Working Paper
R2007:006

Firm Level Productivity and ICT

Productivity effects of incumbent, entering and exiting firms in ICT-producing, intensive ICT-using and less intensive ICT-using Swedish manufacturing in 1997–2002

Harald Edquist
Peter Vikström

SWEDISH INSTITUTE FOR GROWTH POLICY STUDIES

ITPS, Swedish Institute For Growth Policy Studies
Studentplan 3, SE-831 40 Östersund, Sweden
Telephone: +46 (0)63 16 66 00
Fax: +46 (0)63 16 66 01
E-mail info@itps.se
www.itps.se

For further information, please contact Peter Vikström
Telephone +46 (0)63 16 66 15
E-mail peter.vikstrom@itps.se

Foreword

This report is published in ITPS working paper series (R-series)

In the working paper series we publish work in progress, not finished work or other material that serve as background for other analyses. Conclusions and recommendations put forward are the authors' own and do not necessarily reflect the official opinion of ITPS.

Productivity growth is vital for the overall long-term growth performance of the economy. Understanding the process and key drivers behind productivity growth is therefore of great interest both for the economist and the policy maker.

This report aims to measure the contribution of firm dynamics to overall productivity growth. What is the importance of new firms entering the market, old firms leaving the market and incumbent firms surviving in the market for productivity growth?

The analysis is focused on the performance of the Swedish manufacturing industry between 1997 and 2002, and pays special attention to the ICT-related bransches.

The report is authored by Harald Edquist, Centre for Business and Policy Studies, SNS, and Peter Vikström, ITPS.

Östersund, May 2007

Peter Vikström

Director Growth analysis and Statistics

Table of Content

Summary

This paper presents productivity estimates of entering, exiting and incumbent firms in Swedish manufacturing in 1997–2002. The “exit” and “entry” effects are decomposed so that the reasons for entry and exit can be analyzed in detail. Moreover, productivity growth is also analyzed in ICT-producing, intensive and less intensive ICT-using industries. Depending on the method used, the results show that approximately 70–85 percent of the productivity growth occurred within incumbent firms. Moreover, the effect from incumbent firms was particularly high in ICT-producing industries. Finally, the effect of new firms entering was negative in manufacturing in 1997–2002.

Sammanfattning

Denna rapport “Företagsproduktivitet och IT – Produktivitetseffekter av överlevande, nya och nedlagda företag i IT-producerande, intensivt IT-användande och mindre intensivt IT-användande företag i svensk tillverkningsindustri 1997–2002” redovisar skattningar av produktiviteten hos nya, nedlagda och överlevande företag i svensk tillverkningsindustri 1997 till 2002. Effekten av nya och nedlagda företag delas vidare upp i olika skäl till start och nedläggning. Produktivitetstillväxten delas vidare upp på de olika sektorerna IT-producerande och IT-användande företag. Beroende på val av metod visar resultaten att ungefär 70–85 procent av produktivitetstillväxten sker i överlevande företag. Effekten från de överlevande företagen var speciellt stark i de IT-producerande företagen. Slutligen, effekterna av nya företag i tillverkningsindustrin på produktivitetstillväxten var på det stora hela negativ i tillverkningsindustrin mellan 1997 och 2002.

1 Introduction

Schumpeter (1966) argued that creative destruction is the essential fact about capitalism. According to Schumpeter creative destruction is a "process of industrial mutation … that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one". In the Schumpetarian framework a new innovator or entrepreneur enters a market with new technology and competes with incumbent firms with conventional technology. If the innovation is successful, the entrants will be able to replace the incumbent firms and if not they will fail to survive.

In a competitive market new firms will only survive, in the long run, if their innovation increases productivity more than the conventional technology used by existing firms. Thus, productivity growth governs the pace at which potentialities opened by new technology can be exploited (Nelson 1981). However, how large is the contribution to productivity growth from entering and exiting firms and how important are their contribution in relation to existing firms? The purpose of this paper is to investigate the contribution of incumbent, entering and exiting firms to labour productivity growth in Swedish manufacturing in 1997–2002.

During the 1990s, productivity growth in Sweden was very high in industries producing information and communication technology (ICT). In particular, productivity increased rapidly in the Swedish Radio, television and communication equipment industry (RTC). These growth patterns have also been found for many other countries (see Edquist & Henrekson 2006). Moreover, Stiroh (2002) and van Ark *et al*. (2003) distinguish between ICT-producing, intensive ICT-using and less intensive ICT-using industries.[1] According to Stiroh (2002), industries that made the largest ICT investments in the 1980s and early 1990s have larger productivity gains after 1995 in the US.

Stiroh (2002) also provides decomposition of aggregate productivity growth into the contribution of individual industries. The results show that ICT-producing and intensive ICT-using industries accounted for approximately 80 percent of the productivity growth in the US economy 1995–2000. These findings raise the question whether the contribution to labour productivity growth from incumbent, entering and exiting firms also differs between ICT-producing, intensive ICT-using and less intensive ICT-using industries? We therefore also investigate the contribution to labour productivity growth from incumbent, entering and exiting firms in these industries.

There are some earlier studies on decomposition of productivity growth at a detailed level in Sweden (see Hakkala 2004 and Hedén 2005). Hedén (2005) finds that surviving establishments accounted for approximately 60 percent of labour productivity growth in the total business sector in 1990–2000. Moreover, in manufacturing approximately 90 percent of the Swedish productivity in manufacturing occurred within existing establishments in 1992–1997. Unlike earlier studies on Swedish productivity at the detailed level, this paper will be based on firm data and not establishment data.

[1] For a definition of ICT-producing, intensive ICT-using and less intensive ICT-using industries see Stiroh (2002) and van Ark et al. (2003).

Moreover, one limitation of many studies at the detailed level is that they are unable to distinguish why firms enter and exit. In this paper an additional method is used to match firms and thereby investigate why firms enter and exit. Hence, it will be possible to separate the effects from new firms, firms that are shut down, firms splitting up or merging and firms that are reclassified.

The description above is very broad and more specifically we will address the following questions:

1 What was the contribution to labour productivity growth from incumbent, entering and exiting firms in Swedish manufacturing in 1997–2002?

2 How large are the productivity effects from firms entering or exiting due to merger, split, reclassification or firms being either new or shut down?

