PAPERS PRESENTED AT THE
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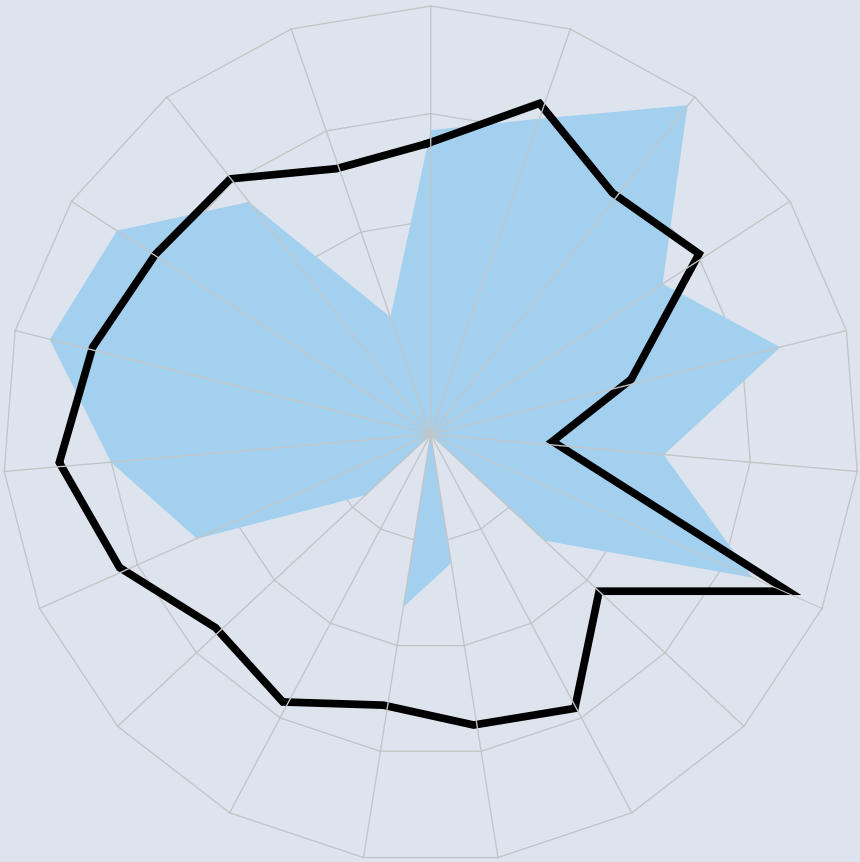

Statistiska centralbyrån Statistics Sweden

Yearbook on Productivity 2006

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Foreword

Growth is important. Today's growth is what we have to live on tomorrow. This is why we have focused on productivity and growth, and this is why Statistics Sweden has decided to create a yearbook on productivity. The yearbook is also an important part of our work on improving the economic statistics in Sweden. The objectives and priorities for this work were outlined by the Commission on the Review of Economic Statistics. The commission's proposals were well received by the Government, which commissioned Statistics Sweden to carry out this programme, of which this yearbook is a part of.

This yearbook contains a number of productivity studies; some are more oriented towards measurement and some more towards analysis. The articles have been written by colleagues outside Statistics Sweden as well as people from our own organisation, or in cooperation. This year's yearbook is the second one and was presented at our yearly conference in Saltsjöbaden as the coming yearbook.. We want to especially thank Anders Hoffman from FORA in Denmark and Yoshiaki Tojo from OECD for their contributions, and Patrik Karpaty for his contribution to our offshore article. We also are in debt to Paul Schreyer at OECD, Henrik Sejerbo Sörensen at Statistics Denmark and Jukka Jalava at Statistics Finland for valuable comments on our growth accounting article. Those involved at Statistics Sweden include Claes-Håkan Gustavsson, Eva Hagsten, Jack Hansson, Birgitta Magnusson, Tomas Skytesvall, Stefan Svanberg and Hans-Olof Hagén, Project Manager.

Gunnel Bengtsson

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Contents

Effects on productivity from Swedish offshoring[1]

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Abstract

To examine whether there are any effects on productivity from international offshoring of services and intermediate goods, a panel of firm data covering both the Swedish manufacturing and service industries during the period 1999-2004 has been used. The degree of offshoring is measured by the firm level imports of either intermediate goods or services. Moreover, different effects from offshoring are allowed by separating firms with respect to country of origin of their imports, status of ownership, previous international experience and industry. The estimations gave that both manufacturers and services firms gained from offshoring of services. So did also firms with international experience and Swedish multinationals. The offshoring of intermediate goods to low-wage countries led to losses in productivity for services firms, Swedish multinationals and pure domestic firms.

JEL Classification: F14, F23, L23
Keywords: Offshoring, productivity, non-exporters, exporters, intermediate goods, services

1 *The authors are grateful to Martin Fors, Ronnie Jansson and Hans-Olof Hagén for sharing with us their knowledge of the data and for their support in different phases of our analysis. Without Patrik Gustavsson Tingvall, Claes-Håkan Gustafson, Erik Mellander and Chiara Criscuolo, who have read and commented on various drafts of this paper, we would not as yet have reached this far. The authors also wish to thank Sveriges riksbank (the Riksbank), who gave us permission to use its micro level international trade statistics for this analysis.*

Summary

Recently, international relocation of jobs or production to low-wage countries has aroused increasing interest from policy makers, media and researchers. The debate has up to now mainly been concentrated on the negative sides of this phenomenon such as the effects on demand for labour. The OECD in cooperation with The Office of National Statistics (ONS) has conducted a pilot study using firm level data for the United Kingdom to explain effects on productivity from international relocation of production. At the University of Nottingham similar studies have been made on data for the Irish industry.

This study on Swedish firm level data focuses on the possible effects on productivity from international relocation of production during the period 2000-2004. Instead of using the ambiguous concepts relocation of production or jobs and outsourcing the term offshoring is favoured, meaning imports of services or intermediate goods from either independent or affiliated firms abroad. The analysis includes both descriptions of the features of offshorers and regression analyses to explain the relationship between offshoring and productivity.

Based on a general Cobb-Douglas production function including capital, skilled and unskilled labour, intermediates and a technology parameter (productivity) the effects on productivity from offshoring have been estimated. Due to changes in methods of the data collection as from 2003, the period up to 2004 has been estimated separately.

Being an offshorer in general means higher labour productivity, higher share of capital per employee and more staff with post secondary education. For the offshorers of services this is strongly so, while the offshorers of goods only differ slightly from firms in general.

The effects on productivity from Swedish offshoring could be expected to turn in several different directions. Either they could coincide with the Irish study, where the multinational enterprises gained from offshoring, or like the British case, where a positive productivity premium was found for less internationally experienced firms. Small open economies, dependent on international trade like Sweden, could also be expected to gain less in productivity or not be affected at all from offshoring.

The results show that both manufacturing and services firms gained from offshoring of services, although the effects were not very strong. Firms internationally engaged had some productivity advantages as well from their offshoring of services, while ownership did only seem to be of importance during the later period of time when Swedish multinationals and pure domestic firms

were positively affected by offshoring of services. If there were any effects on productivity from offshoring of intermediate goods to low wage countries, they were negative.

Introduction

Recently, international relocation of production, or jobs, to low–wage countries has aroused increasing interest from policy makers, the media and researchers. Despite the fact that not much evidence has been found as yet of the magnitude and real effects of this phenomenon, the debate has mainly focused on the negative sides. This includes discussions on the labour market effects, such as demand for labour, and migration of jobs to countries where firms can pay far less to qualified workers than in their home countries. Initially, the discussions centred on the relocation of manufacturing but lately there is also an increasing interest in the international relocation of services, since new technologies such as information technology have facilitated many transactions and contacts between people, irrespective of national boarders. In this paper the intention is to explore also the feasible positive effects from relocation of production.

The OECD, in cooperation with the Office of National Statistics (ONS), has conducted a pilot study using firm level data from the United Kingdom to explain the effects on productivity from international relocation of production. The study was executed by Criscuolo and Leaver (2006). Preliminary results from the study were presented at the OECD Globalisation and Production Work Shop meeting in Paris in November 2005.

The OECD is striving after some more general conclusions on the effects from globalisation and has therefore invited several countries to carry out studies similar to the pilot one, under its wing of cooperation. This study on Swedish data will focus on the possible effects on productivity from international relocation of production, and is the first of its kind nationally. The cooperation with the OECD limits the choices of methods to a certain degree, but gains from the increased opportunity to compare results with other countries. The UK pilot study, together with a study on Irish data by Görg et al (2005), will be the major methodological references.

The analysis will include both an investigation of the relative characteristics of firms that relocate production internationally, and a regression analysis to explain the casual relationships between relocation of production of services and intermediate goods on the one hand and productivity on the other. Emphasis will be made on if and to what degree it affects productivity.

Following the introduction to this paper, including a background and the description of the purpose, is a discussion of central concepts. Thereafter some recent findings from both the international and national literature are presented as well as the expected pattern of behaviour for the Swedish offshorers. In the subsequent section the data sources are presented alongside a description of the average offshorer. The models used and the different steps of estimations will be presented as well as the results. Finally, the conclusion will cover a discussion of the results, both in comparison with other countries and related to the expectations.

Central concepts

Offshoring

Initially in this paper, the term relocation of production or jobs has been used to introduce the reader to the subject. However, there is some general confusion over concepts and definitions, like Mattila and Strandell (2006) and Boulhol and Fontagné (2005) points out. Therefore, a clarification of what it is meant should be in place here. Görg et al talks about international outsourcing, Criscuolo and Leaver about offshore outsourcing or offshoring, the United States Government Accountability Office (2004) uses offshoring, while they all seem to mean more or less the same phenomenon.

Being able to study this phenomenon exactly, information on decisions of firms on international trade, locations, movements of plants et cetera would be needed. Such a detailed level of information will hardly ever be available due to confidentiality of firms or high marginal costs for more detailed data. However, a good approximation of this could be the import of services or intermediate goods. Criscuolo and Leaver define offshoring as ”the purchases of services abroad with the supplier and buyer remaining in their respective locations, including trade with either a foreign affiliate or an external overseas supplier”. This definition is quite clear and is therefore easy to support, yet with the inclusion of intermediate goods. Since the concept offshoring is not as ambiguous as outsourcing and relocation, which each can refer to both activities within a country and between countries, the former concept will be the one favoured here (with the exception of direct references to other studies). Ekholm (2006) has drawn the same conclusion about concepts.

Productivity

Productivity can be defined and measured in several different ways. According to the OECD (2001) the productivity measures are generally divided in two different groups, single factor productivity and multifactor productivity. Labour productivity and capital productivity represent the former group, while total factor productivity is an example of the latter. In this context, where the intention is to study the overall productivity effects on firms, total factor productivity is preferred. This measure isolates effects other than the inputs of labour and capital which otherwise cannot easily be singled out. Such effects include structural change, technological development and return to scale. If nothing else is mentioned, productivity will be used here synonymously with total factor productivity.

Multinationals and groups of countries

The effects from offshoring on productivity have mainly focused on the implications for high-wage countries. In this study the Swedish trade partners are divided in two groups, high- and low-wage countries. These could be considered synonymous to developed and under-developed countries, even though the former expressions will be preferred in this context. Included in the group of high-wage countries are the EU15, Norway, Iceland, Switzerland, Canada, The United States, New Zealand, Australia and Japan.

Multinationals (MNEs) are firms based in one country with at least one affiliate abroad. A Swedish MNE is defined like this or as a firm being a part of an enterprise group with affiliates abroad; see Bandick (2005) for further descriptions.

Recent literature

According to Aubert and Sillard (2005), a limited numbers of jobs in French industry have been affected by the migration of jobs to other countries, and only slightly less than half of these jobs were lost to low-wage countries. Boulhol and Fontagné conclude that maybe a fifth of the decline of industry in total employment could be traced to low-wage countries. This decline might in turn be accelerated by globalisation. The OECD (2005a) finds anecdotal evidence suggesting that international relocation of services in information technology is growing rapidly, and that India has emerged as a major supplier. However, even the largest job losses from international relocation are still considered small in comparison with the general job turnover. The most important long run impacts from globalisation of international trade and investments on labour markets have been to raise average real wages according to the OECD (2005b).

Several studies have discussed if international relocation exists, generally in terms of goods, and its effects on employment in high-wage countries. Fewer studies

include the service industry and the effects on productivity. Exceptions to this rule are Görg et al, Criscuolo and Leaver as well as Amiti and Wei (2006), who have all used microdata on firms in Ireland, the United Kingdom (UK) and the United States (US) respectively, to study the effects on productivity. The UK study finds that there is a positive correlation between services offshoring and productivity, but this result only holds for services sector firms. The Irish case shows positive effects on productivity for both services and goods inputs, but these results only hold for affiliates or foreign-owned multinationals and exporters. Even for the US positive effects on productivity were found from both offshoring of intermediate goods and services.

Findings for Ireland

Görg et al investigate the effects on productivity from offshoring by using plant level data on manufacturing industries from the Irish Economy Expenditure Survey, and cover the period 1990 to 1998. Offshoring (or international outsourcing, the term used) is defined as the value of the imported intermediates (materials) at the level of the plant.

The theoretical point of departure for the Irish study is a generalised Cobb-Douglas production function where production in terms of value added is explained by the inputs of capital and labour. The function also includes a technology parameter, that is, the total factor productivity. In addition to this the lagged value-added is used as a learning by doing and continuous production variable together with variables controlling for global engagement and status of ownership. The regressions were estimated by GMM and all data series used were deflated by the consumer price index. The offshoring intensity is expressed as total imports of intermediate goods or services over the total wage bill and amounts to about 20 per cent for the offshorers of services and even higher for the offshorers of intermediate goods.[2]

The study shows that internationally experienced or foreign owned firms are on average larger and have higher labour productivity than pure domestic non-exporters. The equations gave that there are potential positive effects from offshoring on both intermediate goods and services inputs. For foreign-owned plants, evidence was found for productivity-enhancing effects from offshoring of both intermediate goods and services. Concerning domestic plants, this was only true for intermediate goods, while services outsourcing was associated with reductions in TFP. Exporters showed significant positive effects on productivity for both intermediate goods and services from offshoring. However, for non-exporters, statistically significant negative effects of offshoring on productivity were found.

