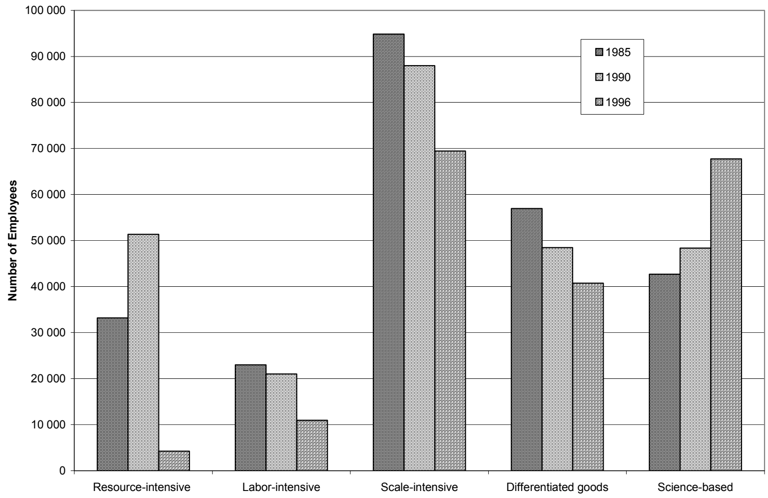

Figure 2: The sample corporation employment by industry groups according to OECD taxonomy.

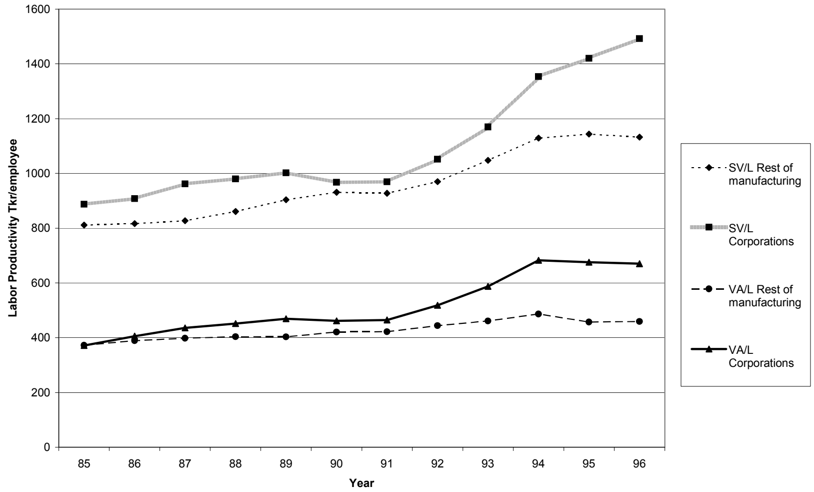

Figure 3: Average labor productivity of the sample corporations and the rest of the manufacturing sector.

found evidence of similar dynamics among the foreign affiliates. Their analysis suggested an opposite direction of change in Sweden and abroad for most industries, which they interpreted as a sign of increasing specialization in the home-country operations of the corporations.

Figure 3 shows the average levels of real labor productivity of the sample corporations and the rest of the manufacturing sector. Productivity is measured as sales value per employee (SV/L) and value added per employee (VA/L).[18] Until the beginning of the 1990s, the sample corporations had modestly higher productivity than the rest of the manufacturing sector. However, the productivity gap seems to have increased dramatically during the 1990s. In that period, the annual rate of productivity growth in the sample corporations was about 1.02 percent (SV/L) while the annual productivity growth in the rest of the manufacturing sector was 0.47 percent. There may be several reasons for the increasing productivity gap. For instance, the fact that the sample corporations became increasingly specialized in science-based industries may explain why they became increasingly more productive. We will return to these issues in the next section.

[18]Real sales value and value added are computed as PPI-deflated (1990=100).

4 Restructuring and Labor Productivity

The overall productivity growth within a corporation can be divided into the contributions of internal and external sources by using methods of decomposition originating from studies on industry-level productivity growth. For robustness, I use two different decomposition methods suggested by Foster, Haltiwanger and Krizan (1998) and Griliches and Regev (1992). Foster, Haltiwanger and Krizan (FHK) (1998) propose a decomposition of overall industry-level productivity growth into five components; within, between, covariance, entry and exit effects.[19] The within effect accounts for the contribution of productivity growth within surviving plants. The between effect is the contribution of changes in the shares of the continuing plants, implying that productivity grows if productive plants grow relatively more in an industry. The covariance effect is counted as the product of changing shares and changing productivity of the continuing plants. The covariance effect is positive (negative) when the shares of plants with growing (falling) productivity increase. The entry and exit effects comprise the contributions of new and closed plants to industry productivity. When the less (more) productive plants are closed down and replaced by new more (less) productive ones, the contribution to industry-level productivity growth is positive (negative).

The methods of decomposition for industry-level productivity growth need to be modified for the corporation level analysis. At the corporation level, the between and covariance effects capture the contribution of changes in the shares of the continuing plants within a corporation. Thus, the effects capture the contribution of organizational restructuring within the corporation instead of changes in the market structure of an industry. Another important difference is that entry and exit at the corporation level comprise acquisitions and divestitures in addition to start-ups and closures. The contribution of all these four effects can be computed separately. Furthermore, the contribution of plants changing industries, but remaining in the ownership of the same corporation, is not defined as entry or exit like in industry-level studies. The contribution of these plants can be computed as for the other continuing plants or as a separate effect when the available industry classification so allows.[20]

[19] The method is a modified version of that used by Baily, Hulten and Campbell (1992). See Haltiwanger (1997) for a discussion of the limitations of the original method.

[20] During the period studied, the Swedish classification of industries (SNI) is changed. A translation of the old, SNI69, to the new, SNI92, involves problems at the disaggregated level. Changes in industries can only be analyzed during the sub-periods of 1985-90 and 1990-96, where the standard remains the same throughout the period.