3 Is there a large difference of the impact of incumbent, entering and exiting firms on productivity in ICT-producing, intensive ICT-using and less intensive ICT-using industries?

In order to answer these questions we will use micro data for Swedish firms. Section 2 and 3 describe the methods and data that will be used. Section 4 investigates the contribution to labour productivity growth of incumbent, entering and exiting firms in Swedish manufacturing in 1997–2002. Section 5 concludes.

2 Method

2.1 Measures of productivity

The two most common measures of productivity are labour productivity and total factor productivity (TFP). From a theoretical standpoint TFP is the most appropriate measure of productivity because it takes into account the combined effects of inputs of labour and capital. Unfortunately, it has not been possible to provide data on capital stock at the firm level. Therefore, labour productivity will be the only measure of productivity used here. According to Hakkala (2004) the estimation of labour productivity often give better accuracy than TFP, because estimating the value of capital stock at disaggregated levels often implies large errors. Moreover, labour productivity measures are often highly correlated with other productivity measures (Hakkala 2004).[2]

2.2 Decomposition method

There are a number of ways to decompose productivity growth. According to Ahn (2001) aggregate productivity in a given industry can be represented by a weighted average of each individual firm's productivity in the industry.

$$P_t = \sum_i \theta_{it} p_{it} \qquad (1)$$

where P_t is an aggregate productivity measure for the industry at time t. θ_{it} is the share of firm i in the given industry at time t and p_{it} is a productivity measure of an individual firm i at time t. The employment or output share can be used to weight labour productivity. For robustness both output and employment shares will be used as weights in this paper.

Aggregate productivity change can be decomposed into several factors. Following Haltiwanger (1997) and Foster, Haltiwanger and Krizan (1998):

$$\Delta \ln P_t = \sum_{i \in C} \theta_{it-k} \Delta \ln p_{it} + \sum_{i \in C} \Delta\theta_{it} (\ln p_{it-k} - \ln P_{t-k}) + \sum_{i \in C} \Delta\theta_{it} \Delta \ln p_{it} + \sum_{i \in N} \theta_{it} (\ln p_{it} - \ln P_{t-k}) - \sum_{i \in X} \theta_{it-k} (\ln p_{it-k} - \ln P_{t-k}) \qquad (2)$$

where Δ refers to changes over the k-year interval between the first year ($t–k$) and the last year (t). θ_{it} is the share of firm i in the given industry at time t. C, N and X are sets of continuing, entering and exiting firms, respectively. $P_{t\text{-}k}$ is the aggregate productivity level of the industry as of the first year ($t–k$).[1]

The five components of the above decomposition are defined as follows:

Within effect – within-firm productivity growth weighted by initial market shares.

Between effects – initial firm productivity level compared with the average productivity level of the industry. It reflects gains in aggregate productivity, which comes from the expanding market shares of high productivity firms or from shrinking market shares of low productivity firms.

[2] Labour productivity will be defined as production value per person employed (see section 3.2).
[1] Under this decomposition method, it is clear that an entrant will contribute positively to productivity only when it has higher productivity than the initial industry average.

Cross effect – covariance term that is positive when market shares increases for firms with growing productivity or when market shares shrinks for firms with decreasing productivity.

Entry effect – the sum of differences between each entering firm's productivity and initial aggregate productivity, weighted by its market share.

Exit effect – the sum of the differences between each exiting firm's productivity and initial aggregate productivity, weighted by its market share.

According to equation (2) the "between effect", the "entry effect" and the "exit effect" involve deviations of firm-level productivity from the initial productivity level in the industry. This implies that for an incumbent firm an increase in the output share only contributes positively to the "between effect" if the firm has higher productivity than the average initial productivity for the industry. Moreover, an entering firm contributes positively only if the firm has higher productivity than the initial average and an exiting firm only contributes positively if the firm exhibits lower productivity than the initial average.

There are other methods for decomposing aggregate productivity change. Baily, Hulten and Campbell (1992) suggests the following decomposition:

$$\Delta P_t = \sum_{i \in C} \theta_{i,t-k} \Delta p_{it} + \sum_{i \in C} \Delta \theta_{it} p_{it} + \sum_{i \in N} \theta_{it} p_{it} - \sum_{i \in X} \theta_{i,t-k} p_{i,t-k} \qquad (3)$$

The first terms productivity growth of incumbent firms or the "within effect". The second term describes the "between" effect and the final two effects describes the "entry" and "exit effects", respectively. The models (2) and (3) differ in the treatment of entry and exit. One problem with the treatment in (3) is that the net entry effect can be mixed up with the between effect. Even if entrants are highly productive and exitors are very unproductive, the net entry effect can be negative due to differences in the market shares of entrants and exitors. This problem is solved in the decomposition shown in (2) where the productivity of entrants and exitors are related to the initial productivity level.

Foster, Haltiwanger and Krizan also points out that their decomposition can be sensitive to measurement errors, which might lead to an understatement of the "cross" and the "within effects" (Heden, 2005, p65). They also suggest a decomposition due to Griliches and Regev (1992):

$$\Delta P_t = \sum_{i \in C} \bar{\theta}_i \Delta p_{it} + \sum_{i \in C} \Delta \theta_{it} \left(\bar{p}_i - \bar{P} \right) + \sum_{i \in N} \theta_{it} \left(p_{it} - \bar{P} \right) - \sum_{i \in X} \theta_{i,t-k} \left(p_{i,t-k} - \bar{P} \right) \qquad (4)$$

Where the bar indicates a time average over the base and end year. This procedure removes some of the effects originating from measurements errors by averaging. The disadvantage is that interpretation is more complicated since the within effect in (4) will to an extent reflect external restructuring or between effect.

In this study we choose to use the decomposition shown in (2), due to its better treatment of the net entry effect than the decomposition (3). The decomposition in (2) and (3) produce similar results as demonstrated in Heden (2005) in her analysis of the Swedish and UK manufacturing industry.

2.3 Defining incumbent, exiting and entering firms

This paper estimates the contribution to labour productivity growth from incumbent, entering and exiting firms. It is therefore of crucial importance to define what is meant by these terms. The IFDB database uses organization numbers to identify firms. Therefore, a firm with the same organization number in 1997 and 2002 that still belongs to the industry group that is being investigated is defined as an incumbent firm. Moreover, exiting firms are defined as firms with an organization number that belongs to the investigated industry group in 1997, but where the organization number is missing for the investigated industry group in 2002. Finally, entering firms are defined as firms with an organization number that belongs to the investigated industry group in 2002, but where the organization number is missing for the particular industry group in 1997.