2 *See Hanley (2006).*

When the sample was split once more, by exporting status within groups of ownership, some new results emerged. Foreign-owned non-exporters did not benefit from offshoring, but significantly negative effects were associated with the offshoring. In contrast, foreign-owned exporters benefited from both outsourcing of services and intermediate goods. Strong negative effects were also found for domestic non-exporters. The domestic exporters, in contrast, were found to have a positive productivity effect from offshoring of intermediate goods inputs but not from services inputs. The magnitude of the negative effect from offshoring of services was less substantial for exporters than for non-exporters.

As a robustness check, the equations were also estimated by ordinary least square regressions. This gave somewhat stronger significances, but otherwise results in the same directions as the GMM estimator.

British results

Following the definition that equalises offshoring with import of services, Criscuolo and Leaver have studied the relationship between productivity and offshoring of services. In doing so, micro level firm data for the manufacturing and services sector in the UK from 2000 to 2002 have been used.

Offshoring firms are those that have reported a positive value of services imports in the Annual Business Inquiry. Less than 10 per cent of all firms are offshorers of services. These firms are on average larger and have higher intermediates to labour and capital to labour ratios than other establishments. They also have more IT capital, both hardware and software. Furthermore, offshorers pay higher salaries to their employees than non-offshorers. The study also shows that offshoring is likely a part of a more general global engagement strategy since 60 per cent of the offshorers are also exporters, compared with only five per cent of the non-offshorers.

The assumption made is that offshoring of services affects the productivity by shifting the technology parameter through several channels.

The theoretical approach originates from a production function where gross output is explained by inputs of capital, labour and intermediates, including also a technology parameter. Added to this were variables controlling for age, region, time effects, ownership and international experience. Instead of deflating the data series, the equations are estimated by ordinary least square regressions, based on a multivariate generalized mean value theorem to express the production function in terms of logarithmic deviations of the output and each of the inputs from a point of reference. The offshoring variable is calculated as imports of services over total purchases of services. Among offshorers, the average offshore intensity was almost 20 per cent.

The study shows that a 10 per cent increase in offshore intensity is associated with a 0.37 per cent increase in total factor productivity. The effects come mainly from firms that are domestic and non-globally engaged, that is, are not exporters and not parts of multinational enterprises. The study also ranks firms in accordance to their productivity.

As robustness check alternative measures were also used. Similarly significant, but stronger effects on productivity were found when the value added was used instead of the production value in the estimations. No robust additional effect coming from any form of the types of services or partner countries considered were found.

Previous Swedish studies

The debate on the effects of globalisation has been similarly vivid in Sweden, partly due to the continuous growth in GDP during the last few years, more or less without decreasing unemployment rates. This has lead to speculations about the extent and effects of offshoring to low-wage countries.[3] However, the economy is complex and employment is affected by a vast amount of factors, of which international trade is only one. Nor should the political dimension be forgotten, which sometimes facilitates and sometimes complicates the function of the economy. This complexity of the economy were stressed by Gustafson and Hagsten (2006), in suggesting that the extended time delay between the growth in GDP and the changes in employment could partly be explained by market interferences, rather than by an increased offshoring.

According to Mattila and Strandell, the driving forces behind offshoring could be sorted in three groups: competence driven, market driven and cost driven. Swedish international firms have a majority of their employees abroad, and a vast majority of these are located in high-wage countries. This is in itself considered as proof of the market argument as the leading one behind the Swedish offshoring. However, the increase of employment in Swedish firms abroad has been at its highest for such activities as formerly were considered non-movable, like security services, construction and energy. Despite this, Mattila and Strandell consider that manufacturing still has most to gain from moving labour intensive production to low-wage countries.

According to Ekholm and Hakkala (2006), there is an effect on the Swedish labour demand from offshoring of intermediate inputs. Ekholm, alone, also

3 *"Ekonomisk debatt" (2006) dedicates a whole issue to discussions on the effects from globalisation on the labour market. In general, the articles consider relocation of production an imminent threat to either the Swedish labour market or welfare. Unfortunately, not much is mentioned about presumptive effects on productivity.*

concludes that offshoring recently has gained more attention than its proportion of the Swedish economy could motivate and that the threats from low-wage countries are exaggerated as long as those countries cannot reach the same levels of productivity as the high-wage countries. This does not, according to Ekholm, mean that the employees are less efficient, only that low-wage countries in general still lack the markets, institutions and infrastructures needed to reach similar levels of productivity. She also stresses that international trade should be considered a natural force in the ongoing structural change. Despite the fact that Swedish imports from low-wage countries have increased recently, Ekholm shows that the major international trade flows still run between Sweden and other high-wage countries.

Expectations

Theoretically, offshoring is expected to affect the production function of the firm via the technology parameter, or the productivity. It is not quite clear if there really is a change of this type, nor is it apparent what direction it takes, since both historic data and logics can be used as arguments for results in different directions.

Small open economies like Sweden are to a high degree dependent on other countries for its welfare. International trade has therefore been a natural part of the economy for a long period of time. This means that many Swedish firms are used to acting on the international market and probably also already have adapted their productivity to a competitive level. This may lead to an assumption that offshoring does not affect Swedish firm productivity on the same scale as when a formerly closed country or protected industry goes international. Sweden also has strict labour market regulations, a fact that at least in the short run may impede productivity gains from offshoring. The same reasoning could be applied to the high level of taxation on goods, services, labour and capital, something that can generate unofficial trade, the value of which could not easily be accounted for in the official statistics. In that case, neither can the magnitude nor the effects of offshoring be correctly estimated.

Even though the size of Ireland is more comparable with Sweden than the UK, neither of these countries have an industry structure that resembles the Swedish one, with relatively few small and middle sized companies and a high degree of both openness and dependence on international trade. Ireland, in contrast, has a high share of international firms while the UK in turn is a large country with both a broader variety of firms, but with a heavy weight of services ones, and opportunities to be self-supportive (at least within the Commonwealth). The Irish

economy has also transformed itself the most during the past ten to fifteen years. This does in fact mean that the differences between the countries could result in completely contradictory results. Assuming that the Görg et al and Criscuolo and Leaver methods are in fact comparable, which at least the Criscuolo and Leaver robustness checks indicate, this is already the case between the UK and Ireland. However, it is important to keep in mind that those two studies do not cover the same periods of time, a fact in itself that could disturb any comparisons as well as more technical issues like deflators used.

Not only the structure of the industry, size of country, degree of openness, political system et cetera influence how offshoring affects productivity, but also the reasons behind it. If Swedish offshoring is mainly driven by the argument of a larger market like Strandell and Mattila suggest, the question could be posed whether this will affect productivity less than an offshoring based on cost minimizing. It is also possible that the effects may differ between industries, as well as between countries to where services and intermediate goods are offshored.

Despite somewhat contradictory results in the UK and Irish studies, both found out that multinationals and exporters in general were more productive than non-exporters. This could simply mean that the conditions on the international market are harder, so regardless of the reason behind trade, once on the international arena a higher productivity is needed if the firm wishes to survive. Unfortunately, the complete opposite argument also seems logical; the gains from entering the international market are so high that firms are spurred to try. A further factor that could explain decisions on and effects from offshoring is the different stages and intensity of structural change in the economy. Contradictory results can then be expected if Sweden is in the lead or lags behind in that sense.

Görg et al. mention the search costs for international supplier as important factors in the short run behind decisions on offshoring. The weight of these costs could probably differ among firms, depending on the reasons behind offshoring. If the decision of offshoring is closely linked to the firm's efforts to widen its market, the costs might even be allowed to increase initially. There is also a possibility that services firms have higher thresholds or search cost since international trade in services might require more personal contacts between sellers and buyers than the mere trade in goods. As opposed to that, the offshoring of goods may face lower search costs due to lesser needs of personal contacts as well as more developed channels on the international markets.

Description of the data set used

The data used in this analysis originate from the International Trade Statistics, The Structural Business Statistics and The Swedish Register of Education as well as from the National Accounts. The Riksbank (Sveriges riksbank, Swedish Central Bank) is the authority responsible for the trade statistics, and did formerly even produce them. However, as from 2003, Statistics Sweden produces these series, as well as all other series used in this analysis. When the responsibility for producing the import of services series changed, also the methods of data collections were altered. This led to irreparable breaks in the disaggregated series.

The structural Business Statistics

The Structural Business Statistics (SBS) is an EU-regulated survey carried out on a yearly basis[4]. The SBS consists of information on profit and loss accounts, investments and employment. All firms operating in Sweden are included in the register and are reported by their unique identification number.

Up to the year 1996 the Swedish SBS was entirely based on a sample survey. From 1997 onwards, the use of administrative data from the Tax Authority started. Initially, administrative data was only used for enterprises with less than 50 employees. Larger enterprises were surveyed through a questionnaire. In 2003 this was changed, and the taxation data is now used both as a primary data source and as mean of constructing complementary samples and estimators.

Data needs, exceeding those supplied by the taxation data or other existing registers are covered by three independent sample surveys, as well as a special data collection for the 500 largest firms. The latter substitutes the taxation data completely and the questionnaire including somewhat more detailed data about income statement, balance sheet, investments, shares and participation.

International Trade Statistics

As opposed to the international trade in goods, international trade in services is based on a sample survey. This leads to some differences in the methods of data collection.[5]

Exports and imports of services

The statistics on international trade in services are based on a questionnaire to enterprises, government authorities and non-profit organisations in addition to

4 *This description is mainly based on Hertzman et al (2006).*

5 *A more comprehensive description of the international trade statistics can be found in Fors and Jansson (2006). Statistics Sweden has received a permission from the Riksbank to use the disaggregated trade statistics for this study.*

a system of special reporting used by the Riksbank for travel funds and certain government authorities.

As from 2003, when Statistics Sweden started to produce the series on imports and exports of services, the representative sample amounts to slightly more than ten per cent of the population of international traders, which in turn corresponds to 41 000 firms. The sample is stratified by sector, industry group, indication of trade in services and size (turnover) and contains around 50 different service categories. The questionnaire includes a further specification to the 1 400 largest enterprises for specifying income and expenditures to and from abroad by country. Roughly 500 enterprises receive a simplified questionnaire with less detailed service categories. The response rate generally amounts to around 80 per cent. Non-responses are covered by imputation.

Until the last quarter of 2002 the settlement system was used by the Riksbank (then responsible for the data collection), a system that registered collated bank transactions between Sweden and other countries when the transactions amounted to more than SEK 150 000. This threshold value meant that many lesser transactions were excluded, the combined value of which was not insignificant. The breaks in the time series due to the methodological change have been linked only at the aggregated data level, which prevents dynamic, disaggregated analyses covering this period of time.

Exports and imports of goods

The statistics on exports and imports of goods cover all physical deliveries between Sweden and other countries that take place every month, as well as partner country, net weight, quantities other than weight for some goods and the statistical value of goods.

For firms trading goods with countries outside the EU (Extrastat), data are based on the export applications and import declarations submitted to customs at the time of dispatch or arrival of goods.

Within the EU, detailed data on goods items and country are collected from firms with a trade sum exceeding a certain threshold value, in accordance with the Intrastat system. The total value of the trade in goods with EU countries is calculated with the help of two sets of data. The main one consists of directly collected monthly data from firms with annual dispatches of goods to the EU of at least SEK 4 500 000 or arrivals of goods of at least SEK 2 200 000. These data are reported by goods item and EU country. Non-response is estimated using data on the value of goods deliveries and acquisitions taken from enterprises' VAT declarations.

Imports from another EU country only contain details of the member state from which the goods were sent. Imports reported by country of origin from outside the EU cover those goods that have gone through customs in Sweden and not via a third country.

The Swedish Register of Education

The Swedish Register of Education consists of data on graduation and educational background from the 1990 and 1970 censuses, each year updated with graduation and examination data from regular educational institutions such as primary and secondary schools, universities et cetera. The register comprises the population 16-74 years old registered as residents in Sweden.

The register contains a core of demographic and education data in addition to the Personal Identification Number, necessary as a linking key in building and updating the register. The main demographic variables are age, sex, municipality of residence and the main variables concerning education are highest education level and completion year.

The National Accounts

Several indexes are customized and available for deflation at the four-digit level. If disaggregated specific indexes cannot be found, or when the quality is not considered sufficiently high, the National Accounts two-digit level industry deflators or implicit indexes can be used.

Recent trends among offshorers

During the last ten years up to 2005, both imports of goods and services have grown steadily. These imports have partly been driven by products such as telecommunications, cars, petroleum and gas. The major trade countries have not changed significantly during the period and Sweden still trades mainly with other high-wage countries. Despite this, the imports of goods from Russia, China and Poland have shown high growth rates, even though they are not yet very substantial in size. Neither have the services imports changed markedly during the period. The countries from where Sweden imports are still the same, with a heavy emphasis on EU 15 and North America. Imports of services from China have increased lately, but is still, like the case with the imports of goods, not yet overly important to Sweden. Imports from India, which often have been mentioned in connection with offshoring of services, have only changed marginally during the last ten years.

In table 1 the development of offshoring between 1999 and 2004 is illustrated. Due to the change of method after 2002 in the import of services statistics, the development over time is difficult to interpret. It seems that the change may miss out on the number of firms that offshore, but to a lesser degree on the shares of value added and per employee. Some of the changes could also be referred to as business cycle effects, since there was a decline in the Swedish economic activity in the early 2000s, almost at the same time as the change in method.

From 1999 and up to the year of 2002 the services offshorers amounted to around 3.5 per cent of the population studied. Unfortunately these shares are not available for the consecutive years, when the import of services became a sample survey. The offshorers of intermediate goods reached around 15 per cent of the same population. However, these shares do not give a particularly clear picture of the extent of offshoring, and are also difficult to compare, partly due to the fact that the statistics used comprise number of firms and not number of plants and partly because of data limitations. That is why offshoring in relation to value added or per employee might be a less misleading measure. The offshoring of intermediate goods is spread among far more firms than offshoring of services. As a share of value added these activities evolved around a higher percentage than the offshoring of services, which was around sixty five per cent over the period of time. Even though a downward trend seems to be detectable for both types of offshoring, this does not necessarily imply a decrease in offshoring, but could simply reflect changes in relative prices.