The average change in the productivity of the corporations, P_t, between year t and $t-k$ is counted as

$$\Delta P_t = \sum \overline{\theta}_c (P_{c,t} - P_{c,t-k}), \tag{1}$$

where $\overline{\theta}_c$ is corporation c's average of the start year and the end year share in the sample and $P_{c,t}$ the real labor productivity of the corporation in year t. To sum across corporations, I consider two alternative weights: output and employment weights.[21] A decomposition of ΔP_t in corporation c according to the method proposed by Foster, Haltiwanger and Krizan (1998) is given by

$$\Delta P_{c,t} = \sum_{j\epsilon S} \theta_{j,t-k} \Delta p_{j,t} + \sum_{j\epsilon S} \Delta\theta_{j,t}(p_{j,t-k} - P_{c,t-k}) + \sum_{j\epsilon S} \Delta\theta_{j,t}\Delta p_{j,t} + \sum_{j\epsilon N} \theta_{j,t}(p_{j,t} - P_{c,t-k}) - \sum_{j\epsilon E} \theta_{j,t-k}(p_{j,t-k} - P_{c,t-k}), \tag{2}$$

where $\theta_{j,t}$ is plant j's share in the corporation and $p_{j,t}$ the real labor productivity of plant j in year t and where S, N and E denote surviving, entering and exiting plants. The terms on the right-hand side are the within, between, covariance, entry and exit effects in that order. The within effect accounts for the productivity growth in continuing plants, given unchanged shares within the corporation. The contribution of changes in the shares of continuing plants implies that productivity grows if productive plants (between effect) or plants with high productivity growth (covariance effect) gain shares within a corporation. The between and the covariance effects are defined as internal restructuring. The entry effect consists of the contributions of new and acquired plants and the exit effect includes the contributions of closed and sold plants. These effects are computed as entry and exit effects in equation (2) and are displayed separately. The aggregated entry and exit effects are defined as external restructuring. To aggregate across plants within a corporation, I use both employment and output weights. Employment weights are seemingly more appropriate for labor productivity measures and have been used in industry-level studies by e.g. Griliches and Regev (1995), Baily, Bartelsman and Haltiwanger (1996a) and Foster, Haltiwanger and Krizan (1998).

Foster, Haltiwanger and Krizan (1998) point out that the decomposition method is

[21] The weights used at the corporation level correspond to plant weights used in the decompositions.

sensitive to measurement error. For instance, if employment were measured as spuriously high in one period, the result would be a spuriously low measured productivity. The error would yield a negative correlation between $\Delta\theta$ and Δp and a spuriously high within effect. For robustness, we therefore also use a decomposition method proposed by Griliches and Regev (GR) (1992)

$$\Delta P_{c,t} = \sum_{j\epsilon S} \overline{\theta}_j \Delta p_{j,t} + \sum_{j\epsilon S} \Delta\theta_{j,t}(\overline{p}_j - \overline{P}_c) + \sum_{j\epsilon N} \theta_{j,t}(p_{j,t} - \overline{P}_c) - \sum_{j\epsilon E} \theta_{j,t-k}(p_{j,t-k} - \overline{P}_c) \quad (3)$$

where the bar indicates an average of the base year and the end year values. The first and second terms are the equivalent of the within and between effects of the FHK decomposition. The internal restructuring thus only consists of the between effect. The third and the fourth terms are entry and exit effects. The advantage of the decomposition method is that averaging removes some of the measurement error. However, a disadvantage is that the interpretation of the effects is not as straightforward. Averaging the weights implies that the within and between effects reflect the covariance effect to some extent.

4.1 Results

To first examine the role of external restructuring may play in generating productivity growth, Table 1 gives summary statistics of productivity for the different types of plants in the sample. Columns 1 and 2 report labor productivity of sold, closed, acquired and new plants relative to continuing plants in the start and end year of the studied period. We see that in average sold and closed plants were less productive than the continuing plants in the start year. Of the plants that entered the sample corporations between 1985 and 1996 only the new plants were more productive than the continuing plants. Acquired plants had a lower average productivity than the continuing plants, but the difference in means was not statistically significant. The average productivity levels suggest thus that plant turnover may have affected the overall productivity growth of the sample corporations.

Column 3 in Table 1 reports also the average relative labor productivity that is computed as the ratio of plant labor productivity to the average labor productivity of its industry.[22] It is worth noting that in the start year all the different plants were on average relatively productive. However, in the end year productivity of all plants except for

[22] Industry level productivity is computed at the four-digit level of industries according to the Swedish classification of industries (SNI69 in 1985 and SNI92 in 1996).

Table 1: Productivity levels of plants by type

Type of plants	Productivity measure				
	(1)	(2)	(3)	(4)	
1985	SVL[1]	VAL[1]	RLP[2]	t-test[3]	Number of plants
Sold	0.885	0.886	1.332	1.969**	365
Closed	0.875	0.855	1.302	1.689*	129
Continuing			1.489		197
1996					
Acquired	0.923	0.896	0.875	1.102	224
New	1.272	1.213	1.079	-2.431**	66
Continuing			0.898		197

Notes: (1) Continuing plants VAL=SVL=1, (2) RLP=$SVL_{plant}/SVL_{industry}$,(3) t-value is for the test of equality of means of RLP ** and * signify statistically significant at 5 and 10 percent level.

the new plants was on average less than the industry average. The productivity differences between different types of plants are similar in terms of the productivity measure that controls for some industry-specific variation. Column 4 reports t-values for the test of equality of means between the continuing plants and the respective group of plants. The descriptive statistics in Table 1 thus suggests that the differences in average productivity of different types of plants do not only reflect industry-level variation in productivity.