Using the organization number as a method for identifying entries and exits is limited in the sense that it is not possible to distinguish the reason for entry or exit. In order to analyze exit and entry in detail a complementary method denoted FAD will be used. The FAD-method makes it is possible to distinguish why firms enter or exit (i.e. due to mergers, splits or "pure" entry or exit) a specific industry. Hence, it is possible to quantify the productivity effect from firms entering or exiting due to different reasons. The FAD-method is described in section 3.1. However, by using the FAD method it will be possible to classify entry and exit into the following categories that represents different reasons for entry and exit:

Reclassification – firms that enter or exit because they are reclassified to belong to another industry than the one being investigated.

Split – firms that enter or exit because they are split up.

New or shut down – firms that enter because they are completely new or firms that exit because they are shut down.

Merger – firms that enter or exit due to merger.

Unidentified – firms that are identified as exiting or entering by the IFDB database, but not according to the FAD database (see section 3).

2.4 ICT-producing, intensive and less intensive ICT-using industries

In addition to decomposing labour productivity growth for incumbent, entering and exiting firms in total manufacturing, decomposition is also undertaken in ICT-producing, intensive ICT-using and less intensive ICT-using industries. Stiroh (2002) uses the flow of capital services from ICT as a share of total capital services.[3] He then defines the ICT-intensive industries as the industries with an above median value of the 1995 ICT share of capital services. The industries with below median value are defined as less intensive ICT-using industries.

[3] Service flows are calculated by estimating a user cost of each type of capital.

Table 1 ICT-producing, intensive ICT-using and less intensive ICT-using industries in manufacturing

Industry	ISIC
ICT-producing industries	
Office accounting and computing machinery	30
Insulated wire and cable	313
Radio, television and communication equipment	32
Medical and measuring equipment and process control	331
Intensive ICT-using industries	
Wearing apparel, dressing and dying of fur	18
Printing and publishing	22
Machinery and equipment	29
Electrical machinery and apparatus, excluding insulated wire	31 excl. 313
Precision and optical instruments, excluding ICT instruments	33 excl. 331
Other transport equipment	35
Miscellaneous manufacturing and recycling	36–37
Less intensive ICT-using industries	
Food products	15–16
Textiles	17
Leather, leather products and footwear	19
Wood and products of wood and cork	20
Paper products	21
Coke, refined petroleum products and nuclear fuel	23
Chemicals	24
Rubber and plastic products	25
Non-metallic mineral products	26
Basic metals	27
Fabricated metal products	28
Motor vehicles, trailers and semi-trailers	**34**

Source: van Ark et al. (2003).

The definition of ICT-producing industries is based on OECD (2002).[4] Since there are no data of the ICT capital stock available for Swedish manufacturing at a disaggregated level, it has not been possible to define which industries that are intensive users of ICT in Sweden.

Therefore, the classifications pioneered by Stiroh (2002) will be used. This implies that the classification is based on data of US capital services flow. However, according to an investigation by van Ark *et al* (2003) ICT intensive industries in the US are also ICT intensive in some EU countries.[5]

[4] OECD (2002) defines the following manufacturing industries as ICT producing: Office accounting and computing machinery (ISIC 30), Insulated wire and cable (ISIC 313), Radio, television and communication equipment (ISIC 32), Instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment (ISIC 3312). Industrial process control equipment (ISIC 3313).

[5] Van Ark *et al*. (2003) use rank correlations between the intensity of IT investments by industry to test whether ICT intensive industries in the US are also ICT intensive in France, Germany, the Netherlands and the UK. Overall, the rankings suggest that the intensive ICT-using industries are similar across countries.

Hence, it is reasonable to believe that US ICT diffusion also could be used as a measure of the ICT intensity in Swedish industries. Table 1 presents the ICT-producing, intensive and less intensive ICT-using industries for Sweden based on van Ark *et al*. (2003).[6]

6 The classification by van Ark et al. (2003) has been used since it is based on ISIC classification instead of the one proposed by Stiroh (2002) that uses US industry classification.

3 The Data Set

3.1 The IFDB database

The results of this study will be based on the IFDB database created by the Swedish Institute for Growth Policy Studies (ITPS) in cooperation with Statistics Sweden. The database consists of a number of registers with data on individuals, firms and establishments collected from Statistics Sweden that are reconciled so that both individuals, firms and the link between individuals and firms can be analyzed. In this study, only data for firms will be used. The database has been assembled to provide ITPS with material for different kinds of growth analyses, both on the national and regional level.

The IFDB database includes data on value added and production value for Swedish firms, producer price indexes for disaggregated industry levels and number of persons employed in 1986–2004. In this paper we will only focus on the period 1997–2002. The reason to use 1997 as the starting year for our investigation is because production value for firms only exists from 1997 and onwards. Moreover, the sample of Swedish firms included in the IFDB database was changed in 1996/97. Hence, calculations based on data prior to 1997 cannot be compared with calculations based on data after 1996 without evoking measurement problems. The reason behind the break is that the collection method for the statistics on Swedish firms was changed between 1996 and 1997. Before 1997, only a fraction of the firms with less than 50 employees were sampled. From 1997 onwards, the statistics are based on registers and covers all firms.

In addition to the use of organisation numbers as a key to identify entry and exit, this study will also use a demographic method denoted FAD to get more details on entering and exiting firms. New organisation numbers can be created despite that the company is an old one, for instance due to change of legal form. This means that such a company erroneously will be treated as an entry if all new organisation numbers are treated as new firms. The FAD method tries to remedy this by classifying a firm as an entry, exit or incumbent depending on changes in the labour force of the firm. In addition, the FAD method also identifies entries and exits due to mergers and splits of firms.

Data on entries, exits and incumbents according to the FAD method are also included in the IFDB database and can be matched to the firms data on production, value added and number of employed, which means that the decomposition of productivity will also be conducted using the FAD-data, in addition to the more traditional method of using organisation numbers.