Table 1. Numbers and shares of offshorers

Year	1999	2000	2001	2002	2003	2004
Total firms, number[1]	187 703	193 658	195 265	194 785	195 429	200 135
Offshorers of services, number[2]	7 178	7 289	7 364	6 626	(2 372)	(2 047)
Offshorers of intermediate goods, number	29 836	30 785	29 883	29 542	29 382	29 768
Share of services offshorers, per cent	3.8	3.8	3.8	3.4	-	-
Share of intermediate goods offshorers, per cent	15.9	15.9	15.3	15.2	15.0	14.9
Value added of services offshorers/total value added, per cent	48.5	47.6	47.1	44.4	38.2	39.1
Value added of intermediate goods offshorers/ total value added, per cent	67.5	68.0	66.0	64.8	63.3	64.5
Share of total employees, services offshorers, per cent	39.9	39.9	39.9	37.6	30.6	30.0
Share of total employees, intermediate goods offshorers, per cent	61.4	61.8	60.8	58.9	57.1	56.4

Note: Since a firm can be both an offshorer of intermediate goods and an offshorer of services at the same time, the shares for each type of offshorer do not add up to 100 per cent.

1 Swedish firms except one-man businesses and those with no employees are included. This leaves about one fourth of the slightly more than 750 000 firms in the Structural Business Statistics in 2004. The exclusion follows the assumption that these firms do not have any extensive import activities. In reality, there is also a data problem, since only limited information about small firms is available.

2The actual numbers of services offshorers from the sample of 4 600 firms are shown within brackets. For the earlier years the numbers are based on data from the Riksbank cut-off survey, which comes closer to what could be defined as a census.

Source: Statistics Sweden

As a contrast to the offshorers of services, those firms offshoring intermediate goods are more often small, that is, with less than 20 employees. However, measured as their contribution to total value added the differences are less clear, since the major part of the value added comes from firms with more than 50 employees. This is valid for both offshoring of intermediate goods and services, even though there is a heavier emphasis on really large firms, with more than 500 employees, for the offshoring of services. The distribution of firm size has been more or less unchanged for firms offshoring intermediate goods since 1999, while the development for the services offshorers has gone towards more real large firms at the expense of the next largest firm size. However, this needs to be interpreted carefully, since the change in shares could be affected by the sample design.

Table 2. Size of offshorers in 2004

Number of employees	Share of firms offshoring, per cent		Offshorer share of total value added, per cent	
	Services	Intermediate goods	Services	Intermediate goods
1-5	10.1	47.2	0.2	2.1
5-20	18.5	29.7	1.0	6.3
20-50	16.5	11.6	1.5	7.1
50-500	41.5	10.2	23.65	31.9
>500	13.3	1.2	73.71	52.5

Note: As opposed to the offshoring of goods, data on the offshoring of services are based on the international trade sample of 4 600 firms.

Source: Statistics Sweden

In general, the firms offshoring services have a much higher labour productivity than all firms, something that is illustrated in Table 3. They also have higher production per employee and intermediates per employee than firms in general. During 2004 the value of production per employee for services offshorers was four times the value for all firms, and labour productivity was two times higher. The services offshorers also have a higher capital intensity as well as more employees with post-secondary education. Among the services offshorers, almost all firms

are also exporters. As could be expected, a majority of the services offshorers are internationally affiliated. In 2004 two thirds of the services offshorers belonged to a multinational enterprise and slightly less than a third of these firms were Swedish multinationals. Despite the fact that far more manufacturing firms are active within offshoring of services, they are not only to a lesser degree parts of multinationals, either Swedish or foreign-owned, but are also exporters to a lesser extent than the services firms.

Table 3. Facts about average offshorers in 2004
Unweighed means

Variable	All firms	Offshorers of services	Offshorers of intermediate goods
Number of full time employees	11.39	327.9	42.9
Labour productivity (value added per employee), SEK	517.9	1095.1	587.8
Value of production per employee, SEK	1 192.9	4 336.3	1 570.5
Value of intermediates per employee, SEK	688.5	3 300.0	1 001.8
Capital intensity (capital per employee), SEK	719.5	1 019.8	404.6
Import intensity (imports/total purchases), per cent*	0.07	7.1	5.2
Export intensity (exports/value of production), per cent	0.0	0.2	0.01
Share of MNEs, per cent	6.1	67.7	23.9
Share of Swedish MNEs, per cent	2.9	29.5	10.3
Share of exporters, per cent	12.3	90.6	57.4
Share of employees with post-secondary education, per cent	15.0	22.6	13.5
Share of imports from low-wage countries, per cent	-	33.4	43.2

**There is a certain risk that the offshoring intensities are somewhat overestimated, in particular for the services offshoring, which itself has not shown a stable value over the period of time studied. This refers to problems with tracing where different transactions are accounted for within multinational firms.*

Source: Statistics Sweden

The mean values for offshorers of intermediate goods follow the same pattern as for the services offshorers, being higher than for firms on average, but in this case only slightly. However, the capital intensity is much lower than for firms on average. While the offshorers of services tend to have a higher share of employees with post-secondary education than firms in general, the offshorers of intermediate goods show contradictory figures. The relations of the variables analysed have not changed significantly during the period of time studied,

although there has been an increase in labour productivity on average for all offshorers.

The description of the Swedish offshorers coincided to a large extent with the characteristics of Irish and British offshorers. That is, multinationals and firms internationally active with exports or imports tend to have higher labour productivity and capital intensity than purely domestic ones. However, the offshoring intensity is much lower among the Swedish offshorers than the British ones. While the share of exporters offshoring intermediate goods resemblances the size of the British offshorers of services, almost all Swedish offshorers of services are also exporters.

The calculation of the offshoring intensity preferred is one similar to that of Amiti and Wei, Criscuolo and Leaver and Feenstra and Hanson (1996), where imports of the intermediate goods or services are expressed as their respective share of the total purchases of each input. This was initially considered a simple straightforward measure, but unfortunately could not be calculated due to non-existing services data at firm level. In order to overcome this problem, total intermediates were tested, but gave ambiguous results. Instead, an imputation was made, based on the National Accounts use-tables, where the share of services purchased for the two-digit industry level was calculated. This implies that the shares in reality only are correct for the two-digit industry level. Since the results not are meant to be interpreted at the firm level, this is not considered a major problem. The import of services as a share of the intermediates amounted to on average six per cent for the offshorers in 2004. In the end, this measure did not deviate much from the import of services over total services purchased, which showed that on average seven per cent of the services purchased by the offshorers came from abroad.

The analytical framework

To estimate the importance of offshoring, a production function approach is used where total factor productivity is modelled as a function of the offshoring intensity and several control variables, assumed to capture their respective contribution to total factor productivity.[6]

6 *Due to data limitations a calculated TFP is not available for firms with less than 50 employees. If the smaller firms were left out, the number of offshoring services firms would be reduced by almost fifty per cent, but only by three per cent as a share of value added. However, the offshorers of goods would be reduced by almost 90 per cent of the firms, and about 15 per cent measured as value added. An operation like this would probably run the risk of distorting the result from several other aspects. The alternative measure of TFP at hand is instead to use the labour productivity, controlled for different inputs.*

A generalised Cobb-Douglas function

Assuming that the production function of the firm is a generalized Cobb-Douglas where output is a function of the inputs skilled labour, unskilled labour and capital:

$$Q_{it} = A_i U_i^{\alpha_U} S_i^{\alpha_S} K_i^{\alpha_K} IMG_i^{\alpha_{IMG}} IMS_i^{\alpha_M S} \qquad \mu = \alpha_U + \alpha_S + \alpha_K - 1 \quad (1)$$

and where $Q_{it}, A_i, U_i, S_i, K_i, IMG_i, IMS_i$ is output (value added or value of production), total factor productivity, inputs of unskilled labour, skilled labour, capital, intermediate goods and intermediate services, in the *i*:th firm in period *t*, and μ is an indicator of returns to scale, where $\mu > 0$ indicates increasing returns to scale. The parameters are the same for all firms. However, if value added is chosen to illustrate the output, the explanatory intermediate variables have to be dropped since the value added per definition excludes the inputs. Dividing both sides of Equation 1 by total employment $L_{it} = U_i + S_i$ (that is, multiplying with $L^{-1} = L^{\mu - \alpha_U - \alpha_S - \alpha_K - \alpha_{IMG} - \alpha_{IMS}}$) labour productivity can be written $q_{it} = \frac{Q_i}{L_i}$ as

$$q_{it} = A_i u_i^{\alpha_U} s_i^{\alpha_S} k_i^{\alpha_K} img_i^{\alpha_{IMG}} ims_i^{\alpha_{IMS}} L_i^{\mu} \qquad (2)$$

where u, s, k, m, img and ims are shares of unskilled and skilled workers (skill intensity) respectively, capital intensity, the intensity with which materials and services are used in the production and *L* is supposed to capture scale effects. The inputs of intermediate goods and services may be further divided into purchases from the domestic market or from the international market.

Specification of Total Factor Productivity

Total factor productivity (A_{it}) of the *i*:th firm in period *t* is assumed to be proportional to the stock of firm-specific knowledge. Such knowledge may come from different sources, internal or external to the firm, such as R&D expenditure of the firm itself, learning by doing or knowledge spillovers from various sources, domestic or international. Productivity of the *i*:th firm can also increase by outsourcing of production of intermediate goods or services, domestic or international. Alternatively, productivity gains can follow with fragmentation of production which takes advantage of technology or specialist services, lower factor costs and higher quality. Offshoring may results in a more specialized production in the home market.

Total factor productivity can be written as a function of the different components of the knowledge capital stock:

$$A_{it} = F(\kappa_i^{E}, \kappa_i^{S}, \kappa_i^{EXP}, \kappa_i^{MNE}, \kappa_i^{OFFS}) \qquad (3)$$

On the sources of knowledge coming from learning (κ_{it}^{E}), spillovers in general, domestic and international (κ_{it}^{S}), there is no information available. This leads to the assumption that these components of knowledge are the same for all firms. However, there is information on exporting activities (κ_{it}^{EXP}),and whether or not the firm is a multinational firm (foreign or domestically owned), (κ_{it}^{MNE}).

Moreover there is also information on the intensity with which firms import their intermediate goods and services, labelled as offshoring (κ_{it}^{OFFS}).

Since $s_{it} + u_t = 1$ (share of skilled- and unskilled employees), only one of these shares needs to be included in the equation. Adding industry, λ_j, time, λ_t, and region λ_r, gives:

Firm size, L_{it} is measured as employment of the *i*:th firm. By substituting multinational firm and offshoring of services and intermediate goods for A_{it} in equation 2 the following specification is estimated:

$$\ln q_{it} = \beta_0 + \underbrace{(\beta_1 MNE_{it} + \beta_2 \ln offG_{it} + \beta_3 \ln offS_{it} + \beta_4 exp_{it})}_{A_{it}} + \beta_5 \ln s_{it} + \beta_6 \ln k_{it} + \beta_7 \ln img_{it} + \beta_8 \ln ims_{it} + \beta_9 \ln L_{it} + \lambda_j + \lambda_t + \lambda_r + \varepsilon_{it}, \quad |\beta_1 < 1| \tag{4}$$

where MNE_{it} is a dummy variable for multinational firms ($MNE_{it} = 1$ for MNE firms) and $\exp_{it}$ is a dummy for international experience[7]. Age of the firm as well as age squared are also used as control variables. Equation 4 is thus an augmented production function, where the coefficient estimates on the A_{it}, that is, the non-input regressors ($\beta_2 - \beta_4$) capture their contribution to the TFP.

The estimation model

The offshoring decision is likely to be the outcome of a process where such economic variables discussed earlier are involved. In particular it may be the case that firms beginning to offshore production of intermediate goods or services happen to be more labour productive. Moreover, the input variables capital and labour may also be endogenous. The existence of such two-way causality risks leading to erroneous conclusions about the offshoring effects on productivity. Due to the possible endogeneity in both the non-input regressors (import intensities) assumed to capture their contribution to productivity and the input regressors an instrumental variable approach is appropriate. The Differenced Linear Generalized Methods of Moments (GMM) estimator uses time-differenced variables in order

7 *The effect captured by the MNE dummy should reflect superior technology but could also follow by foreigners having better access to markets abroad, resulting in higher productivity (with constant technology).*

to remove permanent unobserved heterogeneity, Arellano and Bond (1991). When there is relatively little persistence in the series the lagged levels may be valid instruments for endogenous variables. However, when time series are short or when there is persistence over time, the Arellano and Bond GMM estimator suffers from poor precision Blundell et al (2000). The years 2003 and 2004 will only be dealt with in a static ordinary least square regression.
Blundell and Bond (1998) propose an improved GMM for shorter panels and when there is persistence in the series. The model suggests that lagged time differenced regressors should be used as instruments for the endogenous variables. Blundell and Bond also show that this "system panel estimator" that simultaneously considers variables in both differences and levels, produces estimates that are both consistent and efficient.

The GMM model may be specified assuming an autoregressive (AR1):

$$\begin{aligned}\Delta \ln q_{it} = {} & \beta_0 + \beta_1 \ln q_{it-1} + \underbrace{\left(\beta_2 MNE_{it} + \Delta\beta_3 \ln offG_{it} + \Delta\beta_4 \ln offS_{it} + \Delta\beta_5 exp_{it}\right)}_{A_{it}} \\ & + \Delta\beta_6 \ln s_{it} + \Delta\beta_7 \ln s_{it-n} + \Delta\beta_8 \ln k_{it} + \Delta\beta_9 \ln k_{it-n} + \Delta\beta_{10} \ln img_{it} + \Delta\beta_{11} \ln img_{it-n} \\ & + \Delta\beta_{12} \ln ims_{it} + \Delta\beta_{13} \ln ims_{it-n} + \Delta\beta_{14} \ln L_{it} + \Delta\beta_{15} \ln L_{it-n} + \lambda_t + \lambda_i + \lambda_r + \Delta\varepsilon_{it}\end{aligned} \tag{5}$$

Up to this point, the firms have been described as if they were homogenous, which they in reality are not. They can differ in size, location, industry and age. These differences can easily be controlled for by dummies (even though . Even endogenous effects, such as learning by doing can be captured by a lagged variable. Offshoring effects on productivity may also be different depending on other characteristics of the firm, such as ownership and global engagement. That is why some extensions are considered here. Previous international experience can be captured by checking if the firms are exporters or not. The different status of ownership can be handled by separating foreign and domestic multinational firms as well as purely domestic ones. Different productivity premiums may also be available for certain industries while there are no effects for others. Even the country of origin of intermediate goods or services, formulated here as low or high wage countries, may affect productivity. All this is controlled for by different dummies.