Table 2 shows the results of the decompositions for the 1985-96 period.[23] Each component's contribution is displayed as a share of total growth. The results for the two weights, decomposition methods and productivity measures differ somewhat, as would be expected. With respect to the relative importance of external restructuring, however, the results are similar for both methods of decomposition. The total contribution of external restructuring is 42-47 of the productivity growth of the sample corporations. This result is striking. Summing the effects of both internal and external restructuring, the results suggest that the productivity of the sample corporations grew at least twice as fast as that of single-plant firms with the same productivity growth within continuing plants.[24]

If we look at different internal sources of productivity growth, it is seen that the most

[23]Table A2 in the Appendix shows the employment share and the number of plants defined as continuing, changing industry, new, acquired, closed and sold.

[24]The decompositions are also computed using value added per employee. The results obtained are very similar to those in Table 3.

Table 2: Decomposition results

Labor Productivity Growth								
Productivity Measure	SVL				VAL			
Weight	Employment		Output		Employment		Output	
Decomposition Method	FHK	GR	FHK	GR	FHK	GR	FHK	GR
Within	0.440	0.483	0.198	0.479	0.466	0.516	0.424	0.507
Between	0.045	0.045	-0.240	0.060	0.030	0.043	0.020	0.137
Covariance	0.087		0.562		0.099		0.167	
Acquired	0.242	0.132	0.301	0.177	0.238	0.130	0.296	0.169
Sold	0.026	0.178	0.053	0.161	0.021	0.177	0.010	0.113
New	0.147	0.083	0.095	0.034	0.150	0.072	0.094	0.028
Closed	0.012	0.079	0.031	0.089	-0.004	0.063	-0.010	0.046
Internal Sources	0.572	0.528	0.519	0.539	0.595	0.559	0.610	0.644
External Sources	0.428	0.472	0.481	0.461	0.405	0.441	0.390	0.356
-Ownership Changes	0.268	0.310	0.355	0.338	0.259	0.307	0.306	0.282
-Entry and Exit	0.159	0.162	0.126	0.195	0.146	0.135	0.084	0.074
Growth Rate (%)	0.85		0.86		1.12		1.50	

Note: Decompositions are computed for continuing corporations.

important effect is the within effect: continuing plants had high productivity growth. The within effect accounts for about 44-52 percent of total productivity growth computed with labor weights. The labor weighted results imply that nearly half the productivity growth would have occurred even if the plant shares had remained constant. The between effect, that is the contribution of continuing plants with high initial productivity increasing their share within corporations, varies between 3.0 and 4.5 percent computed with labor weights, depending on the method. The covariance effect, the contribution of plants with high productivity growth increasing their share only computed by the FHK method, varies from 8.7 to 56.2 percent depending on the weights used. When output weights and the FHK method are used, the share of the within plant component is much smaller, while the covariance effect is larger, thereby suggesting that the effect of plants with high productivity growth increasing their shares is more important. This is reasonable. With employment weights, the most productive firm may stand still, although it captures much of the output market.

The differences between the methods are more obvious for the components of external restructuring. The contribution of new and acquired plants is much larger computed by the method of FHK than to that of GR. The effect of acquisitions is about 24 percent according to the FHK method and only about 13 percent according to the GR method when using labor weights. One reason for these differences is that averaging corporation productivity in the GR decomposition reduces the large differences appearing in the productivity of new and acquired plants in the end year and average corporation productivity in the base year. The opposite holds for the effects of closed and sold plants. The total shares of internal and external sources are more similar for the two methods. The contribution of net ownership changes was between 26-36 percent and the total contribution of external sources varies between 36 and 48 percent. The net entry effect varies from 14 to 16 percent computed with employment weights. This share may be considered as relatively small. For instance, Disney et al (2003) find that around a third of total labor productivity growth in manufacturing was due to closures and startups of plants within existing multi-plant firms.

To shed light on the differences in results for the FHK method of different weights, I compute simple correlations between output, employment and productivity growth rates for continuing plants (see Table A3 in the Appendix). As expected, employment and output growth are highly positively correlated. The positive correlation between labor productivity and output growth explains the positive covariance term in the decompositions using output weights. The same result is not obtained using employment weights, since employment growth is weakly negatively correlated with productivity growth. Foster, Haltiwanger and Krizan (1998) obtained similar differences in their results when using output and employment weights for the decomposition of industry-level labor productivity. Interestingly, they found the decomposition of labor productivity using output weights to yield very similar results to those of multifactor productivity decompositions. Disney et al. (2003) obtain a much smaller within contribution to TFP growth than to labor productivity. They interpret the results to indicate that much of the within contribution to labor productivity growth was driven by downsizing. The negative correlation between labor productivity growth and employment growth here indicates that downsizing and the consequent capital-labor substitution explain the large within contribution to productivity growth among the continuing plants of sample corporations.

The decomposition results seen in Table 2 are the weighted averages for the corporations. While most of the corporations experienced positive growth in labor productivity during the 1986-96 period, their performance was far from conform. It is therefore useful to consider some corporation-specific differences. I compute correlations between corporation level employment, output, productivity growth (SVL) and the components of decomposition (see Table A4 in the Appendix). Employment and output growth are highly positively related to productivity growth, even at the corporation level. It suggests that corporations with high productivity growth were expanding both in terms of employment and sales. The total internal effects are negatively correlated with employment weighted productivity growth and positively correlated with output weighted productivity growth. The correlations between different components of internal sources and productivity growth have same signs for both weights used. The positive correlation between the effect of sell-offs and productivity growth suggests corporations with high productivity growth to be rationalizing. The effect of acquisitions, in turn, is negatively correlated with productivity growth suggesting corporations with low productivity growth to be sourcing productivity growth externally.