Basically, the FAD method is based on the matching of employees over two consecutive years i.e. year 1 and year 2. Employees that enter or exit the labour market, during these years, are not included in the calculations. All firms that reports having employees to the Swedish tax authorities are included in the sample. Additionally, firms without employees that report having a positive income are also included in the sample. The result of the matching process is used for the classification of firms into different categories. For firms with three or more employees, a number of macro-combinations are used to identify entries and exits. The basic conditions is that if more than 50 percent of the employees in two firms are the same, then these firms are treated as incumbents.

If there is a majority of common employees year 1, but a minority year 2 the firm is classified as exiting due to merger and if there is a majority of common employees year 2, but a minority year 1 the firm is classified as new due to split.

A firm is classified as exiting due to split if there is no majority year 1 and if there is at least one combination of majority year 2 and minority year 1 the. The combination with the largest number of common employees is chosen to define the firm with its variable values. Moreover, if there is no majority year 2 and if there is at least one combination of majority year 1 and minority year 2 the firms is classified as entering due to merger. The combination with the largest number of common employees is chosen to define the firm with its variable values.

Finally, there will entering and exiting firms that are not survivors and these will be classified as new entering firms and firms that are shut down.

Micro combinations are used when there are 2 or less persons employed by the firm in year 1 or year 2. Thus, if at least one of the three criteria below are fulfilled the firms are classified as incumbent. Otherwise they will be classified either as entering or exiting firms.

1 The organization numbers of the firms are the same.

2 The workplace numbers of the firms are the same.

3 The employees in the two periods are exactly the same.

In this paper micro-combinations will not be used since only firms with 3 or more employees in 1997 and 2002 are included in the investigation.

3.2 Potential measurement errors

Labour productivity will be defined as production value per person employed. The reason to use production value instead of value added is that there are no price indexes available for intermediate inputs at a sufficiently disaggregated level. Producer price indexes at the most disaggregate level possible are used for deflation. This implies that for some firms producer price indexes the 5-digit ISIC level are used, while for a few industries it has only been possible to use price indices at the 2-digit ISIC level. Hence, for some product groups the productivity estimates are more uncertain than for others.

Another potential measurement problem is the industry classification of firms. The industry classification of each firm is based on the product with the highest value that the firm produces. However, it is likely that firms may be involved in producing many different products. These products may be so different that the production of the firm should be included in two different industries. This implies that parts of the production value of the firm will be deflated with price indexes that are not equivalent to price development of the products that are of less importance to the firm.

For firms with none or very few persons employed productivity growth can be very volatile. We therefore only include firms with 3 or more employees. Moreover, we also present results of growth decomposition for firms with 10 or more employees and firms with 100 or more employees. We thereby test if the results are robust when small firms are excluded.

The definitions of entering and exiting firms in this paper are based on organization number in the IFDB database (see section 2.3). According to the FAD-method the definitions of entering and exiting firms are not based on organization numbers but on the labour force movements (see section 3.2). This implies that some of the firms classified as entering or exiting, according to the IFDB database, will not have the same classification based on the definition in the FAD-method and vice versa. Thus, there will be a group of firms classified as entering or exiting by the IFDB database, that are classified as incumbent firms by the FAD-method. Hence, it will not be possible to analyze the reason why these firms enter and exit. This implies that there will be a group of firms where the cause of entering and exiting is not identified.

It is not clear whether it is best practice to define entering and exiting firms according to organization numbers or labour movements. Organization numbers may change without any effect on the production and the direction of a firm. However, for small firms it is not certain that the fact that a majority of the employees quit, necessarily implies that the production of the firm changes.

Productivity growth is affected by the business cycle and can therefore be influenced by the selected time period. Unfortunately it has not been possible to investigate productivity growth over the whole business cycle due to data constraints. The time period investigated here starts in 1997 when aggregate growth was quite high and ends in 2002 when growth was slowing down. It is likely that the results may differ depending on the selected period. According to Hedén (2005) labour productivity was quite consistent during the Swedish recession in the early 1990s and the boom in 2000. However, the within effect was relatively larger during the boom, while net entry was relatively larger during the recession.

4 Results

4.1 Total number of firms

Table 2 shows the total number of firms included in the investigation. In manufacturing, there were 17978 firms with more than 2 employees. The corresponding figures for firms with more than 9 and 99 employees were 7948 and 1104, respectively. In ICT-producing industries there were 835 firms with more than 2 employees. The corresponding figures for intensive and less intensive ICT-using industries were 7067 and 10392.[7]

Table 2 Total number of firms included in each industry group

	> 2		*> 9*		*> 99*	
	Total	**Percent**	**Total**	**Percent**	**Total**	**Percent**
Total Manufacturing						
Incumbent firms	10454	58	4759	60	696	63
Exiting firms	3660	20	1745	22	241	22
Entering firms	3864	21	1444	18	167	15
Total number of observations	17978	100	7948	100	1104	100
ICT-producing industries						
Incumbent firms	390	47	157	42	31	41
Exiting firms	233	28	118	32	26	35
Entering firms	212	25	98	26	18	24
Total number of observations	835	100	373	100	75	100
Intensive ICT-using industries						
Incumbent firms	3850	54	1742	56	269	61
Exiting firms	1665	24	777	25	100	23
Entering firms	1552	22	605	19	69	16
Total number of observations	7067	100	3124	100	438	100
Less intensive ICT-using industries						
Incumbent firms	5962	57	2716	58	385	62
Exiting firms	2044	20	1014	22	130	21
Entering firms	2386	23	922	20	102	17
Total number of observations	**10392**	**100**	**4652**	**100**	**617**	**100**

Note: The number of incumbents, entering and exiting firms in ICT-producing, intensive ICT-using and less intensive ICT-using industries will not add up to the total number of firms in total manufacturing. The reason is that some firms changed their businesses considerably in 1997–2002. In some cases this implies that they are reclassified to another industry group than the one that is being investigated. Hence, if a firm classified as ICT-producing in 1997 is reclassified as an intensive ICT-using firm in 2002, it will be an exiting firm from ICT-producing industries and an entering firm in intensive ICT-using industries. However, it is still an incumbent firm in total manufacturing.

Source: IFDB database and authors' calculations.

[7] The number of incumbents, entering and exiting firms in the ICT producing, intensive ICT using and less intensive ICT using industries will not add up to the total number of firms in total manufacturing. The reason is that some firms changed their businesses considerably in 1997–2002. In some cases this implies that they are reclassified to another industry group than the one that is being investigated. Hence, if a firm classified as ICT producing in 1997 is reclassified as an intensive ICT using firm in 2002, it will be an exiting firm from ICT producing industries and an entering firm in intensive ICT using industries. However, it is still an incumbent firm in total manufacturing.