Results

Due to the break in the time series of import of services, the data had to be treated as two different sets in two separate models, one for the period of 2000 to 2002 and one for the period 2003 to 2004. The advantage of adding this latter period comes from the improved quality in the import of services series and the structural Business Statistics as well as the fact that more recent data come closer to shed light on the prevailing situation. The two models are built up on the same basis, but it should be kept in mind that they will never be identical, only similar, a fact that also affects the variety of variables available for use.

The period 2000 to 2002

Due to different structures of the two data sets used, the period 2000-2002 does include fewer small firms than the more recent period of time studied. In practice this means that all firms with fewer than 20 employees are excluded. However, the description of the services offshoring firms in tables 1 and 2 are still valid. Firms offshoring services have on average higher labour productivity than firms in general. At the same time, services offshoring firms are also more skill intensive as well as more physical capital intensive. Services offshorers firms are also larger, in terms of number of employees, outlays on materials and wages.

Table 4A shows the regression parameters from the OLS-estimations of Equation 4, explaining the variation across firms and over time in the logarithm of labour productivity. The estimations have been performed stepwise for all firms, manufacturers and services firms separately. Note that in all regressions, industry, time and region dummy variables are also included. Output is expressed in the form of value added. Clearly, higher skill and capital intensity increase labour productivity.[8] Of the control variables reported, most match the prior expectations. The US MNE variable is positive and strongly significant. The magnitude and significance for other foreign MNEs differ substantially between industries. While US MNEs have a comparative advantage in all industries, this is not true for MNEs from the rest of the world. They do not outperform domestically owned services firms. Effects on productivity from global engagement in terms of exporting activity also vary among industries, possibly due to high transaction costs for exporting services. Exporting firms are more productive in the manufacturing than in the services industry.

8 *The Breusch and Pagan LM test indicates omitted time invariant effects (fixed or random) and thus that a panel estimator is appropriate. The Hausman test for random effects indicates that the fixed effect estimator should be preferred. Since test indicates heteroskedasticity, the heteroskedasticity-robust t statistics are reported.*

Table 4A. Effects on firm productivity performance from offshoring of services in 2000 to 2002, OLS estimations

Variables *Dependent variable:* *Log of labour productivity*	All firms	Manufacturing firms	Services firms
Log of employment	-0.034	-0.016	-0.046
	(0.006)***	(0.010)	(0.007)***
Log of capital intensity	0.114	0.102	0.117
	(0.004)***	(0.009)***	(0.005)***
Log of skill intensity	0.088	0.059	0.102
	(0.006)***	(0.010)***	(0.008)***
Swedish MNEs	0.104	0.064	0.14
	(.0012)***	(0.017)***	(0.016)***
US MNEs	0.189	0.125	0.22
	(0.028)***	(0.051)**	(0.034)***
Foreign other MNEs	0.079	0.068	0.084
	(0.011)***	(0.017)***	(0.015)***
Exporter	0.054	0.004	0.092
	(0.010)***	(0.015)	(0.015)***
Log of import intensity of services	1.73E-7	1.71E-5	1.60E-7
	(0.000)***	(0.000)*	(0.000)***
Age	0.015	0.013	0.019
	(0.002)***	(0.003)***	(0.003)**
Age squared	-0.000	-0.000	-0.000
	(0.000)***	(0.000)**	(0.000)***
Observations	30106	11009	19097
R2	0.39	0.30	0.43

*Note:Heteroskedasticity-consistent standard errors are shown within parentheses, ***, **, *, meaning significant at the one-, five-, ten-percent level respectively. Unreported time, region and four-digit industry dummies are always included. The estimations consist of an unbalanced panel including all firms with at least 20 employees.*

In order to isolate the potential importance of multinational activity per se, as different from nationality, a dummy is included for domestically owned firms with multinational activity. The results show that both Swedish MNEs and affiliates to foreign MNEs are more productive (other things equal) than non-MNE domestic firms, so being international is more important than nationality.[9] The services offshoring variable is significant for both groups of firms, but for the manufacturers only at the 10 per cent level. Thus these results indicate that firms offshoring services have a productivity advantage over firms relying on the domestic market for the provision of inputs.

9 *An F-test of the linear combination of a potential Swedish MNE-premium over foreign MNEs from other countries than the US indicates that labour productivity is not significantly different from that of foreign MNEs.*

The evidence of a positive relation between offshoring intensity and productivity dominantly emanates from the service industry. However, it is important to address a number of econometric problems. Firm specific fixed effects, such as different quality of labour and capital among firms may affect the results. To control for this, the fixed effects model are used to empirically test whether the productivity in a firm is higher due to its offshoring intensity.

The fixed effects regression clearly leads to a loss of significance for the offshoring variable as well as for the ownership variables, but not for the foreign non-US MNE. One explanation could be that the fixed effect estimator (the yearly deviation from the mean) wipes out the firms that are foreign-owned during the whole period. This method can only say something about the effects on productivity from an ownership change. See Karpaty (2006) for fixed effects estimations using a two-step approach.

Table 4B. Effects on firm productivity performance from offshoring of services in 2000 to 2002, within firm estimations

Variables *Dependent variable:* *Log of labour productivity*	All firms	Manufacturing firms	Services firms
Log of employment	-0.233	-0.150	-0.267
	(0.027)***	(0.051)***	(0.032)***
Log of capital intensity	0.065	0.077	0.063
	(0.014)***	(0.017)***	(0.018)***
Log of skill intensity	-0.018	-0.024	-0.010
	(0.011)	(0.022)	(0.013)
Swedish MNEs	0.020	0.028	0.022
	0.025	(0.037)	(0.035)
Foreign US MNEs	-0.215	-0.324	0.130
	(0.170)	(0.240)	(0.212)
Foreign other MNEs	0.056	0.035	0.068
	(0.023)**	(0.034)	(0.032)**
Exporter	0.048	0.010	0.072
	(0.015)***	(0.022)	(0.023)***
Log of import intensity of services	-7.85E-8	1.72E-5	-9.19E-8
	(0.000)	(0.000)	(0.000)
Age	0.007	-0.003	0.012
	(0.006)	(0.009)	(0.009)
Age squared	-3.122E-4	-1.144E-4	-5.386E-4
	(0.000)	(0.000)	(0.000)
Observations	30108	11010	19098
R2	0.76	0.67	0.79

*Note: Within firm (fixed effect) estimations. Heteroskedasticity-consistent standard errors are shown within parenthesis. ***, **, *, meaning significant at the one-, five-, ten-percent level respectively. Unreported time dummies are always included. The estimations consist of a balanced panel including all firms with at least 20 employees.*

After controlling for firm specific time invariant components in the regression, no evidence of effects on productivity from offshoring were found. However, the possible endogeneity of the input and offshoring variables can lead the OLS regressions to biased results, something that motivate further tests of robustness. The GMM SYS uses a system of equations in first differences and equations in levels. By using data from 1996 (while only estimating equation 6 for the period 2000-2002), the regressions can include up to four lags. The lagged levels of the input factors used are: capital, skilled labour as well as the dependent variable (labour productivity) and offshoring dated t-2 and earlier as instruments for the equations in differences. Assuming that the ownership variables are predetermined, the information dated t-1 back to t-4 can be used. For the level equations the lagged first-differences of the above variables dated t-1 are chosen.

Table 4C. Effects on firm productivity performance from offshoring of services in 2000 to 2002, GMM SYS estimations

Variable *Dependent variable:* *Log of labour productivity*	All firms	Manufactu-ring firms	Services firms
Lag of log labour productivity	0.276	0.238	0.273
	(0.034)***	(0.058)***	(0.041)***
Log of employment	-.079	-0.118	-0.126
	(0.056)	(0.059)**	(0.062)**
Log of capital intensity	0.027	0.025	0.038
	(0.012)**	(0.023)	(0.014)***
Log of skill intensity	0.079	0.048	0.085
	(0.028)***	(0.052)	(0.035)***
Swedish MNEs	0.301	0.039	0.137
	(0.199)	(0.027)	(0.299)
Foreign US MNEs	0.130	-0.035	0.132
	(0.087)	(0.075)	(0.116)
Foreign other MNEs	0.089	0.065	0.040
	(0.048)*	(0.037)*	(0.061)
Exporter	-0.016	0.095	0.096
	(0.113)	(0.091)	(0.162)
Log of import intensity of services	-1.72E-6	-3.82E-5	-2.19E-6
	(0.000)	(0.000)	(0.000)
Age	-0.012	0.018	-0.044
	(0.008)	(0.012)	(0.014)***
Age squared	6.038E-4	-3.423E-4	0.002
	(0.000)**	(0.000)	(0.000)***
Observations	25613	9923	15690
Hansen test of overridden restrictions: Prob > chi2	0.000	0.000	0.000
Arellano-Bond test for AR(1) in first differences: Pr >z=	0.000	0.000	0.000
Arellano-Bond test for AR(2) in first differences: Pr >z=	0.448	0.766	0.407

*Note: Heteroskedasticity-consistent standard errors are shown within parenthesis, ***, **, *, meaning significant at the one-, five-, ten-percent level respectively. Unreported time, region and four-digit industry dummies are always included. The estimations consist of a balanced panel including all firms with at least 20 employees.*

From the results of the system GMM estimations, offshoring does not seem to have any effect on firm level productivity. The results suggest that it is important to take into account that the explanatory variables are not strictly exogenous. Moreover, the fixed effect estimator is also inconsistent and biased downwards, following from correlation between the transformed error term and the transformed lagged dependent variable. If the previous OLS results are upward biased and the fixed effect estimate are downward biased, the GMM result should give estimates that are somewhere in between. However, the GMM estimates should come closer to the fixed effects ones since both of them account for not strictly exogenous explanatory variables. Nevertheless, in order to compare the to periods of time in this study, the OLS estimator is the only option available.

Up to this point the issue of offshoring has been dealt with assuming a homogenous group of firms. However, it is possible that potential effects on productivity from offshoring differ in respect to the global engagement and the ownership status of the firm. Nevertheless, the results presented in Table 5 contradict the hypothesis that firms with global engagement should benefit more from offshoring due to smaller transaction cost. The offshoring effects, if any, seem to be weaker and less significant for the globally engaged firms, except for the exporters. Multinationals, either foreign or domestic do not seem to neither benefit nor loose in productivity from offshoring. This may have to do with low marginal benefits for firms already globally engaged relative those active only locally.

Table 5. Effects on firm productivity performance from offshoring of services in 2000 to 2002 by previous international experience, OLS estimations

Variables *Dependent variable:* *Log of labour productivity*	Exporters	Foreign MNEs	Swedish MNEs
Log of employment	-0.032	-0.018	-0.032
	(0.009)***	(0.010)*	(0.013)**
Log of capital intensity	0.125	0.099	0.125
	(0.010)***	(0.010)***	(0.013)***
Log of skill intensity	0.164	0.149	0.136
	(0.015)***	(0.017)***	(0.022)***
Log of intermediates per employee	0.016	0.005	0.011
	(0.006)***	(0.005)	(0.007)
Log of import intensity of services	2.31E-7	-1.50E-6	-7.51E-8
	(0.000)**	(0.000)	(0.000)
Age	0.016	0.014	0.017
	(0.003)***	(0.005)***	(0.005)***
Age squared	-3.314E-4	-0.000	-3.995
	(0.000)***	(0.000)***	(0.000)**
Observations	7412	5777	4969
R2	0.38	0.32	0.38

*Note: Heteroskedasticity-consistent standard errors are shown within parentheses, ***, **, *, meaning significant at the one-, five-, ten-percent level respectively. Unreported time, region and four-digit industry dummies are always included. The estimations consist of a balanced panel including all firms with at least 20 employees.*

As further robustness tests, the denominator in the quote of the import intensity were changed to the total wage bill instead of total purchases of the input. This led to similar results in that the estimates were of the same size and sign. However, the significances became somewhat weaker. The regressions were also estimated with gross production instead of value added, including the input of intermediates as explanatory variables, something that hardly affected the results at all.

The period 2003 to 2004

The period 2003 and 2004 covers both offshoring of intermediate goods and services. In order to examine if the model preferred was correct, the different explanatory variables, except the offshoring ones, were added stepwise in the equations on the whole population of firms. This procedure gave significant estimates of skill intensity, capital intensity, size of firm, ownership of firms (partly) and industry. However, the results differed somewhat from each other when the two offshoring variables were used one at a time instead of together in

the same equation. In order not to lose those services firms that do not appear in the import of services sample both years, a pooled sample has been used.

Table 6. Effects on firm productivity performance from offshoring of intermediate goods and services in 2003 and 2004, OLS estimations.