It can be argued that the decomposition results are sensitive to the length of the period chosen. Shorter periods tend to be more dominated by cyclical variation in productivity. Furthermore, the number of plants continuing through a longer period may also affect the results. However, it is not clear if a longer period implies an increase in the net contribution of external restructuring. One obvious effect of lengthening the period is that the contribution of entry in the FHK decomposition is likely to be higher, since the difference between the productivity at the end of the period and the initial year generally grows over time. The higher productivity levels at the end of the period also have an impact on the within and covariance effects. The GR decomposition mitigates the impact of these differences using average values of productivity.

To assess the sensitivity of the results for length of period, the compositions are also computed for two sub-periods: 1985-90 and 1990-96. The descriptive statistics showed productivity growth to be much higher during the 1990s than during the 1980s. 1990 represents a peak year in the business cycle of the manufacturing sector and is therefore chosen as a cut-off point for the two periods. Table 3 shows the decomposition results for the two periods.[25] As mentioned above, two additional effects due to changes in industry by continuing plants can be computed for these sub-periods. The results for the 1985-90 period vary, largely depending on the decomposition method. The within effect varies from 30 percent measured with the FHK method to -48.3 percent measured using the GR method. By examining the other components of internal productivity growth, it is obvious that the negative within effect is generated by an expansion of plants with negative productivity growth. This negative effect is captured by the covariance effect in the FHK decomposition, but it affects both the within and between effects in the GR decomposition. The effect of continuing plants shifting their production to other industries is small during the 1985-90 period. The total shares of internal and external sources are comparable for the same productivity measure, irrespective of the decomposition method. The result that is robust to different decompositions and measures of productivity is the large contribution of ownership changes, 75-96 percent of total productivity growth during the period

For the 1990-96 period, the results are less ambiguous with regard to the within effect. Both methods show the contribution of the within effect to be about 54-60 percent and the total contribution of the internal sources about 69-73 percent. Once more, the FHK method yields a higher effect for the acquired plants and a lower for the sold ones than the GR method, but summing the effects of ownership changes yields similar results for both decompositions. The contribution of ownership changes is 17-21 percent of total productivity growth, which is considerably lower than in the 1985-90 period. These results suggest that the decompositions are not as sensitive to the length of the period as to the business cycle.

To further examine how the business cycle may affect the different sources of pro-

[25] Employment weights are used.

Table 3: Decomposition results for sub-periods

Labor Productivity Growth								
Period	1985-90				1990-96			
Decomposition Method	FHK		GR		FHK		GR	
Productivity Measure	VAL	SVL	VAL	SVL	VAL	SVL	VAL	SVL
Within	0.298	0.026	0.267	-0.483	0.549	0.543	0.592	0.601
Between	0.102	0.831	0.027	0.379	0.057	0.070	0.111	0.129
Covariance	-0.063	-1.018			0.086	0.116		
Acquired	0.393	0.418	0.191	0.144	0.180	0.181	0.109	0.112
Sold	0.356	0.540	0.609	0.809	0.029	0.011	0.083	0.063
New	-0.031	0.007	-0.077	-0.029	0.074	0.060	0.035	0.033
Closed	-0.004	0.236	0.033	0.230	-0.003	-0.009	0.031	0.025
Change of industry	-0.053	-0.039	-0.049	-0.049	0.027	0.026	0.039	0.035
Internal Sources	0.337	-0.161	0.294	-0.104	0.692	0.730	0.703	0.730
External Sources	0.663	1.161	0.706	1.104	0.308	0.270	0.297	0.270
-Ownership Changes	0.749	0.957	0.800	0.952	0.209	0.193	0.192	0.176
-Entry and Exit	-0.035	0.243	-0.044	0.201	0.071	0.051	0.066	0.078
Growth Rate (%)	0.24	0.35	0.24	0.35	1.75	1.36	1.75	1.36

Notes: Decompositions are computed for continuing corporations. Employment weights are used.

Table 4: Decomposition results for sub-periods

Labor Productivity Growth								
Period	1990-93				1993-96			
Decomposition Method	FHK		GR		FHK		GR	
Productivity Measure	VAL	SVL	VAL	SVL	VAL	SVL	VAL	SVL
Within	0.469	0.533	0.498	0.523	0.700	0.661	0.803	0.748
Between	0.034	0.113	0.045	0.098	0.102	0.167	0.225	0.253
Covariance	0.057	-0.021			0.208	0.173		
Acquired	0.228	0.206	0.183	0.149	0.010	0.002	-0.001	-0.009
Sold	0.048	0.046	0.155	0.122	-0.030	-0.004	-0.028	0.012
New	0.105	0.075	0.051	0.042	0.036	0.032	0.006	0.007
Closed	0.003	0.001	0.019	0.020	-0.006	-0.011	0.010	0.004
Change of industry	0.057	0.048	0.048	0.045	-0.019	-0.020	-0.014	-0.015
Internal Sources	0.640	0.625	0.543	0.621	1.010	1.001	1.028	1.001
External Sources	0.360	0.375	0.457	0.378	-0.010	-0.001	-0.028	-0.001
-Ownership Changes	0.276	0.252	0.338	0.271	-0.020	-0.002	-0.029	0.003
-Entry and Exit	0.108	0.076	0.070	0.062	0.030	0.021	0.016	0.011
Growth Rate (%)	1.22	0.94	1.22	0.94	2.29	1.78	2.29	1.78

Notes: Decompositions are computed for continuing corporations.

ductivity growth, the decompositions are computed for the 1990-93 and 1993–96 periods. During the 1991-93 period, the Swedish manufacturing sector experienced negative growth in production, but recovered fast during the following years.[26] Productivity growth in the corporations was positive in both periods, but the annual rate of growth was nearly twice as high in 1993-96. The decomposition results presented in Table 4 show that all productivity growth was generated internally within continuing plants of the corporations during the period of high production growth in the manufacturing sector. Ownership changes had a negative effect on the productivity growth of the corporations.