The share of incumbents firms in total manufacturing was 58–63 percent depending on the number of employees of the investigated firms. The corresponding figures for ICT-producing, intensive ICT-using and less intensive ICT-using industries were 41–47, 54–61 and 57–62 percent. Hence, the share of incumbent firms in ICT-producing industries was lower than in the other two industry groups. Moreover, the share of entering and exiting firms was higher in ICT-producing industries compared to intensive and less intensive ICT-using industries.

4.2 Decomposition of labour productivity growth

The sections below present the results of the decomposition of labour productivity growth. Each section starts by discussing the results based on output shares and then discusses the results based on employment shares.

4.2.1 Total manufacturing

Table 3 shows the decomposition of labour productivity growth in Swedish manufacturing in 1997–2002. According to Table 3, productivity growth in total manufacturing was 17.6–19.9 percent depending on the size of the included firms.[8]

Table 3 Decomposition of labour productivity growth in Swedish manufacturing in 1997–2002 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Within effect	14.3	14.9	18.1	10.3	10.6	12.1
Between effect	0.4	0.01	1.0	2.0	2.1	3.1
Cross effect	0.7	–0.02	–2.1	–2.9	–3.0	–3.6
Entry effect	3.6	3.1	2.2	–9.4	–9.7	–12.9
Exit effect	0.7	0.4	–0.7	–13.1	–13.7	–16.6
Total productivity growth	**18.3**	**17.6**	**19.9**	**13.1**	**13.7**	**15.1**

Note: Labour productivity growth is defined as output per person employed.

Source: IFDB database and authors' calculations.

Moreover, the "within effect" accounted for the largest contribution to labour productivity growth. For firms with more than 2 employees the "within effect" was 14.3 percentage points of the total labour productivity growth of 18.3 percent. Thus, productivity growth within existing manufacturing firms contributed to the major part of the total productivity growth in Swedish manufacturing in 1997–2002. This is in line with the results in previous studies and also confirms the suggestion in Heden (2005) that the within effects declined during the recession in the beginning of the 21th century, since this study estimates that around 80 percent of productivity growth is due to the within effects and Heden's study allocates around 90 percent to the within effect during the period 1992–1997.

The "between effect" was between 0.01 and 1.0 percentage points depending on the size of the firms included. Thus, the effect of expanding market shares of high productivity firms or shrinking market shares of low productivity firms was small. The same holds for the "cross effect", even though the cross effect for firms with more than 99 employees accounted for –2.1 percentage points of the productivity growth in 1997–2002. Finally, the contribution to labour productivity growth for entering firms was larger than for exiting firms. The net effect from entry and exit was approximately 3.0 percentage points.

[8] The size of the firms is measured as the number of employees of a specific firm.

Table 3 also shows the decomposition of labour productivity growth based on employment weights instead of output weights. According to *table 3*, the productivity growth in total manufacturing was lower if employment weights were used. The productivity growth in total manufacturing then was 13.1–15.1 percent in 1997–2002. Moreover, the "within effect" was lower, while the "between effect" increased by a few percentage points and the "cross effect" was more negative. The largest difference was found for the entry and "exit effects" that were negative. Hence, entering and exiting firms with lower than average productivity levels had considerably higher employment shares than output shares, which is to be expected.

Despite the difference in results depending on weighting, the "within effect" still had the largest impact on productivity growth in manufacturing. Thus, productivity growth within incumbent firms accounted for at least 70 percent of the productivity growth in total manufacturing in 1997–2002. Moreover, the net effect from entry and exit was larger when employment weights were used even though both effects were negative.

Table 4 and Table 5 show the decomposition effects of entry and exit in Swedish manufacturing based on combined data from the IFDB database and the FAD method. According to Table 4, only new firms had a negative impact on the total "entry effect" based on output weights.

Table 4 Decomposition of entry effects in Swedish manufacturing in 1997–2002 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Reclassification†	1.60	1.24	0.65	–7.41	–8.04	–11.75
Split	0.74	0.64	0.35	–0.78	–0.81	–1.04
New	–0.07	–0.05	–0.06	–0.51	–0.23	–0.15
Merger	0.24	0.21	0.19	–0.36	–0.31	–0.02
Unidentified	1.11	1.05	1.06	–0.31	–0.26	–0.01
Total entry effect	**3.6**	**3.1**	**2.2**	**–9.4**	**–9.7**	**–12.9**

Note: Labour productivity growth is defined as output per person employed. †Firms that are reclassified as manufacturing firms during the investigated period. Thus, they existed, but were not classified as manufacturing firms in 1997.

Source: IFDB database, FAD database and authors' calculations.

However, based on employment weights, all categories of entry had a negative impact on the "entry effect". Hence, firms with a productivity level below the average in manufacturing had a much larger employment share than output share. The reclassification category had the most negative impact on productivity growth. Thus, incumbent firms that were reclassified as manufacturing firms during the investigated period accounted for much of the negative impact from entry.

Table 5 shows that also for exiting firms the productivity effect was much larger when employment weights were used instead of output weights. Based on output weights the "exit effect" was between –0.7 and 0.7 percentage points. However, based on employment weights the productivity effect of firms exiting was between –13.1 and –16.6. Moreover, firms exiting due to mergers had the largest negative effect when employment weights were used.

Table 5 Decomposition of exit effects in Swedish manufacturing in 1997–2002 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Reclassification†	0.49	0.35	0.05	–1.10	–1.14	–1.13
Merger	0.71	0.53	–0.11	–7.68	–8,37	–11.65
Shut down	–0.07	0.03	–0.04	–0.66	–0,29	–0.06
Split	–0.37	–0.41	–0.39	–1.97	–2.09	–2.25
Unidentified	–0,03	–0.12	–0.19	–1.72	–1.76	–1.55
Total exit effect	**0.7**	**0.4**	**–0,7**	**–13.1**	**–13.7**	**–16.6**

Note: Labour productivity growth is defined as output per person employed. †Firms that were classified as manufacturing industries in 1997, but not in 2002.

Source: IFDB database, FAD database and authors' calculations.