Variables *Dependent variable:* *Log of labour productivity*	All firms	Manufacturing firms	Services firms
Log of employment	-0.057	0.014	-0.077
	(0.006)***	(0.011)	(0.007)***
Log of capital intensity	0.123	0.104	0.125
	(0.006)***	(0.011)***	(0.007)***
Log of skill intensity	0.053	0.024	0.058
	(0.005)***	(0.011)**	(0.006)***
Swedish MNEs	0.117	0.047	0.151
	(0.024)***	(0.039)	(0.03)***
Foreign MNEs	0.097	0.046	0.112
	(0.023)***	(0.04)	(0.028)***
Exporter	0.051	-0.097	0.071
	(0.034)	(0.082)	(0.039)*
Log of import intensity of services	0.004	0.006	0.004
	(0.001)***	(0.003)**	(0.001)**
Log of import intensity of goods from low wage countries	-0.002	0	-0.002
	(0.001)	(0.001)	(0.001)**
Log of import intensity of goods from high wage countries	0.002	0.004	0.002
	(0.001)*	(0.002)**	(0.001)
Age	0.023	0.004	0.027
	(0.006)***	(0.011)	(0.007)***
Age squared	-0.001	0	-0.001
	(0)***	(0.001)	(0)***
Year 2003	-0.08	-0.085	-0.074
	(0.017)***	(0.027)***	(0.021)***
R^2	0.239	0.297	0.234
Degrees of freedom	4 754	1 366	3 375

*Note: Heteroskedasticity-consistent standard errors are shown within in parentheses, ***, **, *, meaning significant at the one-, five-, ten-percent level respectively. Two-digit industry level dummies are used to control for differences in labour productivity.*

In order to facilitate the comparison with the other time period studied, fixed prices are used in the regression for both 2003 and 2004. Otherwise, current prices could as well have worked, since the growth in inflation was fairly moderate during these two years and no lagged variables are used. Results from similar estimations with current prices were almost identical to those presented in this table.

The regression parameters from the ordinary least square estimation of a restricted version of Equation 4 for the period of 2003 and 2004 are shown in Table 6 and 7. Output is expressed as value added. Significant estimates are received for firm size (employment), skill intensity, capital intensity, type of ownership and partly for global engagement. Both manufacturers and services firms gain in labour productivity from an increase in capital intensity as well as from increased skill intensity. Contrary to the manufacturers, the services firms lose productivity from increases in employment, implying decreasing return to scale in this industry. Being a multinational firm is important in terms of labour productivity only for the services firms.

The results here give that both manufacturers and services firms gain from offshoring of services, even though the premiums are quite small. 10 This coincide with the expectations described earlier, implying that offshoring of services may affect firm productivity, but since Sweden is a small open economy used to international trade, not likely hugely. Most of the services offshorers are also members of multinational firms, which itself may reduce the possibility to improve productivity from offshoring.

With information on country group of origin, the offshore variable can be split in two, one for offshoring to low-wage countries, and one for high-wages countries. Unfortunately, data limitations only allow this for the offshoring of goods. The offshoring of intermediate goods by services firms to low-wage countries led to a reduction of productivity, wile manufacturers were not affected. However, the manufacturers received a productivity premium from offshoring of intermediate goods from high-wage countries. Thus, these results do not support the belief that firms move jobs or production to low-wage countries only in order to improve their productivity or short-term profits. As contrary to manufacturing firms concentrating on their core activities, and outsourcing the production of everything else, intermediate goods as well as services, the offshoring of intermediate goods by services firms may sound a bit odd. But, even services firms could need intermediate goods inputs in their production, like the dentists buying materials from abroad. However, this is also a matter of classifications of official statistics, where wholesalers are classified as services firms, and these in turn do indeed import groceries from several different countries.

It is sometimes believed that smaller firms in a study like this one are more likely to create chaos in the results than to clarify them. In an attempt to check if this is also true here, the same equations were estimated for not only the originally

10 Data from the energy industries were excluded since the calculations of labour productivity for these firms gave extraordinary odd results. It could even be discussed whether energy should be considered an intermediate input or not. Also agricultural and financial firms are left out.

chosen group of firms with more than one employee, but also for firms with ten or more employees. This led to both somewhat larger effects on productivity and stronger significances from the offshoring of services, while the significant estimates for offshoring of goods disappeared. A feasible explanation to that could be found in the design of the import of services sample, where all large firms are included and only a sample of the smaller. Excluding even smaller firms runs the risk of distorting the results, since there would be an over-representation of large firms already active on the international arena and often parts of international networks. So, leaving out all smaller firms is not considered a good idea in this case.

The assumption of homogenous firms of course does not hold. Therefore the data set has not only been divided in groups of ownership and earlier international experience, but also in accordance with the two-digit level of the Swedish Industrial Classification 2002. However, ownership and international experience did only change the results marginally. The Swedish multinationals and the exporters gained in productivity from offshoring of services, while the same groups lost marginally from offshoring of intermediate goods to low-wage countries (these results, like the offshoring of intermediate goods to high-wage countries by exporters and Swedish multinationals, are not marked in the table, but comes very close to significances at the ten per cent level).

Table 7. Effects on firm productivity performance from offshoring of intermediate goods and services in 2003 and 2004 by previous international experience, OLS estimations

Variables *Dependent variable:* *Log of labour r productivity*	Exporters	Foreign MNEs	Swedish MNEs	Non-exporters	Domestics
Log of employment	-0.057	-0.067	-0.073	-0.043	-0.054
	(0.006)***	(0.01)***	(0.014)***	(0.025)*	(0.008)***
Log of capital per employee	0.126	0.111	0.143	0.089	0.128
	(0.006)***	(0.01)***	(0.013)***	(0.016)***	(0.007)***
Log of skill intensity	0.053	0.066	0.066	0.057	0.049
	(0.005)***	(0.01)***	(0.017)***	(0.013)***	(0.006)***
Swedish MNEs	0.106	n.a	n.a	0.294	0.121
	(0.025)***	n.a	n.a	(0.088)***	(0.026)***
Foreign MNEs	0.091	n.a	n.a	0.124	n.a
	(0.024)***	n.a	n.a	(0.075)	n.a
Exporter	n.a	0.018	-0.065	n.a	0.069
	n.a	(0.07)	(0.098)	n.a	(0.04)*
Log of import intensity of services	0.004	0.003	0.009	0.003	0.005
	(0.001)***	(0.003)	(0.003)***	(0.013)	(0.002)***
Log of import intensity of goods from low wage countries	-0.001	0	-0.003	0.003	-0.003
	(0.001)	(0.001)	(0.002)	(0.006)	(0.001)**
Log of import intensity of goods from high wage countries	0.001	0	0.001	0.001	0.002
	(0.001)	(0.002)	(0.002)	(0.003)	(0.001)**
Age	0.02	0.033	-0.014	0.051	0.017
	(0.006)***	(0.01)***	(0.014)	(0.02)***	(0.008)**
Age squared	-0.001	-0.002	0.001	-0.002	-0.001
	(0)***	(0.001)***	(0.001)	(0.001)**	(0)**
Year 2003	-0.077	-0.085	-0.104	-0.078	-0.076
	(0.017)***	(0.027)***	(0.035)***	(0.059)	(0.021)***
R^2	0.229	0.27	0.246	0.402	0.23
Degrees of freedom	4413	1641	1233	310	3069

*Note:Heteroskedasticity-consistent standard errors are shown within parenthesis, ***, **, *, meaning significant at the one-, five-, ten-percent level respectively. Two-digit industry level dummies are used to control for differences in labour productivity. Fixed prices are used.*

While being an offshoring exporter partly affected productivity, the non-exporters seemed to be totally unaffected by this. The pure domestic firms (including Swedish MNEs) were affected negatively by offshoring of intermediate goods to low-wage countries. However, these results are influenced by the effects on the productivity of Swedish MNEs, which leads to the conclusion that pure domestic firms except MNEs neither gain nor loose in productivity from offshoring of intermediate goods. The domestic firms also received significant positive estimates

from offshoring of services and goods to high wage countries. These results partly coincide with the British and the Irish ones. Just like for Ireland there are positive productivity premiums for some highly internationally experienced firms, like multinationals, and similar to the British results is the productivity gain from offshoring of services by domestically owned firms. However, some domestic firms do in fact lose productivity from offshoring, just like the cases of Ireland.

The results from the regressions on industry groups gave some significant estimates for both offshoring of services and intermediate goods, but can only be reported briefly due to firm confidentiality. Manufacturers of fabricated metals, computer consultancies and wholesalers increased their productivity by offshoring services, while air transporters lost from the activity. Even manufacturers of food, beverages and basic metals achieved a positive productivity premium, but in this case from offshoring of intermediate goods to low-wage countries. The manufacturers of pulp and paper lost in productivity from offshoring to low-wage countries. Some industries also gained in productivity from the offshoring of intermediate goods to high-wage countries, like travel agencies, business consultants and manufacturers of rubber and plastic products. However, manufacturers of radio, TV and communication equipment lost in productivity from their offshoring to high-wage countries. Notable is that some really strong effects from offshoring can be found in certain industries, and particularly among those firms offshoring intermediate goods to high-wage countries. While a one per cent change in the offshoring intensity leads to a pro mille change in productivity for firms in general, there are industries receiving both negative and positive effects amounting to several per cent.

As a test of robustness the equations were estimated also with gross production instead of value added as the output variable, and with the addition of intermediate inputs as explanatory variables. This led to results only marginally deviating from those with the value added. Some of the estimates became slightly weaker.

Conclusions

Offshoring activity is widely believed to play an important role for firms due to the fragmentation of the production process across countries when there are differences in the relative endowments of skilled and unskilled labour, technology and natural resources among countries. However, the question is, if it is possible to empirically prove the existence of offshoring effects on productivity.

Despite the two different data sets, the results were surprisingly similar, and gave that offshoring of services affected productivity in Swedish services firms over the

whole period of time studied. As discussed earlier, a small open economy, with strict labour market regulations and high taxes, and used to international trade could not be expected to gain hugely from offshoring. In spite of these obvious hindrances positive effects were found, and most strongly from those offshorers of services, expected to have the highest thresholds and search costs.

However, when taking into account firm specifics in the fixed effects model and possible endogeneity in the dynamic system GMM model the effects from offshoring of productivity disappeared. That of course raises the question of which estimation method is the most reliable here. As discussed earlier, the GMM could be considered to give results somewhere in between the OLS and the fixed effects regressions. However, since the OLS regressions by industry for the period of 2003-2004 gave both strong and significant results, there are reasons to believe that offshoring actually affects firm productivity, but necessarily not on an overall basis. And of course, not to mention that for one of the time periods studied no other alternatives were actually at hand.

The static approach to the years of 2003 and 2004 gave not only significant positive results for the offshoring of services by services firms but also by manufacturers. The latter results may be somewhat less surprising than the former. If a firm decide to put emphasis on core activities, services and intermediate goods are often left to be produced somewhere outside the firm.

Since the import of services sample originally is designed to serve other purposes than this study, there is of course a problem of representation for the period 2003-2004. The sample takes such aspects as size, industry, ownership into account, but not necessarily skill and capital intensities. Since the sample is stratified to include all of the largest firms, but only a selection of the smaller ones, possible effects on productivity could then be lesser if the large firms are already multinationals or otherwise already on the international arena with a productivity level adapted to that.

Somewhat surprisingly, the results only partly coincide with those from the Irish and the British studies, despite the fact that the general descriptions of offshorers are quite similar. Like in Ireland, certain firms already internationally experienced gained from offshoring. There were no significant effects on productivity for non-exporters, but for pure domestic firms, like in the United Kingdom. Maybe these results reflect that Sweden is in fact somewhere in between the two other countries when it comes to the structure and the development of the industry.

Not only is it important to emphasis that the chosen method could affect the outcome, but also that there is a high degree of difficulty in working on large microdata sets (with time series breaks).

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Appendix Description of variables

Table 1: Description of variables

Variable name	Description
lmg	The ratio between input of intermediate goods and employment
lms	The ratio between input of services and employment
exp	Share of firms being exporters
offG	Offshoring of intermediate goods (imports over total purchases)
Offs	Offshoring of services (imports over total purchases)
q_{it}	Value added, deflated by the industry producer price index per employee
K	The deflated book value stock of capital over total employment
S	The percentage share of employees with a post-secondary education
Y	Sales
size	Firm size, measured as employment of the i:th firm.
industry dummy	Industry dummies defined at the three-digit level.
Year	Yearly time dummies.
MNE	Takes the value 1 if firm i is foreign-owned or a Swedish MNE

Working time – a complicated variable in measuring labour productivity

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Introduction

The need for information about time worked has increased over the years. The number of employed persons has for a long time been the measure of "the amount of work" in Swedish labour market statistics. At the same time, temporary employment and cyclically adjusted working patterns have increased. As different patterns of working time and new causes for absences have become more common, total hours worked has become an increasingly relevant standard for measuring the amount of work that is performed in the labour market.

The existing international recommendations about working time are very old. The ILO resolution on working time was adopted at the 10th ICLS Conference in 1962 (ILO 1962). The resolution deals with only two concepts of working time: *normal hours of work* and *hours actually worked*. The ILO considers it time to replace this resolution with a new and updated resolution that should be applicable in both richer and poorer countries. The new resolution is expected to be proposed at the next ICLS Conference in 2008.

In this article, we want to present some fundamental questions related to the choice of the measures for *time actually worked*. We present a schematic classification table for time worked and time not worked and discuss classification problems. The classification table is based on the variables *form of working time* and *payment*.

Time worked and productivity

All measurements of productivity imply putting the result of an activity, usually the value added, in relation to the input. Regardless of whether a measurement of the labour productivity or the total factor productivity (TFP) is required, it is

necessary to measure the labour input. It is not obvious which measurement of labour input should be chosen, depending partly on what is relevant to include and partly on what can be accomplished at an acceptable cost.

Labour input should be measured in such a way that improved production methods, increased intensity in work, more effective work organisation and better machines, tools and raw materials result in a higher productivity. *Time actually worked* seems to be a reasonable concept but there are difficulties with the definition. It may, for example, be interpreted as *productive time*, i.e. the time used for the direct production of goods and services. Time for training, breaks etc. is non-productive. It can also be questioned whether time put into failed production, i.e. products rejected for different reasons, should be considered productive.

Alternatively, *time actually worked* can be interpreted as the time an employer expects the employee to put into the work, directly or indirectly. The employer gives the employee training, allows breaks etc. and expects to be rewarded in the long run in the form of higher output and/or better quality in the production. With this interpretation, time that is of value to the employee, but that will not affect production positively even in a long run, e.g. social activities or running private errands, should not be included in *time actually worked.* Nevertheless it may be profitable for the employer to allow such activities, e.g. through reduced staff turnover.