It may be concluded that the results are sensitive to cyclical variation. The contribution of the within effect is relatively more important in the periods of high productivity growth. This result is in line with industry-level studies that have found the within plant

[26] The average annual rate of growth in total Swedish manufacturing production was -1.8 during 1991-93 and 8.6 percent during 1994-96. The growth rates are computed from the manufacturing production index (IPI), Statistics Sweden.

component to be large and positive in periods of robust productivity growth and negative in periods of modest productivity growth (Baily, Hulten and Campbell, 1992, Baily, Bartelsman and Haltiwanger, 1996a and 1996b, and Haltiwanger, 1997). In the long run, however, the contributions of internal and external sources are almost equal. One plausible explanation for the large share of internal productivity growth in the periods of high-productivity growth is that the corporation utilized its spare capacity. The capacity utilization data required to explore the relevance of this explanation are not available. Altogether, the results suggest that during times of low internal productivity growth, the corporations are involved in acquisitions of more productive plants and, in particular, divestitures of less productive ones. This external restructuring seems to compensate for the low, or even negative, productivity growth within their continuing operations.

5 Skill Upgrading and Restructuring

The productivity increases within corporations may be explained by changes in the composition of the production as well as by technological change. The pure compositional effect on productivity is a result of shifting corporate activities through sell-offs and closures of plants in less skill-intensive industries and replacement of them by acquisitions and start-ups of plants in more skill-intensive science-based industries. Given that more skill-intensive production exhibit higher labor productivity, an immediate implication of the restructuring is corporate level productivity increases. As seen in Figure 2, the corporations became increasingly specialized in science-based industries, characterized with high R&D expenditures and skill intensity. The second effect is associated with the skill-biased technological change taking place during the period. Under this interpretation, the relatively skill-intensive plants and plants in skill-intensive industries were better at adopting new technologies that increased their productivity.

In order to examine the importance of the decompositional effect, Table 5 gives summary statistics of skill intensity for the different types of plants in the sample where skill intensity is computed as a share of employees with tertiary education in total number of employees.[27] Column 1 reports skill share of continuing, sold, closed, acquired and new plants in the start and end year of the 1986-96 period.[28] We see that sold and closed plants were on average less skill-intensive than the continuing plants in the start year.

[27]Decompositions are computed also for growth in skill intensity defined as the share of employees with tertiary education.

[28]Data to compute skill shares exists starting 1986.

Table 5: Skill intensity of plants by type

Type of plants									
Period	1986-96			1986-90			1990-96		
	Number of plants		t-test	Number of plants		t-test	Number of plants		t-test
Start year									
Sold	331	0.083	2.991***	361	0.083	1.403	283	0.115	3.171***
Closed	131	0.090	1.794*	131	0.093	0.281	158	0.107	3.200***
Continuing	217	0.114		217	0.097		269	0.151	
End year									
Acquired	199	0.170	1.017	199	0.110	1.907*	138	0.175	0.641
New	61	0.296	-4.452***	61	0.207	-4.213***	37	0.263	-2.549**
Continuing	217	0.186		217	0.128		269	0.186	

Notes: Skill intensity defined as the share of employees with tertiary education. t-value is for the test of equality of means.

Of the plants that entered the sample corporations between 1986 and 1996 only the new plants are more skill-intensive than the continuing plants. The plants that were sold and closed during the first sub-period did not differ significantly from the continuing plants at the start year. However, during the 1990's the sample corporations sold and closed plants that were less skill-intensive and started new plants that were more skill-intensive than the continuing plants. The results suggest that changes in skill intensity taking place through the plant turnover may underlie changes in productivity of the sample corporations.

To examine the second explanation, that is, how the skill-biased technological change taking place during the period is associated with the productivity growth of the corporations, the relationship between skill-intensity and productivity growth is analyzed among the continuing plants. The labor productivity growth of the continuing plants is regressed on the plant skill-intensity in the beginning of the period (SH), which is expected to be positively related to the productivity growth of the plants. Under this interpretation, the relatively skill-intensive plants and plants in skill-intensive industries are better at adopting the new technologies that generated higher productivity growth. The importance of skill intensity at the corporation level is also examined. A positive coefficient of corporation skill share may suggest that skill intensity proxies knowledge capital which is a joint-input shared by several plants of a corporation. The initial relative productivity (RLP), which relates plant productivity (SVL) to its industry average productivity, is included to the regression to control for the convergence to mean- growth.[29] The growth in inputs per employee ($\Delta Input$) and energy per employee (ΔCap), where the latter proxies for changes in capital intensity,[30] are included to control for other factors that affect productivity. The estimated regression is

$$\Delta LP_{it} = \alpha + \beta_1 RLP_{it} + \beta_2 SH_{it} + \beta_3 \Delta Input_{it} + \beta_3 \Delta Cap_{it} + u_{it} \tag{4}$$

The results of the OLS estimations are shown in Table 6. For the plants that stayed with the corporations during the entire period (results in columns 1 and 2), the coefficient of skill share is small and statistically insignificant suggesting that the initial skill intensity did not explain their productivity growth. The corporation level skill share is, however, positive and statistically significant. It may reflect some corporation specific knowledge capital, which benefited the plants and increased their productivity. The entire period is rather long and the plants may have increased their skill share during the period, which further increased their productivity growth. Columns 3 to 6 show results for plants that stayed with the corporations during shorter sub-periods. In the 1986-90 period, the coefficient of plant level skill share is positive and highly significant indicating that initially more skill-intensive plants experienced higher productivity growth. The coefficient of corporation-level skill share is also positive and statistically significant at the ten percent's level.[31] The results for the later sub-period are not statistically significant for neither one of the skill share measures. This may strike as surprising since productivity growth was found to stem mainly internally through productivity increases within continuing plants during the same period. It suggests that other factors than a skill-based technological change explain productivity increases of the continuing plants during the period.