Interestingly, the effects from firms that were new or shut down were very small and almost negligible. For example, new firms with more than 2 employees only accounted for –0.07 percentage points of the total of 3.6 percentage "entry effect". Similarly, firms that were shut down only accounted for a small part of the total "exit effect". Thus, the impact on productivity growth from new firms and firms that were shut down was negligible in Swedish manufacturing in 1997–2002.

4.2.2 ICT-producing industries

Table 6 shows decomposition of labour productivity growth in Swedish ICT-producing manufacturing industries in 1997–2002.

Table 6 Decomposition of labour productivity growth in Swedish ICT-producing manufacturing in 1997–2002 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Within effect	60.3	61.4	64.4	35.1	35.9	38.3
Between effect	0.9	1.4	4.4	4.0	4.4	7.6
Cross effect	–20.0	–20.7	–23.0	–18.8	–19.5	–22.9
Entry effect	–2.5	–2.8	–2.9	–17.3	–17.4	–16.9
Exit effect	–2.4	–2.6	–2.5	–27.8	–28.3	–27.9
Total productivity growth	**41.1**	**41.9**	**45.4**	**30.9**	**31.9**	**34.0**

Note: Labour productivity growth is defined as production value per person employed.

Source: IFDB database (2006) and authors' calculations.

The total productivity growth in ICT-producing manufacturing was 41.1–45.4 percent depending of the size of the included firms in 1997–2002. Hence, productivity growth increased considerably more in ICT-producing manufacturing compared to total manufacturing.

The "within effect" was 60.3–64.4 percentage points depending on the size of the included firms. The corresponding figures for the "cross effect" were between –20.0 and –23.0. Thus, among ICT-producing firms the productivity growth of incumbent firms was very high. Moreover, the negative "cross effect" indicates that firms with high productivity growth were shrinking their market shares or firms with low productivity growth were increasing their market share.

It is likely that the negative "cross effect" is due to shrinking shares of the telecommunication equipment firms due to the crisis in this industry in 2002–2003.[9] The "entry" and "exit effects" were both negative and the difference between them was very small. This implies that entering as well as exiting firms on average had a lower then average productivity level compared to existing firms.

Based on employment weights, the "within effect" decreased to 35.1–38.3 percent depending on the size of the included firms. The "between effects" increased, which implies that the employment share increased more for incumbent firms with high levels or productivity compared to the output share. Moreover, the "entry" and "exit effects" were more negative when employment weights were used instead of output weights. Hence, the employment share was larger for entering and exiting firms with low levels of productivity. However, the net effect from entry was positive and quite large.

Table 7 and Table 8 show the decomposition of "entry" and "exit effects" in Swedish ICT-producing manufacturing. According to Table 7 the "entry effect" was negative both when output weights and employment weights were used. However, the "entry effect" was considerably more negative when employment weights were used. Unidentified firms and firms entering due to split accounted for the largest negative effects.

Table 7 Decomposition of entry effects in Swedish ICT-producing manufacturing in 1997–200 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Reclassification†	0.21	–0.01	–0.08	–1.49	–1.39	–0.74
Split	–0.93	–1.07	–0.97	–8.34	–8.70	–9.93
New	–0.002	–0.07	0	–0.32	–0.01	0
Merger	–0.22	–0.19	0	–1.34	–1.31	0
Unidentified	–1.56	–1.57	–0.85	–5.77	–5.95	–6.23
Total entry effect	**–2.5**	**–2.8**	**–2.9**	**–17.3**	**–17.4**	**–16.9**

Note: Labour productivity growth is defined as output per person employed. †Firms that were reclassified as ICT-producing firms during the investigated period. Thus, they existed but were not classified as ICT-producing industries in 1997.

Source: IFDB database, FAD database and authors' calculations.

Table 8 shows that the "exit effect" was negative, indicating that exiting firms on average had a lower productivity than the average of the ICT-producing firms. Moreover, the exiting effect was much more negative when employment weights were used instead of output weights. Unidentified firms and firms exiting due to merger had the largest negative impact.

[9] In 2001–2003 the largest Swedish telecommunication equipment manufacturing firm Ericsson decreased its employees from approximately 105 000 to 51 000.

Table 8 Decomposition of exit effects in Swedish ICT-producing manufacturing in 1997–2002 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Reclassification†	0.56	0.42	0.22	–2.25	–2.20	–1.53
Merger	–1.45	–1.56	–1.58	–19.75	–20.58	–22.17
Shut down	–0.13	–0.05	0	–0.59	–0.21	0
Split	–0.27	–0.25	–0.09	–1.00	–0.96	–0.37
Unidentified	–1.06	–1.12	–1.04	–4.25	–4.36	–3.87
Total exit effect	**–2.4**	**–2.6**	**–2.5**	**–27.8**	**–28.3**	**–27.9**

Note: Labour productivity growth is defined as output per person employed. †Firms that were classified as ICT-producing industries in 1997, but not in 2002.

Source: IFDB database, FAD database and authors' calculations.

4.2.3 Intensive ICT-using industries

According to Table 9, the labour productivity growth in intensive ICT-using industries was 11.6–12.2 percent, depending on the size of the included firms. Hence, productivity growth in the intensive ICT-using industry was lower than in total manufacturing. The "within effect" was between 2.8–4.1 percentage points depending on the size of the included firms. The largest contribution to labour productivity growth was due to entering firms that contributed 5.0–6.6 percent to labour productivity.

Table 9 Decomposition of labour productivity growth in Swedish intensive ICT-using manufacturing in 1997–2002 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Within effect	2.8	3.4	4.1	5.6	5.9	5.7
Between effect	–0.8	–0.7	–0.4	2.7	2.5	2.3
Cross effect	4.2	3.3	1.9	–2.8	–3.1	–3.4
Entry effect	6.6	5.9	5.0	–17.4	–18.9	–28.2
Exit effect	0.6	0.2	–1.0	–10.1	–10.4	–12.9
Total productivity growth	**12.2**	**11.7**	**11.6**	**–1.8**	**–3.2**	**–10.7**

Note: Labour productivity growth is defined as production value per person employed.

Source: IFDB database (2006) and authors' calculations.

Based on employment weights instead of output weights the contribution from the "within" and "between effects" was 5.6–5.9 and 2.3–2.7 percentage points, while the "cross effect" was negative. Moreover, the "entry" and "exit effects" were negative and thus considerably lower based on employment weights instead of output weights.