An intermediate status between time actually worked and time not worked is time when the employee is free to do private tasks but is simultaneously at the disposal of the employer, e.g. back-up duty at home. Some travelling time may belong to this intermediate status although the employee's ability to use the time as he/she pleases is then limited. Of course, purely non-productive time exists, when the employee refrains from working without the employer's knowledge.

It is essential that time that is affected by actions that are implicitly considered to be productivity improving is included in *time actually worked*. If, for example, it is considered that shorter coffee breaks would increase productivity, those breaks should be included in time actually worked. If coffee breaks were not included in time actually worked, shorter breaks would increase both production and time worked, but productivity would remain largely unaffected.

In many respects, it is practical to measure *time paid for* by the employer. With this definition of time worked, variations in breaks and social activities, both those sanctioned by the employer and those not, which affect production will also affect productivity. On the other hand, work that is done outside the time paid for by the employer would not be accounted for. For example, it would not be possible

to register variations in overtime work from people who receive a fixed monthly remuneration for possible overtime. There would also be problems in defining time actually worked for self-employed and unpaid family members.

Alternative use of working time

Measuring time worked is, of course, important for economic statistics where information is needed for calculating productivity and also for analysing the supply and demand for labour, competitiveness vis-à-vis the rest of the world, etc. However, information on time worked is also important in several other fields.

Data on hours worked are necessary in wage statistics for calculating wage rates, evaluating wage differences and wage distributions and also for calculating the structure and changes in labour costs.

In labour force statistics, information on hours worked is used in descriptions of the situation of different groups on the labour market and when analysing the structure and dynamics of the labour force.

In social statistics, information on hours worked is used in descriptions of the balance between work and leisure, the distribution of work within families and social exclusion.

On the one hand, it is beneficial to use the same definition of time worked for the purposes of comparability. On the other hand, there are probably reasons to treat activities in the indeterminate zone between time worked and time not worked differently in different contexts.

If it were not necessary to consider the costs of collecting and processing data, it would be ideal to produce statistics on everything that could possibly be considered as time worked. In such a situation, every user could compose the definition of time worked most suitable for their enquiry. At the same time, international agreements would determine what should be published and treated as official statistics and used for comparisons between countries.

In practice, however, the lack of resources makes this impossible. The demand for international comparability should therefore be the determining factor, as is the case of statistics on production, employment etc.

Current applications of working time statistics

Data on working time have earlier principally been restricted to the manufacturing industry. As the service sector has grown, the demand for data on this part of the labour market has increased and questions about flexible working time, for example, have become of current interest.

Below are some examples of different aspects of working time and their current areas of application:

Aspects of working time	Areas of application
Hours paid	Wage/salary statistics: wage/salary levels
Hours of paid absence	Business statistics: working conditions etc.
Hours actually worked	National accounts: productivity Business statistics: productivity, competitive power, business cycles etc. Wage/salary statistics: wage differences, wage distributions LFS: structure and development of the work force Social statistics: time use, labour distribution
Overtime	Business statistics: demand for labour LFS: Social conditions, health
Normal hours of work (e.g. 8 hours/day etc.)	Wage/salary statistics: computation variable LFS: attachment to labour force
Hours usually worked (over a long period of time)	Wage/salary statistics: wage/salary levels LFS: attachment to labour force Social statistics: background variable
Underemployment	LFS: labour supply
Terms of employment	National accounts: distribution variable for productivity Business statistics: distribution variable Wage/salary statistics: distribution variable LFS: labour force flexibility Social statistics: welfare

Data sources

The three most common sources of information about working time are:

1. Establishment surveys. In Sweden, wage statistics are the main source.
2. Household-based surveys. In most cases, the Labour Force Survey (LFS).
3. Administrative registers.

In addition there are different types of Time Use Surveys.

Establishment surveys

Establishment-based information is most often tied to the wage payment systems, which is a basic weakness. Different types of deviations from the agreed working time are registered if they affect the wage payment or if the tax authority demands such information. Such registrations might differ between enterprises and could therefore produce inaccurate estimations at aggregate level. The time that is reported in establishment surveys tends to represent *time paid* or *normal time* rather than *time actually worked*.

Household-based surveys

The household-based surveys, including the LFS, depend on individuals' answers to a number of standardised questions. The answers will depend on the respondents' willingness and ability. In most cases, the direct question is asked "How many hours did you work last week?" The answer will to a great extent depend on the respondent's understanding of "work". Moreover, special procedures for obtaining information from self-employed persons, whose activities may to a great extent be in the intermediate zone between work and leisure, are often lacking. These circumstances, plus the fact that household surveys often accept indirect respondents, tend to create underestimations of both absence from work and overtime work, compared to administrative sources. A set of questions to guide and assist the respondents is therefore needed.

Administrative registers

These statistics are based on registers set up on the basis of legislation to obtain information about different kinds of activities. They may, for example, concern time normally worked, sick leave and parental leave. The tax authorities' registers of income and payroll taxes might be useful in the present context.

Time Use Surveys

This kind of survey is rarely used for measuring time worked. It might, however, be used for the adjustment and quality control of other surveys. Since the respondents to such surveys are asked to report different kinds of time use, the measurement of time worked may to some extent be created when processing the survey data. The cost of time use surveys is of course high.

A classification table for working time

The following proposal is based on the classification of working time that seems to be internationally accepted, *time worked vs time not worked* combined with *time paid vs time not paid*. This classification is complemented by a number of sub-classifications for the purpose of clarifying the problem areas with regard to the definitions of *time actually worked* in particular.

Variable 1: Form of working time

A. Time actually worked, TAW

1. Time actually worked during Normal time of work

a. Fully productive time (FPT)
b. Indirectly productive time (IndPT)
c. Non-productive time (NPT)

2. Overtime (time worked exceeding Normal time of work)

a. Fully productive time
b. Indirectly productive time
c. Non-productive time

B. Time not worked (e.g. absence), TNW

1. Absence (during normal time of work)
2. Back-up duty. Time when a person is at the employer's disposal (outside normal time of work)
3. Remaining time that cannot fully be used as spare time because of work (outside normal time of work)

The remaining time of the day may, from a working perspective, be called *spare time*. In this context, one may disregard any employer contributions of money or other resources to be used for a person's spare time, e.g. sporting activity.

Variable 2: Payment

X. Time paid in time or money

1. Paid at a higher tariff than the usual tariff
2. Paid at the usual tariff
3. Paid at a lower tariff than the usual tariff

Y. Time not paid

From this classification, different concepts of working time can be formed, e.g.:

Time actually worked = Normal working time + Overtime – Absence

(A = (A1 + B1) + A2 – B1)

Example of combinations of variables

TAW=Time actually worked, TNW=Time not worked, NTW=Normal time of work, FPT=Fully productive time, IndPT=Indirectly productive time, NPT= Non-productive time

Form of working time/Payment	Paid, higher tariff (X1)	Paid, usual. tariff (X2)	Paid, lower tariff (X3)	Not paid (Y)
TAW/NTW, FPT (A1a)	- (11)	Normal working time (12)	- (13)	- (14)
TAW/NTW, IndPT (A1b)	- (21)	Short breaks, vocational training, stand-by work, travelling for work/ NTW (22)	Stand-by work (23)	- (24)
TAW/NTW, NPT (A1c)	- (31)	Non-productive time (32)	- (33)	- (34)
Overtime, FPT (A2a)	Ordinary overtime (41)	Time bank (42)	- (43)	"Optional" overtime exceeding contract (44)
Overtime, IndPT (A2b)	Short breaks etc. (51)	- (52)	Travelling for work/outside NTW (53)	- (54)
Overtime, NPT (A2c)	Non-productive time (61)	Non-productive time (62)	- (63)	- (64)
TNW, absence (B1)	- (71)	Holidays, attending hospital etc. (72)	Sick leave (73)	Leave without pay (74)
TNW, time at disposal (B2)	- (81)	Back-up duty (82)	Back-up duty (83)	- (84)
TNW, Remaining time (B3)	- (91)	- (92)	- (93)	Travelling to and from work (94)

Problems related to the definition of "time actually worked"

Notes inside the brackets refer to the classification table of working time above (V1/V2), where V1 stands for variable 1 (Form of working time) and V2 for variable 2 (Payment).

Working time[1] is discussed by Ómar S. Harðarson and Arturo de la Fuente in a paper to the Paris group on 15-17 May 2006:

Working time is the time persons spend under the control and responsibility of a producing unit and

A. *directly engaging in producing the goods or services which are the principal or secondary output of the producing unit, or*
B. *engaging in an ancillary activity creating the necessary condition for the production of the goods or services of the producing unit, or*
C. *spending time in work-related pauses, which are the necessary consequence of the principal, secondary or ancillary activities of the producing unit, or*
D. *participating in education or training which is immediately and directly connected to the principal, secondary or ancillary activities of the producing unit."*

Harðarson & de la Fuente use the concepts work-related and not work-related pauses:

"*A pause is a work-related pause if it fulfils three conditions:*

A. it is clearly demarcated by events in time marking the start and end of the activity;
B. if during that period no contribution to the production is made and
C. the pause is a necessary consequence of the production process."

Work or labour input that are not under the control and responsibility of a production unit are outside this definition.

This definition has clear advantages but leaves us with questions (how do we handle unpaid overtime?) and conclusions (all time travelling between places of work is working time) that will be discussed below.

According to the EU and the ILO, *hours actually worked* include

A. Hours actually worked under Normal time of work (A1).
B. Hours actually worked outside Normal time of work that are usually paid in a higher tariff, so-called overtime (A2).
C. Hours spent at the workplace preparing work, cleaning of work instruments, filling in forms and other reports etc. (included in A1b+A2b).

1 *Harðarson & de la Fuente use the concept working time with the same intention as we use time actually worked in this paper.*

D. Unproductive hours spent in the course of work, e.g. time for stand-by for technical or economic reasons such as lack of material supply, machinery breakdown, accident or other paid hours spent on non-productive activities (included in A1b+A2b).
E. Short periods of rest including coffee breaks (included in A1b+A2b).

Hours actually worked should exclude:
F. Hours paid for but not worked, such as paid annual leave, paid public holidays, paid sick leave, paid parental (maternity, paternity) leave (included in B1/X).
G. Meal breaks longer than 30 minutes (included in B3/Y).
H. Time spent on travel between home and workplace (included in B3/Y).

The definition pays only limited attention to the variable Paid/Not paid. It does not deal with the following problem areas:
1. Only paid overtime is discussed. How should *unpaid overtime* (A2/Y) be dealt with? The unpaid overtime could be of two kinds:
a. Unpaid overtime at the production unit or externally that is directly or indirectly known by the employer cannot be said to be under the control and responsibility of the employer. However, if the employee performs tasks that otherwise would have been performed during the normal time of work or as paid overtime, it could be looked upon as ordinary work.

In our opinion, this type of unpaid overtime should be counted as *time actually worked*.
b. Unpaid overtime that is unknown to the employer and from the employer's point-of-view could even be unnecessary. There is a thin line between these two kinds of overtime but, in some occupations, (especially white-collar occupations) there is a tendency to count the time as working time as soon as the employee is "thinking about work" in his/her spare time.

In our opinion, this type of unpaid overtime should not be counted as *time actually worked*.

2. A problem that is hardly ever mentioned is that part of *time actually worked* that could be described as *non-productive time,* i.e. time that is not productive but is paid as *normal time* or *overtime* ((A1c+A2c)/X). An example is when an employee takes longer lunch breaks than agreed with the employer and this time is paid for as time actually worked. *Productive time* is really a narrower concept: "the time when the employee really produces goods or services". Using this definition, a lot of time is non-productive but is still counted as *time actually worked.* People are not robots and common human behaviour, such as short breaks or going to the

toilet, must be included. That is, every short break that the employer would accept if he/she knew about it. On the other hand, all time that the employer would not accept if he/she knew about it should be counted as non-productive time. This time does not fulfil the demands for being classified as a work-related pause.

We suggest that this *non-productive time* (not accepted by the employer) should be excluded from *time actually worked*. This would result in measurement problems, something that applies to more variables than just this one.

3. *Stand-by time* and *back-up time* are time when the employee is at an employer's disposal at or outside the production unit and is often paid at a lower tariff (B2/X3). This kind of working time is not dealt with in the present international classifications of *time actually worked*. This work-related time can be on a scale from "back-up time" that is almost the same as spare time to "stand-by time" that is almost the same as working time. In some back-up time, one is very rarely put on duty and the demands are very vague. In other cases, it is compulsory to spend the time (sometimes sleeping) at the workplace.

As the *stand-by time* is spent at the workplace, the employee is under the production unit's control and responsibility. This goes for whatever task the employee is set to perform (e.g. sleeping). We suggest that stand-by time should be included in *time actually worked.*

As the *back-up time* is not spent at the workplace, the employee is not under the production unit's control and responsibility before he/she is called into duty. We suggest that *back-up time* normally should not be included in *time actually worked.* But there are occasions when the employer's demands on the employee's back-up time are so extensive that it is reasonable to draw a parallel between back-up time and stand-by time. How back-up time and stand-by time are paid is irrelevant.

4. Normal travelling between home and the workplace (B3/Y) is not normally included in *hours actually worked,* as this time is not under the production unit's control and responsibility.

We suggest that if such time is paid and the employee is expected to do some work during the travelling time, it should be included in *time actually worked*, otherwise not.

5. Travelling time that is necessary for carrying out the work ((A1.b+A2.b)/ X3) is a problem if it is performed outside normal working hours. The most common way to look at this is as something between work and spare time. This time is most frequently paid at a lower tariff then the usual one. According to Harðarson & de la Fuente's model, all this time, i.e. the transportation between home/workplace and a new workplace, is included in *time actually worked*. This is because the

travelling time is under the production unit's control and responsibility and the travelling is a necessary ancillary activity for the production process.

We suggest that all travelling time of this kind should be included in *time actually worked,* irrespective of when it is performed. How it is paid is irrelevant.

6. Time that is paid at the usual tariff but is, in reality, spare time (B3/X2), i.e. time that could be classified as paid spare time. This could be for example physical training on paid working time. The employer of course has a reason to do this: he/she may for example hope for lower staff turnover, less sick leave etc., and can therefore consider this a sound investment.