[29] According to the convergence to mean hypothesis plants with low productivity exhibit higher productivity growth than plants with high productivity. Average industry labor productivity is measured at the four-digit level of industries.

[30] Data to compute capital stocks is not available at the plant level. Energy outlays are generally believed to proxy capital stocks. To investigate the relevance of this proxy, energy costs are correlated with the book value of capital assets (machinery, buildings and land) for affliate firms in the sample and at the four-digit level of manufacturing industries in 1985-96. The correlation is 0.74 (7100 obs) at the firm level and 0.89 at the industry level. This evidence suggests that energy outlays may proxy capital stocks.

[31] It is not statistically siginificant in a regression that include both the plant and corporation level skill intensity.

Table 6: Productivity growth in continuing plants

Productivity Growth						
Period	1986-96		1986-90		1990-96	
SVL_rel	-0.003***	-0.003***	-0.005***	-0.005***	-0.006***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Skill_plant	0.0001		0.018***		0.005	
	(0.005)		(0.006)		(0.006)	
Skill_corp		0.016**		0.024*		0.015
		(0.008)		(0.013)		(0.011)
Cap_gr	-0.037	-0.041	-0.040	-0.055	-0.025	-0.023
	(0.050)	(0.047)	(0.058)	(0.057)	(0.036)	(0.035)
Input_gr	0.348***	0.342***	0.340***	0.339***	0.202***	0.194***
	(0.095)	(0.095)	(0.097)	(0.098)	(0.053)	(0.054)
Constant	0.696***	0.703***	0.624***	0.610***	0.783***	0.791***
	(0.092)	(0.090)	(0.105)	(0.106)	(0.068)	(0.071)
R^2	0.26	0.27	0.27	0.26	0.24	0.24
Number of obs	214	214	355	355	267	267

Notes: Robust standard errors in parentheses. ***,** and * signify statistically significant at 1, 5 and 10 percent level.

6 Conclusion

This study has examined the sources of productivity growth in multi-plant corporations. Although the analysis is largely descriptive, it can provide new important insights about organizational restructuring and the sources of productivity growth for multi-plant corporations. Using data for a sample of the largest manufacturing corporations in Sweden for the 1985-96 period and studying the sources of productivity growth at the level of the corporation, this study approaches the issue of productivity growth from a new perspective and extends both the micro-level productivity studies analyzing particular internal determinants of firm productivity growth and macro-level studies emphasizing the importance of external restructuring at the industry level.

The decompositions of productivity growth suggest two conclusions. First, the results show that external restructuring contributes almost as much to long-term labor productivity growth of the multi-plant corporations as internal sources. Particularly important is the contribution of ownership changes of plants. Together, the internal and external restructuring accounted for more than half the total productivity growth in the sample corporations. This result suggests that the productivity of the sample corporations grew at least twice as fast as that of a single-plant firm with the same plant-level productivity growth.

Second, the relative importance of external and internal sources of productivity growth varies substantially with the business cycle at the corporation level. This finding is in line with the results of industry-level studies showing the within plant component to be large and positive in periods of robust productivity growth and negative in periods of modest productivity growth (Baily, Hulten and Campbell, 1992, Baily, Bartelsman and Haltiwanger, 1996a and 1996b, and Haltiwanger, 1997). In times of lower productivity growth, the decompositions show that a large contribution to productivity growth stems from acquisitions and divestitures of plants. The external restructuring thus seems to compensate for low or even negative productivity growth within the continuing operations of the corporations. This may explain why multi-plant corporations were able to sustain higher productivity growth throughout the business cycle.

The results further suggest that some of the observed changes in labor productivity may be associated with changes in specialization, changes in labor quality and skill-based technological change. Corporations sold and closed less skill intensive plants compared to the continuing plants and opened up new more skill intensive plants. The plants acquired by the corporations did not differ significantly from the continuing plants in terms of skill intensity. The observed differences in average skill levels of sold, closed, new and continuing plants suggest that changes in skill intensity taking place through the plant turnover may underlie changes in productivity of the sample corporations to a certain extent. In the 1986-90 period, when the contribution of the continuing plants to the overall productivity growth was low, the plant level skill share is positively related to productivity growth indicating that initially more skill-intensive plants experienced higher productivity growth. The large contribution of continuing plants to the overall productivity growth during the 1990's is, however, not explained by plants being more skill intensive and better at adopting new skill-based technologies that generate higher labor productivity.

The results of decompositions provide important insights into how larger corporations can sustain higher productivity growth than that of single-plant firms. By emphasizing the role of ownership changes, this study extends the findings of Disney et al (2003) who found that an important contribution to overall productivity growth was due to multi-establishment firms closing down poorly performing plants and opening high productivity new ones. The role played by ownership changes may actually be explained by the characteristics of the sample corporations. Previous research shows that some industries characterized by the importance of intangible assets and high levels of multinational activity and concentration exhibit extensive and productive changes in control and rather less exit/entry turnover.[32] Nevertheless, there is corporation level heterogeneity within the sample. The finding that rationalization through sell-offs and closures seems to be associated with expanding corporations and corporations with high productivity growth rather than with downsizing corporations facing declining productivity sheds new light on the concept of "creative destruction". Further work, however, is needed to analyze the sources of corporation heterogeneity and to verify its implications on productivity growth.

[32] See e.g Baldwin and Gorecki (1990) and Baldwin and Caves (1991).

References

[1] Audretsch, D.B. (1994), “Business Survival and the Decision to Exit”, *Journal of the Economics of Business*, 1, pp. 125-37.