For firms with more than 99 employees the "entry effect" was –28.2 percentage points, while the "exit effect" was –12.9 percentage points. In total, the net effect from entry and exit was negative. Thus, total labour productivity growth for intensive ICT-using industries was negative based on employment weights.

Table 10 and Table 11 show the decomposition of entry and exiting effects among intensive ICT-using manufacturing firms. According to Table 10, reclassified firms accounted for the largest impact on the "entry effect". However, the impact from reclassified firms was positive based on output weights, but very negative based on employment weights. Hence, reclassified firms with below average productivity level had considerably larger employment shares compared to output shares.

Table 10 Decomposition of entry effects in Swedish intensive ICT-using manufacturing in 1997–2002 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Reclassification†	3.67	3.54	3.02	–17.26	–18.98	–28.63
Split	1.00	0.81	0.43	–0.02	–0.02	–0.16
New	0.11	–0.10	–0.07	–0.34	–0.20	–0.17
Merger	1.17	1.04	1.10	0.19	0.21	0.36
Unidentified	0.64	0.58	0.57	0.07	0.12	0.37
Total entry effect	**6.6**	**5.9**	**5.0**	**–17.4**	**–18.9**	**–28.2**

Note: Labour productivity growth is defined as output per person employed. †Firms that are reclassified as intensive ICT-using firms during the investigated period. Thus, they existed, but were then not classified as intensive ICT-using industries in 1997.

Source: IFDB database, FAD database and authors' calculations.

Table 11 shows the decomposition of "exit effects" among Swedish intensive ICT-using manufacturing industries. Based on output weights, the firms exiting due to split had the largest negative impact, while the largest positive impact came from unidentified firms. However, when employment weights were used, firms exiting due to merger had the largest negative effect.

Table 11 Decomposition of exit effects in Swedish intensive ICT-using manufacturing in 1997–2002 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Reclassification†	0.16	–0.03	–0.44	–1.28	–1.26	–1.00
Merger	0.17	0.06	–0.41	–3.79	–4.12	–5.74
Shut down	–0.11	–0.02	0.01	–0.58	–0.22	0.01
Split	–0.59	–0.67	–0.93	–3.74	–4.04	–5.56
Unidentified	0.95	0.90	0.76	–0.73	–0.73	–0.57
Total exit effect	**0.6**	**0.2**	**–1.0**	**–10.1**	**–10.4**	**–12.9**

Note: Labour productivity growth is defined as output per person employed. †Firms that were classified as intensive ICT-using industries in 1997, but not in 2002.

Source: IFDB database, FAD database and authors' calculations.

4.2.4 Less intensive ICT-using industries

Table 12 shows that the productivity growth for less intensive ICT-using industries was 18.0–20.7 percent in 1997–2002 depending on the size of the firms included.

Table 12 Decomposition of labour productivity growth in Swedish less intensive ICT-using manufacturing in 1997–2002 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Within effect	9.3	9.6	11.4	9.2	9.5	10.8
Between effect	1.3	1.7	2.5	1.4	1.6	2.7
Cross effect	4.2	3.2	3.1	–0.5	–0.4	–0.04
Entry effect	4.4	3.9	3.4	–1.6	–1.0	0.4
Exit effect	1.2	0.8	–0.3	–12.6	–13.2	–15.7
Total productivity growth	**18.0**	**17.6**	**20.7**	**21.1**	**22.9**	**29.6**

Note: Labour productivity growth is defined as production value per person employed.

Source: IFDB database (2006) and authors' calculations.

Thus, productivity growth in less intensive ICT-using manufacturing was approximately the same as in total manufacturing. Moreover, the "within effect" had the largest contribution to labour productivity growth with 9.3–11.4 percentage points. Moreover, the net effect from entry and exit was positive.

When employment weights were used instead of output weights the labour productivity growth slightly increased, as opposed to the previous results. However, the "within effect" decreased to 9.2–10.8 percentage points. The "between", "cross", "entry" and "exit" effects also decreased.[10] The reason that total labour productivity growth increased, based on employment weights, is that the "exit effect" was considerably more negative than the "entry effect". Hence, employment shares were considerably larger for exiting firms with below average labour productivity level, than the output shares.

Table 13 and Table 14 show the decomposition of "entry" and "exit effects" in less intensive ICT-using manufacturing industries. According to *table 13*, the "entry effect" was 3.4–4.4 percentage points based on output weights.

Table 13 Decomposition of entry effects in Swedish less intensive ICT-using manufacturing in 1997–2002 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Reclassification†	1.82	1.38	1.09	–0.43	–0.31	0.10
Split	0.99	0.96	0.67	–0.21	–0.17	–0.09
New	–0.13	–0.06	–0.06	–0.55	–0.24	–0.13
Merger	0.11	0.12	0.11	–0.37	–0.29	0.03
Unidentified	1.59	1.51	1.62	–0.02	0.06	0.46
Total entry effect	**4.4**	**3.9**	**3.4**	**–1.6**	**–1.0**	**0.4**

Note: Labour productivity growth is defined as output per person employed. †Firms that are reclassified as less intensive ICT-using firms during the investigated period. Thus, they existed, but were not classified as less intensive ICT-using industries in 1997.

Source: IFDB database, FAD database and authors' calculations.

[10] Except the "cross effect" for firms with more than 99 employees.

If employment weights were used the "entry effect" decreased to between –1.6 and 0.4. Unidentified and reclassified firms had the largest positive effects, while new firms had a negative impact. When employment weights were used there is no category that has a particularly large impact.

According to Table 14 the "exit effects" for less intensive ICT-using firms is between –0.3 and 1.2 percentage points based on output weights and between –12.6 and –15.7 percent based on employment weights. Thus, the employment weights were considerably larger for exiting firms with low levels of productivity compared to output weights. Moreover, firms exiting due to merger had the largest negative impact on the "exit effect", based on employment weights.