We suggest that, because it cannot be classified as a work-related pause, this time should be excluded from *time actually worked*.

7. *Vocational training* (A1b/X) is another area with no obvious classification. To be included in time actually worked, vocational training must be under the production unit's control and responsibility and be production-oriented.

We suggest that education designed to enable the employee to perform his/her tasks in a more efficient way should be included in *time actually worked.* Education that is intended to enable the employee to take on more qualified jobs or language courses that are not necessary for performing the working tasks should not be classified as a work-related pause.

8. The trainee system is common in several countries, leading to the question of whether to include it in *time actually worked*. In Sweden, the extent of this system is limited and, therefore, the problem is reduced to separating the time of the new employee between work and education.

As the trainee system fulfils the criteria of control and responsibility and is linked to production, it is our opinion that the trainees' time should be included in *hours actually worked*.

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Volume calculations of individual government production in the National Accounts

Birgitta Magnusson, Statistics Sweden

Introduction

Over twelve years have passed since the release of the most recent reports on productivity in the public sector; among other things, Sweden has since then become a member of the EU. Requirements for harmonised calculations of the National Accounts have increased markedly within the union. Since 1996, an EU regulation on the European System of National Accounts, ESA95 has been in effect. During the first years of membership, work has focussed on harmonising calculations of the Gross National Income in current prices, because this is an important basis for deciding how much countries should contribute in membership fees.

Considering that GDP volume development is the most widely used indicator from the System of National Accounts, and the requirements of the Stability Pact, increased demands have been made on harmonisation principles for calculations of changes in prices and volumes. A supplementary regulation within this area was taken by the Commission in December 2002. This regulation was preceded by development work in several international working groups to draw up guidelines for the calculations. The working groups treated the areas where changes in prices and volumes were assessed to be particularly difficult to measure, such as: health and medical care, education, public administration, computers and software, financial services, renting and other business services. Results have been put together in a handbook on methods to measure prices and volumes, which include recommendations and principles on which calculations should be made[1]. However, the handbook is of a rather general nature, and it is a great challenge to find relevant material and perform the calculations.

1 *Handbook on Price and Volume Measures in National Accounts, ISBN 92-894-2000-6.*

Project team

Within the National Accounts Unit at Statistics Sweden, several people have been engaged in various stages of the development of methods and compilations according to the Eurostat guidelines. Jan Redeby, Christina Liwendahl, Angelica Arellano, Cecilia Sörensen, Jonas Larsson, Ingegerd Hörnström, Ann-Lous Päivinen and Jenny Davidsson have all contributed to different parts of this work. Birgitta Magnusson has put the material together in this report.

In this work we have also had discussions with authorities that are responsible for the official statistics and have expert knowledge within each area. We are grateful for valuable information and comments on our work from the personnel within these organisations. Contacts have been established with the National Board of Health and Welfare, the Swedish Association of Local Authorities and Regions (SALAR), the Swedish National Agency for Education, the National Agency for Higher Education, the National Council for Cultural Affairs, the Swedish Migration Board and the National Board of Institutional Care.

Purpose

This report describes the development work that is being done within the National Accounts at Statistics Sweden. As an introduction, a brief presentation of the current procedures is given, followed by a summary of those EU requirements placed on the methods of calculation. Thereafter, we will take a look at the information and methods used within the different areas. The preliminary results obtained so far are presented and comments are given on some of the problems of the information and calculation methods.

Current calculation of non-market production in the National Accounts

The greater part of the production of the public sector is non-market production, meaning that there are no market prices for the services produced. Therefore, the calculations are based on the principle that production value is equal to the sum of the costs for the production in question. The production value thus consists of the sum of salaries, employers' social contributions, depreciation, and intermediate consumption of various goods and services.

Constant prices are also calculated according to the cost method as the sum of the parts. In order to calculate production in constant prices, i.e. measure the change in volume adjusted for inflation, the various components are recalculated to constant prices. Intermediate consumption, consisting of goods and services that are purchased, are re-calculated with respective price indices. The same price indices as for the investments in question are used for depreciation. Salaries and

employers' social contributions are extrapolated from the constant price value of the previous year with volume development of the number of hours worked within each area of activity. Since production requires a great deal of personnel, the largest part of the constant price calculation is done with the aid of labour input. The method involves an assumption that the change in volume of input is representative for the change in the produced volume. But it is not at all certain that an increased input results in more production.

Since labour productivity is calculated by using the ratio between value added and the number of hours worked, this way of calculation results in unchanged productivity. When using production costs to roughly measure production, it is not possible to analyse conditions for productivity, which in many cases may be unsatisfactory. Some countries make their calculations on an assumption of a certain increase in productivity, but this general assumption is not made in Sweden or most of the other countries.

The size of the public sector

In Sweden, as in many other European countries, public authority production accounts for a large proportion of GDP. The value added of general government comprises slightly more than 20 percent of the total value added in the Swedish economy, and municipal activities account for nearly 75 percent of public authority production. Government activities are grouped according to an international classification called Classification of Functions of Government, COFOG. The various proportions of the functions in relation to GDP and the total public consumption are illustrated in the table below. Total public consumption accounts for about 28 percent of GDP

New method of calculation from 2006 onwards

According to the European Commission's decision 1990/2002, all member states[2] from 2006 onwards must report calculations according to the new method of public sector production that is directed towards individuals. For collective services, the costs method may need to be used even in the future due to a lack of reliable quantity indicators. In the ESA95 those services which are regarded as collective or individual are clarified. Services directed towards individuals are mainly found in the 07-10 areas of COFOG.

The current calculation method is no longer accepted. Instead, production should be calculated with the help of output methods. Those countries that do not change their calculations will receive notices to do so. However, Eurostat is aware that this requires a significant changeover, and will not be completely satisfactory from the

2 *Except Denmark, which has been granted a postponement until 2012.*

beginning. But the objective is that each country will do its best, and later when better information and calculation methods have been developed, these can be introduced and previous calculations can be revised.

The change implies that the production value shall be calculated in constant prices based on the volume change of production. Value added in constant prices will then be received as production minus intermediate consumption, similar to the calculations for market production. Production in current prices will also be calculated in the future as the sum of production costs.

The new way to make calculations will involve a methodological break in the time series of the National Accounts. Presently, it is unfortunately not possible to obtain the necessary data on different activities and their costs at the desired level of detail for any longer time period back in time. In most cases, calculations can only be done from 2001 onwards. For certain areas, this is currently not possible even from 2001 onwards.

The volume index is used instead of the price index

Since there are no market prices on production, it is not possible to obtain any price indices to re-calculate to constant prices. In cases where no price indices are available, the national accounts can instead provide methods that are based on calculations of volume changes of the topical products. However, it is essential that the products are homogenous and are not objects for significant quality changes between calculation periods.

Eurostat consequently recommends that volume indicators should be used for projections of production value. In the Eurostat handbook indicators for inputs, activities, outputs and results (outcome) are discussed. The current method based on indicators for input, is not acceptable for Eurostat regarding production that has an individual approach.

Which indicators should be used?

The handbook takes up the advantages and disadvantages of the various probable indicators. The output indicator method is clearly preferred in the handbook. Some of the viewpoints brought forth are presented in the following paragraphs.

Activities. Examples of activities mentioned in the handbook include the number of operations that are conducted at a hospital. Activities reflect the actions of the producers, based on the inputs that they have. But if new improved treatment methods reduce the number of operations, this indicates a lowered production volume and a worsened productivity. This is not reasonable if patients have

received equal help by the use of a new treatment method that does not include an operation.

Indicators for output are therefore the measurements that should be used. However, it is not always easy to exactly define what a unit of output consists of, i.e. the breakdown that should be done for all production. In principle, it is possible for specific goods and services, with the actual delivery of output that occurs in the transfer from producer to consumer. Within education, it is for example the amount of teaching that is consumed by the pupils in a certain training course. Within health and medical care, it is the care/treatment that the patient receives, and for cultural services, it could be the number of theatre performances that the consumers have seen.

Indicators for outcome can finally be exemplified by the level of education in society, or life expectancy. However, the problem with these kinds of indicators is that they can be influenced by factors that do not have anything to do with the activity itself, and are thus not generally representative for output. In some cases however, they can be of help as indicators for quality of output.

General requirements for indicators

To be considered as acceptable methods, output indicators should fulfil the following requirements:

- cover all services that are produced for external users
- be weighted with costs of the reference year for each type of output
- be defined in as much detail as possible
- be adjusted for quality

In addition, an exact report of costs for the various services that are produced is needed to reflect the costs for each separate service in a correct manner.

Classification of methods

Eurostat's handbook includes a description of potential/suitable methods to use under different circumstances. The methods are then classified as A, B or C methods[3] where

- "A methods" are the most appropriate methods.
- "B methods" can be used in case an A method cannot be applied.
- "C methods" are those methods which shall not be used.

A B method could be the use of an indicator that has not been adjusted for quality. Accordingly, calculations should thus at least be on the B level. Quality adjustment

3 *Commission Decision 98/715/EC.*

components are very difficult to grasp. Indicators that are otherwise relevant but are not adjusted for quality are considered as acceptable alternatives.

Classification of methods is different for different types of services. The intention is that this classification shall form a basis for a harmonised approach to improve accuracy and comparability of price and volume measurements within the National Accounts.

Ongoing activities for various areas and quality adjustment

With help of the source material that the National Accounts have succeeded in gathering, work has been going on for several years now to develop methods and make calculations according to the new guidelines. In our work we have involved people from associations and authorities that have special knowledge within each area. Cooperation is necessary and very valuable, firstly to obtain help with statistical information and data quality, and secondly to discuss and obtain viewpoints on models and calculation methods. Discussions are also held about changes and additions to the information. We also like to have viewpoints on whether or not the calculation results appear to be reasonable.

We have begun with those activities that have the greatest significance proportionally. These activities are health and medical care, education and social services. But work is also going on to try to calculate the remaining parts of public service production aimed at individuals. However, we have had problems in finding suitable information for some areas, and generally there is a need for more statistics that is more in line with our needs for these compilations.

It is important to receive information on those indicators that best reflect the production carried out. From the perspective of a time series, it is also important to calculate quality changes in the production carried out. The selected indicators shall reflect that which has actually happened within each area in a correct way. In order to use the best methods, volume indicators are adjusted for changes in quality. The handbook admits that this is a delicate problem, and it is also here that we run up against the most difficult problems of all.

Because it is optimal to be able to break down the information to a very low level, it is important to have access to detailed information. As a result, good calculations will be obtained. By making calculations with the help of indicators that reflect activities on a detailed level, structural changes occurring in the activities are included. Changes are then reflected in relation to the various sub-activities and comprise a part of the change in quality. It is also important that costs and output are connected so that the weighted total between the various sub-outputs is correct.

Calculations within the area are now ongoing in most of the European countries, and some countries have already introduced volume calculations for parts of the production in the public sector.

Examples from the calculations of the National Accounts

1. Model for compulsory school

Eurostat's handbook discusses methods for volume calculations in a specific section for each area. The section on education says for example that a distinct feature of education is that it is often given to groups varying in size from very small groups with extensive guidance to lectures for more than 100 participants. Classes in schools usually consist of 20-30 pupils. The output-indicator to be used should be the number of pupil-hours for education. Output of education can be defined as the amount of teaching that is given to pupils and students, adjusted for changes in quality for each type of education.

The number of pupil-hours broken down by the levels of education and the various types of schools and educational programmes can at least be regarded as a B method. If this number is adjusted for quality it can be regarded as an A method.

One potential quality indicator is the number of pupils that leave compulsory school with acceptable grades and eligibility to upper secondary school. Average grades can also be weighted.

Services that do not involve teaching, such as school meals, school healthcare and school transport can be calculated separately at constant prices.

Our calculations of volume measurements within the school system include specifications of the following six services. Volume indices are calculated for each of these and are then weighted together with the costs as weights.

A. Teaching

B. School meals

C. School transport, travel compensation and board and lodging

D. Pupil welfare (school nurse, school doctor, study and vocational guidance)

E. Other services

F. Pre-school class

A. Teaching can be divided into two components:

a) Normal teaching (all teaching except mother tongue[4] and Swedish as a second language)

4 *Previously called home language.*

b) Mother tongue and Swedish as a second language

a) Normal teaching. The volume measurement is the number of pupil-hours. Now only the number of pupils broken down by classes is available. The current curriculum lists a total of 6 665 hours (60 minutes) for all of compulsory school, but does not list how these hours are distributed among the various classes. Teaching time has thus been broken down according to conditions prior to the new curriculum:

1st year class	20 hours per week
2nd year class	24 hours per week
3rd year class	30 hours per week
4th year class	34 hours per week
5th-9th year classes	35 hours per week

The number of pupil hours has been adjusted with three quality indicators:

- The number of pupils who have left 9th year class who lack final grades. There is also a small number of pupils who left compulsory school in 7th and 8th year classes without grades, for example because compulsory school attendance has been discontinued. This number is so small that it is insignificant.
- The merit rating for a pupil who has left compulsory school with final grades is the sum of the grades for pupil's 16 best grades, where G (pass) = 10, VG (pass with distinction) = 15, and MVG (pass with special distinction) = 20. The merit rating for subjects that a pupil has not completed successfully is of course equal to zero.
- The percentage of pupils who have left compulsory school and are eligible for upper secondary school. These pupils have grades in all three of the subjects Swedish, English and mathematics.

b) Mother tongue and Swedish as a second language (SVA) is considerably more expensive per hour than other teaching. Therefore volume indices have been calculated separately for these two activities with the number of pupils as a volume measurement. Data for the number of hours is missing. Costs for SVA are presented separately up to and including 1997. Weighting factors have been used for the following years after 1997. The figures are about 1.5 percent for mother tongue and 2.5 percent for Swedish as a second language.

B. School meals Total number of pupils in compulsory school is used as a volume measurement. By and large, all pupils eat at school.

C. School transport, travel compensation and board and lodging. There is no longer any information on the number of pupils who have school transport. In addition,

this cost item also includes travel compensation and board and lodging. However, the last-mentioned item ought to be insignificant for compulsory school. In cases where volume indicators are missing, constant prices are calculated by deflating the weight cost with a price index calculated as a weighted average value of the price index for constant-route bus traffic (0.8) and taxis (0.2). A volume index for this item is then calculated based on the deflated values.