[2] Aw, B.Y., X. Chen and M.J. Roberts (1997), “Firm-Level Evidence on Productivity Differential, Turnover, and Exports in Taiwanese Manufacturing”, *Fondazione Eni Enrico Mattei Note di Lavoro*, 69/97, pp.28.

[3] Baily, M.N., C. Hulten and D. Campbell (1992), “Productivity Dynamics in Manufacturing Plants”, *Brookings Papers on Economic Activity: Microeconomics*, pp.187-249.

[4] Baily, M.N., E.J. Bartelsman and J. Haltiwanger (1996a), “Labor Productivity: Structural Change and Cyclical Dynamics”, *National Bureau of Economic Research Working Paper*: 5503.

[5] Baily, M.N., E.J. Bartelsman and J. Haltiwanger (1996b), “Downsizing and Productivity Growth: Myth or Reality?”, *Small Business Economics*, 8,4, pp. 259-78.

[6] Baldwin, J.R. (1993), *The Dynamics of Industrial Competition,* Cambridge and New York: Cambridge University Press.

[7] Baldwin, J.R. (1994), “Structural Change in the Canadian Manufacturing Sector” *Research Paper Series*: 61*,* Statistics Canada

[8] Baldwin, J.R. and R.E. Caves (1991), “ Foreign Multinational Enterprises and Merger Activity in Canada” in L. Waverman ed., *Corporate Globalization Through Mergers and Acquisitions*, pp. 89-122. Calgary: University of Calgary Press.

[9] Baldwin, J.R. and P.K. Gorecki (1990), “ The Contribution of the Competitive Process to Productivity Growth: The Role of Firm and Plant Turnover” *Research Paper Series:* 28, Statistics Canada.

[10] Baldwin, J.R. and P.K. Gorecki (1991), “Firm Entry and Exit in Canadian Manufacturing Sector, 1970-1982” *Canadian Journal of Economics*, 2, pp.300-323

[11] Bernard A. and J.B. Jensen, (2002), “The Deaths of Manufacturing Plants”, *National Bureau of Economic Research Working Paper*: 9026.

[12] Cabral, L.M.B. (1993), “Experience Advantages and Entry Dynamic” *Journal of Economic Theory*, 59, 2, pp. 403-16.

[13] Disney R.F., J. Haskel and Y. Heden (2003), “Restructuring and Productivity Growth in UK Manufacturing”, *The Economic Journal,* 113, pp.666-94.

[14] Fors, G. and A. Kokko (2001), “Home Country Effects of FDI: Foreign Production and Structural Change in Home Country Operations”, in M. Blomström and L.Goldberg eds., *Topics in International Economics; A Festschrift in Honor of Bob Lipsey,* University of Chicago Press, Chicago.

[15] Foster, L., J. Haltiwanger and C.J. Krizan (1998), “Aggregate productivity Growth: Lessons From Microeconomic Evidence”, *National Bureau of Economic Research Working Paper:* 6803.

[16] Gregg, P., S. Machin and D. Metcalf (1993), “Signal and Cycles: Productivity Growth and Changes in Union Status in British Companies 1984-89” *Economic Journal*, 103, 419, pp.894-907.

[17] Griliches, Z. and H. Regev (1995), “Firm Productivity in Israeli Industry: 1979-1988”, *Journal of Econometrics*, 65, 1, pp. 175-203.

[18] Haltiwanger, J. (1997), “Measuring and Analyzing Fluctuations: The Importance of Building from Microeconomic Evidence”, *Federal Reserve Bank of St. Louis Review*, 79, 3, pp. 55-77.

[19] Hopenhayn, H.A. (1992), “Entry, Exit and Firm Dynamics in Long Run Equilibrium”, *Econometrica*, 60, 5, pp. 1127-50.

[20] Jovanovic, B. (1982), “Selection and the Evolution of Industry”, *Econometrica*, 50, 3, pp. 649-70.

[21] Levinsohn, J. and A. Petrin (1999), “When Industries Become More Productive, Do Firms? Investigating Productivity Dynamics”, *National Bureau of Economic Research Working Paper*: 6893.

[22] Liu, L. and J.R. Tybout (1996), ”Productivity Growth in Chile and Colombia: The Role of Entry, Exit, and Learning” in *Industrial evolution in developing countries: Micro patterns of turnover, productivity, and market structure*, pp. 73-103, Oxford and New York: Oxford University Press for the World Bank.

[23] Maksimovic V. and G. Phillips (2002), "Do Conglomerate Firms Allocate Resources Inefficiently across Industries? Theory and Evidence", *Journal of Finance*, 57, 2, pp. 721-67.

[24] OECD (1987), *Structural Adjustment and Economic Performance*, Paris.

[25] OECD (1992), *Industrial Policy in OECD Countries*, Paris.

[26] Olley, G.S. and A. Pakes (1996), "The Dynamics of Productivity in the Telecommunications Equipment Industry" *Econometrica*; 64, 6, pp. 1263-97.

[27] Pakes, A. and R. Ericson (1998), "Empirical Implications of Alternative Models of Firm Dynamics" *Journal of Economic Theory*, 79, 1, pp. 1-45.

[28] Schuh and Triest (2000), "The Role of Firms in Job Creation and Destruction in US Manufacturing", *Federal Reserve Bank of Boston New England Economic Review*, 0, 0, pp. 29-44.