Table 14 Decomposition of exit effects in Swedish less intensive ICT-using manufacturing in 1997–2002 (percent)

Number of employees in firms	**> 2**	**> 9**	**> 99**	**> 2**	**> 9**	**> 99**
	Output weights			*Employment weights*		
Reclassification†	0.06	–0.08	–0.32	–1.56	–1.63	–1.34
Merger	1.12	0.89	0.08	–8.47	–9.26	–13.13
Shut down	0.05	0.14	–0.01	–0.56	–0.22	–0.03
Split	–0.05	–0.07	0.01	–0.53	–0.54	–0.08
Unidentified	0.01	–0.07	–0.02	–1.50	–1.51	–1.08
Total exit effect	**1.2**	**0.8**	**–0.3**	**–12.6**	**–13.2**	**–15.7**

Note: Labour productivity growth is defined as output per person employed. †Firms that were classified as less intensive ICT-using industries in 1997, but not in 2002.

Source: IFDB database, FAD database and authors' calculations.

5 Conclusions

This paper has presented results from the productivity growth in Swedish manufacturing at the firm level in 1997–2002. The contribution to labour productivity growth from incumbent, entering and exiting firms was investigated by decomposing productivity growth into five components based on Haltiwanger (1997) and Foster, Haltiwanger and Krizan (1998). Moreover, the effects of the five components were investigated not only in total manufacturing, but also in ICT-producing, intensive ICT-using and less intensive ICT-using manufacturing. Based on the results in this paper a number of conclusions can be reached.

The results show that incumbent firms accounted for a very large part of the productivity growth in Swedish manufacturing. The "within effect" was approximately 80 percent of the productivity growth in manufacturing based on both output and employment weights. Thus, most of the productivity growth in Swedish manufacturing was due to incumbent firms increasing their productivity. These findings are also robust with respect to firm size.

The net effects from entry and exit, in total manufacturing, were approximately 3–4 percentage points based on output as well as employment weights. However, the actual contribution of entry and exit to labour productivity growth varied considerably depending on whether output or employment weights were used. For example, the "entry effect" was 2.2–3.6 percentage points based on output weights, while the corresponding figures based on employment weights were between –9.4 and –12.9 percentage points. It is evident that entering and exiting firms, due to lower than average productivity levels, had larger employment shares compared to output shares.

Firms entering due to reclassification and unidentified firms accounted for the largest positive effect based on output weights. However, reclassification had a negative "entry effect" based on employment weights. Moreover, firms exiting due to merger had a small effect based on output weights, but a large negative effect based on employment weights. Thus, the decomposition effects of "entry" and "exit" were not robust with respect to different weights. This indicates that firms with productivity levels below and above the average of the industry had very different weights with respect to employment and output. Nonetheless, the effect from new firms entering and firms that were shut down was very small in manufacturing both when output and employment weights were considered. Hence, the impact from new firms on productivity was negligible in Swedish manufacturing in 1997–2002.

Most of the productivity growth in ICT-producing and less intensive ICT-using industries occurred in incumbent firms. However, in intensive ICT-using industries the "entry effects" were larger than the "within effects". One possible reason why the "entry effect" contributed relatively more to productivity growth could be that the barriers to entry are lower in intensive ICT using industries. In ICT-producing industries, the cross effect was large and negative. This implies that high productivity growth firms decreased their market shares or low productivity growth firms increased their market shares. It is reasonable to believe that the negative "cross effect" is due to the telecommunication crisis in Sweden in 2002–2003.

The decomposition of "entry" and "exit effects" shows that different categories had very different impacts on productivity in ICT-producing, intensive ICT-using and less intensive ICT-using industries. Moreover, the results were seldom robust with respect to whether output or labour weights were used. Thus, there is no common category that accounts for a large part of the productivity growth among entering and exiting firms in all three industry groups. However, the impact from new and shut down firms was very small in ICT-producing as well as intensive and less intensive ICT-using industries. These findings are also robust with respect to output and labour weights. Thus, as for manufacturing the impact of new firms on productivity growth was almost negligible in all industry groups 1997–2002.

In summary, there are two important conclusions that can be reached from the result in presented here. The first is that the "within effect" accounted for approximately 80 percent of the productivity growth in Swedish manufacturing in 1997–2002. Thus, much of the productivity growth was due to increased productivity within incumbent firms. The second is that new firms had a negative impact on productivity growth in manufacturing. Thus, incumbent Swedish firms seem very skilled to take advantage of new technology and innovation, while start-ups are not large and productive enough to have a substantial impact on productivity growth initially.

References

Ahn, Sanghoon (2001), Firm Dynamics and Productivity Growth: A Review of Micro Evidence from OECD Countries", OECD Economics Department Working Paper 297, OECD, Paris.

van Ark, Bart, Inklaar, Robert and McGuckin Robert H. (2003),"'Changing Gear' Productivity, ICT and Service Industries: Europe and the United States," in Christensen, Jens F. and Maskell, Peter (eds.), *The Industrial Dynamics of the New Digital Economy*, Edward Elgar, Cheltenham.

Baily, Martin N., Hulten, Charles and Campbell, David (1992), *Productivity Dynamics in Manufacturing Plants*, Brookings Papers on Economic Activity, Microeconomics, pp187-249.

Edquist, Harald and Henrekson, Magnus (2006), "Technological Breakthroughs and Productivity Growth," *Research in Economic History*, Vol 24, pp.–?

Foster, Lucia, Haltiwanger, John, and Krizan, C.J. (1998), *Aggregate Productivity Growth: Lessons from Microeconomic Evidence*, NBER Working Paper 6803.

Griliches, Zvi and Regev, Haim (1992), *Productivity and Firm Turnover in Israeli Industry 1979-88*, NBER Working paper 4059.

Hakkala, Katariina (2004), "Corporate Restructuring and Labour Productivity Growth," Working Paper No. 619, The Research Institute of Industrial Economics, Stockholm.

Haltiwanger, John C. (1997), "Measuring and analyzing aggregate fluctuations: the importance of building from microeconomic evidence," *Federal Reserve Bank of St Louis Economic Review*, May/June.

Hedén, Ylva. (2005), "Productivity, Upskilling, Entry and Exit: Evidence from the UK and the Swedish Micro Data," Thesis submitted for the degree of PhD, Queen Mary, University of London.

Nelson, Richard R. (1981), "Research on Productivity Growth and Productivity Differences: Dead Ends and New Departures," *Journal of Economic Literature*, Vol. 19, pp. 1029–1064.

Schumpeter, Joseph A. (1966), *Capitalism, Socialism and Democracy*, Unwin University Books, London.

Stiroh, Kevin J. (2002), Information technology and the US productivity revival: What do the industry data say? *American Economic Review*, Vol. 92, No. 2, pp. 1559–1576.