A Appendix

A.1 Data appendix

The data set includes information on the manufacturing firms and plants that were under the control of the thirty sample corporations during the period of 1985-98. Four of the corporations only appear in part of the period. One of them exits as it merges with another corporation in the data, another corporation enters as a new corporation and the third is established after a separation from one of the other corporations in the sample. Statistics Sweden has linked each plant to a firm, and each firm to a company group by using a corporation register. A corporate group can consist of firms and plants in several industries. All manufacturing plants with at least five employees are included. Every year, plants that are new or acquired are added to the data set and plants that are sold or divested are excluded from the data set. Information about the plant status before being added to or after being excluded from the data enables me to separate ownership changes from greenfield entry and closures. For an identifier appearing for the first time in the sample, this information shows whether it previously existed under other ownership or if it is a new plant. The new plants are assigned with information about the month and the year of start-up. For an identifier that disappears from the sample there is information showing whether the plant continues under other ownership or if it is closed down. Closed plants are assigned with information about the month and the year of closure.

The establishment identifier is continuous during the 1985-1996 period. In 1997 Statistics Sweden defined a new establishment identifier and included even establishments with less than five employees in the population. The old identifiers can be linked to the new ones, but the match is not perfect. It implies that some plants may be spuriously categorized as closed ones after 1996. However, the closure rates are not higher in 1997 compared to previous years which indicates that the measurement error is rather small if it exists.

There are cases when an establishment disappears from the data one year, but thereafter continues under the control of the same corporation as before. These plants are defined as continuing and data of employment and productivity are added by interpolation.[33] This alternative is preferred to excluding the drop-outs or defining them as temporary changes in ownership. Plants exiting one industry but continuing in another are regarded as continuing plants. Thus, entry and exit are universally defined, and not at

[33] The values for year t are computed as the averages values for $t-1$ and $t+1$.

the industry level. Firm-level changes in ownership of plants internal to a corporation are disregarded. These plants are defined as continuing plants within a corporation. There are cases where plants do not appear in the statistics before being added to the sample, but are not assigned with a start-up date either. These cases are defined as greenfield entry. There are also plants lacking information about the time of closure, but which do not continue after disappearing from the sample. These are defined as closures. An implication of this procedure is that some plants falling below the limit of five employees may be misleadingly regarded as non-existing. However, these cases are expected to be rare since Statistics Sweden has included plants that temporarily, during one or a few years, fell below the size limit.

Table A1

Classification of industries according to OECD taxonomy

1	Resource-intensive industries	4	Differentiated Goods
	Manufacture of food, beverages and tobacco		Manufacture of engines and turbines
	Manufacture of leather, except footwear and wearing apparel		Manufacture of agricultural machinery and equipment
	Manufacture of wood, wood and cork products, except furniture		Manufacture of metal and wood working machinery
	Manufacture of pulp, paper and paperboard		Machinery and equipment except electrical nec
	Manufacture of miscellaneous products of petroleum and coal		Manufacture of electrical industrial machinery and apparatus
	Petroleum refineries		Manufacture of electrical appliances and housewares
	Manufacture of non-metallic mineral productss		Manufacture of electrical appliances and suppliers nec
	Non-ferrous metal basic industries		Manufacture of watches and clocks
2	Labor-intensive industries	5	Science-based industries
	Manufacture of textiles		Manufacture of tdrugs and medicines
	Manufacture of wearing apparel, except footwear		Manufacture of chemical products nec
	Manufacture of furniture and fixtures, except for primary metal		Manufacture of office, computing and measuring and controlling equipment 1)
	Manufacture of footwear except rubber or plastic footwear		Manufacture of photgrphic and optiv´cal goods
	Other Manufacturing Industries		Manufacture of aircraft
	Manufacture of fabricated metal products, except machinery and equipment		Manufacture of radio, television and communication equipment and apparatus 2)
3	Scale-intensive industries		
	Manufacture of paper, paper products, printing, publishing nec.		Manufacture of plastic products nec
	Manufacture of industrial chemicals		Manufacture of glass and glass products
	Manufacture of paints, varnishes and laquers		Manufacture of pottery, china and earthenwares
	Manufacture of soap and cleaning preparations, perfumes, cosmetics etc		Iron and steel basic industries
	Manufacture of rubber productss		Manufacture of transport equipment excluding 3845 (aircraft)

Source: OECD (1987) and (1992). The taxonomy is adjusted by reclassifying 1) and 2) in differentiated goods industries as as science-based industries. The changes are supported by Baldwin's (1994) discriminant analysis on Canadian manufacturing sector.

Table A2

Employment share and number of plants in different categories						
Period	1985-90		1990-96		1985-96	
Base year						
Continuing	312	0.599	273	0.560	197	0.472
Changing Industry	46	0.051	53	0.077		
Sold	259	0.303	254	0.288	365	0.431
Closed	74	0.048	114	0.076	129	0.097
End year						
Continuing	312	0.637	273	0.693	197	0.649
Changing Industry	46	0.052	53	0.088		
Acquired	338	0.259	140	0.152	224	0.237
New	72	0.051	40	0.067	66	0.115
Number of corporations	27		28		26	

Note: Continuing plants in 1985-96 (197 observations).

Table A3

Plant-level correlations between growth rates				
	(1)	(2)	(3)	(4)
Productivity (SV/L)	1.000			
Productivity (VA/L)	0.8671	1.000		
Sales values	0.6799	0.5828	1.000	
Employment	-0.0611	-0.0306	0.68703	1.000

Note: Continuing plants in 1985-96 (197 observations).

Table A4

Corporation-level correlations		
Correlation	Productivity Growth	
Weight	Employment	Output
Employment Growth	0.4908	0.6611
Sales Growth	0.4991	0.7875
-Within Effect	-0.1783	-0.0561
-Between Effect	0.1796	0.2065
-Covariance	-0.2055	-0.1665
-acquired	-0.1888	-0.1735
-sold	0.1791	0.3086
-new	0.1755	-0.1622
-closed	0.0703	0.0746
Internal Sources	-0.1074	0.1369
External Sources	0.1983	-0.0226
-Ownership changes	0.1376	0.1834
-Net Entry	0.1711	-0.1403