D. Pupil welfare All pupils, regardless of their class year, are assumed to visit the school doctor and school nurse equally. However, study and vocational guidance is only assumed to occur in year nine. A volume index for pupil welfare is thus calculated as the total number of pupils with the number in year 9 counted twice.

E.Other services All pupils are assumed to use these not specified services equally.

F.Pre-school class The number of children in pre-school class is used as a volume measurement. The fact that more resources are needed for pupils with language support is also taken into consideration. This is done by increasing the number of these pupils with a factor of 0.2.

2. Model for upper secondary school

Four different services can be specified for calculations of volume measurements. Volume indices are calculated for each of these and are then weighted together with the costs as weights.

A. Teaching

B. School meals

C. School transport, travel compensation and board and lodging

D. Pupil welfare (school nurse, school doctor, study and vocational guidance)

E. Other services

A. Teaching. Separate volume measurements are calculated for each programme and are then weighted together. The average cost per pupil differs sharply among the various programmes. Calculations for each programme are made as follows:

Current prices (CuP) as the number of pupils per calendar year (= average of two study years) × average cost per pupil in current prices = cost per programme in current prices

Constant price (CoP) as the number of pupils per calendar year (= average of two study years) × average cost per pupil in prices for previous year = cost per programme in prices for previous year

A volume index is then calculated as: ΣCoPt / ΣCuPt-1

The number of pupils has been adjusted by using two quality indicators:

- The percentage of pupils in year 3 with final grades. Pupils in year 3 without grades include those who supplement studies in certain subjects and receive final grades later. We can still regard the percentage of those with final grades as a measurement of quality in teaching. Pupils who achieve the results required to continue do not change programmes to supplement courses.
- Average grades for pupils who have completed upper secondary school with final grades. Fail (IG) = 0, pass (G) = 10, pass with distinction (VG) = 15 and pass with special distinction (MVG) = 20. The merit rating for subjects that a pupil has not completed successfully is of course equal to zero.

No adjustment has been made for the percentage of pupils who left upper secondary school and were eligible for university studies. This measurement interacts to a high degree with average grades. Adjustment for changes in this would thus be counted twice. However, discussions are now ongoing with the Swedish National Agency for Education about whether there is any other information that is more relevant for quality adjustment of the produced teaching. To produce an A method, the volume of teaching should be adjusted for quality.

B. School meals. In contrast to compulsory school, school lunches are not served to all pupils in upper secondary school. Constant prices are thus calculated by deflating the weighted cost with the index for institutional catering for municipalities. A volume index for school meals is then calculated based on the deflated values.

C. School transport, travel compensation and board and lodging. In cases where volume indicators are missing, constant prices are calculated by deflating the weight cost with a price index calculated as a weighted average value of the price index for constant-route bus traffic (0.8) and taxis (0.2). A volume index for this item is then calculated based on the deflated values.

D. Pupil welfare. All pupils, regardless of their class year, are assumed to visit the school doctor and school nurse equally. A volume index for pupil welfare is thus calculated as the total number of pupils.

E. *Other services* are calculated by the use of the total number of students.

3. Model for university education

Undergraduate education

The number of pupils, or actually the number of full-time students, is used as a volume indicator, meaning the number of registered students for two terms (40 credits) or the registrations of several students for smaller amounts of teaching that add up to 40 credits. Forty credits equal one year's full-time studies. Discussions with National Agency for Higher Education have been held concerning volume indicators and possible quality measurements.

There is also some commissioned education at universities. Commissioned education is often tailor-made education for staff at various companies. Employers pay for the education. Information on most of this type of education is available at the National Agency for Higher Education. The number of full-time students engaged in commissioned education was about 5 000 for the years 2000-2002, compared to about 270 000 full-time students engaged in regular education for the corresponding years. Calculations have been made both including and excluding commissioned education.

Discussions with the National Agency for Higher Education have revealed that there are actually no good quality measurements and that for the time being, it is better to exclude this aspect in the calculations. There are a number of measurements that at first glance could be used to obtain quality in the calculations. Because of the nature of the higher education system and the many different types of education, together with the fact that it is largely the labour input and use of time by the student that affects the number of degrees or completed credits, it is very complex to attain quality. It is also difficult to show differences in quality based on the number of teachers or the level of education of teachers. Even if some of these measurements would be acceptable, there is no data that states that calculations can be done.

The Eurostat handbook on constant price calculations recommends that costs should be weighted to the greatest possible extent. Universities and institutes of higher education in Sweden are mostly financed through appropriations, and government appropriations are paid out per area of education, full-time student, and full study year. This information is used as weights for students in various fields of education.

Compensation for full-time students and full study years differs of course, depending on the area of education. A student who studies law does not cost as much as a student who studies design. In 2002, 45 percent of all full-time students in regular education were in the educational areas of humanities, theology, law and social sciences. Thirty-two percent were in the areas of natural science,

technology and pharmacology, 8 percent in health care education and 7 percent within the area of teacher training. This distribution has been relatively stable over time.

Postgraduate education

Unfortunately no information is available to allow weighting indicators for the various subject fields. The alternative for output has been active postgraduate students and the number of full year equivalents. Full year equivalents or *the number of full-time terms.*[5] were chosen. This should be a better measure of output since one is considered as active as soon as one has an activity level of 10 percent. Presently we have not found any suitable measurements for quality of postgraduate education.

Requirements for an A method are not met for university education unless quality adjustments have been made.

4. Model for pre-school activities and care of school-age children

Open pre-school

There is no information on the number of attendants at open pre-school (where children are accompanied by their parents). Results are measured in terms of availability, i.e. the number of open pre-schools and opening hours per week. Since longer opening hours give better availability, the open pre-schools with varying opening hours have been given different weights in the model. Open pre-school with a maximum of 15 hours open per week has been given a weighting factor of 1.0, open pre-schools open 16–20 hours 1.5 and pre-schools open 21 hours or more 2.0. The sum of the product of the number of open pre-schools in each category times the number of the topical weight gives the volume measurement.

Pre-school

Information is available on the number of registered children in pre-school, broken down by age. This information is used to obtain a volume measurement. Since resource intensity varies depending on the age of the child, the number of children has firstly been re-calculated in staff equivalents. This is based on an old recommendation from the National Board of Health and Welfare: 0.4 staff for each child aged 0-2 years, and 0.2 staff for children aged 3-6 years. A staff equivalent has also been added for children who receive home language training, 0.2 staff for each such child. The sum of all staff equivalents (0-2 years, 3-6 years, children with mother tongue support) provides the volume measurement. However, the National Agency for Education is hesitant about this calculation since the

5 *Information on the number of full-time terms has been compiled by Statistics Sweden.*

recommendation from the National Board of Health and Welfare does not seem to be relevant anymore. Alternative approaches are now being discussed.

Family daycare homes 0-12 years

Volume measurements for family daycare homes are calculated in the same way as for pre-school, based on the number of registered children. Re-calculation to staff equivalents is done in the same way also. School children aged 7-12 are only counted as taking up one-half of a full-time position, and a staff equivalent of 0.17. Information on the number of registered children receiving home language training is available, but since the number is very small it is not included in the model. The sum of all staff equivalents (0-2 years, 3-6 years, and 7-12 years) provides the volume measurement.

Open leisure time activities

There is no information on the number who take part in open leisure time activities. Results are measured in terms of availability, in the same way as for open pre-schools. Weighting factors are the same as those for open pre-schools. The sum of the number of open leisure time activities, in each category, multiplied by the topical weight provides the volume measurement.

Leisure time centres

Information about leisure time centres is available on the number of registered children and is used to obtain a volume measurement. Information on the number of registered children is broken down by age groups, but in this case there is no reason to differentiate between age groups, and the total number of registered children serves as a volume measurement. Because the measurement period for the number of registered children is 15 October, the calendar year is calculated as the average value of the number of registered children on 15 October the previous year, and 15 October for the current year.

5. Model for care of the elderly and disabled persons

Care of the elderly

For the municipal care of the elderly four different services can be identified. They are:

A. Services for elderly persons living in normal housing
B. Services for elderly persons living in specific housing
C. Services for elderly persons in short-term housing
D. Permits for elderly persons to use special transportation services

A. Services for elderly persons living in normal housing. There is information on total costs and number of persons but also on number of hours of help. Compilations

were made on both alternatives. They showed very different results, which is an indication to be very careful in the choice of volume indicator. We thought that hours would be the most accurate indicator and put it forward as our main alternative.

However, the National Board of Health and Welfare, who is the responsible authority for statistics within this area, came to the conclusion that hours of help was not a good enough indicator to be used. *The hours recorded in the statistics constituted the hours as deemed by the social officers*. There is no clear-cut relation between the actual number of hours of service carried out and the number of hours of service granted. Furthermore, in some cases two personnel is needed to handle one elderly person, as there may be cases of heavy lifting involved. Studies made in some municipalities also show that there is a wide variance between hours granted and hours carried out. There were also great differences between groups of people with various needs for help. Therefore the calculation based on hours has been rejected for the moment.

B. Services for elderly persons living in specific housing. For this group only information on total costs and number of persons is available. This is also a problem, as different persons may have various needs. Some maybe only need help a few times a day while others may have to be assisted in most activities.

C. Services for elderly persons in short-term housing. The volume indicator is based on the number of persons for which short-term housing has been provided. There is neither information on the length of the visits nor on the care provided.

D. Elderly persons with permits for transportation services. A volume index can be calculated from the information on the number of persons that carry a permit to use special transportation services. The production of the municipalities in this case is only for administration of the permits. The municipalities buy the actual transport service from private taxi and bus operators.

Disabled persons

A volume measurement on care for disabled persons carried out by the municipalities can be made in a similar way to that described for elderly care. Apart from the above-mentioned services A, B and D, four more services can be specified for this group.

- Disabled persons with daily activities according to the Act concerning Support and Services for Persons with Certain Functional Impairments
- Disabled persons with housing according to the Act Concerning Support and Services for Persons with Certain Functional Impairments

- Disabled persons with a personal assistant according to the Act Concerning Support and Services for Persons with Certain Functional Impairments
- Disabled persons with other services according to the Act Concerning Support and Services for Persons with Certain Functional Impairments

The same problems regarding the relevance and usefulness of the available statistics is true also for this group.

Alternative methods

Close cooperation occurs with the National Board of Health and Welfare concerning the area of elderly care and care for disabled persons. The statistics have been analysed and improvements have been proposed. Discussions and development of methods are ongoing, among other things regarding quality adjustments for access to one's own room. We have also looked into the possibilities of putting a higher weight to the group of persons that are considered to need a higher amount of hours of help.

Calculations on different alternatives are shown in the following table. They all relate to elderly persons in normal housing. As we can see, the results are very sensitive to the indicators used.

Volume change/year	*2001/2000*	*2002/2001*	*2003/2002*
1. number of persons	0.2 %	0.7 %	0.5 %
2. number of total services	0.6 %	2.1 %	3.6 %
3. weight of care based on granted hours in intervals	-0.8 %	3.4 %	3.9 %
4. total number of hours granted	0.7 %	5.6 %	-0.1 %

The services given to the elderly and disabled persons and the needs to be met by the services are individual and must be adapted to the particular person who receives the services. The frailer a person becomes the more care and help he/she will need. Detailed knowledge of care for the elderly and disabled persons is needed to correctly measure the services and the changes in their needs. It is particularly important to observe changes over time. When the weight of care per person changes, the unit price is affected, but not the volume, if volume is measured in the number of persons. The volume index would then be incorrect.

The calculations included in this paper for normal housing are based on the number of persons having received different services. For persons living in special housing the number of persons is used together with a quality adjustment for a private room. We are well aware that this is not the optimal model. A better measurement would thus be the number of hours of help carried out and with a

quality indicator for the change in the services between the different periods. If the help changes from home services to care services, for which more qualified staff is needed, the services should also be broken down into hours of care and hours of home services. If the statistics are unable to show these changes, rationalisations within the public sector would involve a drop in productivity, even though the opposite may be true.

Changes in the contents of the services are difficult to pinpoint in a calculation, but these changes can be very significant for calculation results. In general it is apparent that service within elderly care has changed in that more people today have a greater need for care than was the case a number of years ago. Work is now going on to produce supplementary information to better reflect the changes occurring within the area, which will in turn lead to an adjusted calculation within the area.

6. Model for other social services

For administration of social insurance schemes, information is available on the costs and the number of beneficiaries in different areas.

Calculations have also been made in the area regarding care for substance abusers. The indicator is based on the number of persons treated.

Regarding reception of refugees and asylum seekers, the number of matters dealt with have been used.

As no quality adjustments have been used in these cases, the models will be B methods.

7. Model for health and medical care

According to the handbook for volume calculations, the quantity of health care that a patient receives should be measured in terms of complete treatments. A complete treatment is an activity that contains a basket of various services such as care by a doctor, paramedic, etc. If a patient is admitted to a hospital, food and lodging is also included in the treatment.

The focus for calculations of production volumes lies in measuring the value of the actual flow of medical care services and not on the results achieved by the treatment. Information on the results can be used for quality adjustment of different forms of treatment after the changes made in the production process.

A number of visits is included for each type of treatment. According to the manual, the greater the number of visits the more expensive the treatment is.

Theoretically, all medical care services should be as homogenous as possible concerning content and expense so that they can be compared over time. Ideally,

all medical care that a patient receives should be related to a diagnosis and reported as a complete treatment.

Hospital care

Various treatments within the area of hospital care are registered with the help of Diagnosis Related Groups, DRGs. The method was first developed in the US for quality control of hospital care, and later also as an instrument for cost control and economic management. The DRG system groups medically similar types of treatments, which are also approximately equal in cost. Sweden uses a common Nordic system called NordDRG, which includes about 500 groups for hospital care. NordDRG is adapted to diagnosis coding according to ICD-10 (International Statistical Classification of Diseases and Health, 10th revision). It includes 10 000 diagnoses for hospital care and coding for procedures according to NCSP (Nomesco Classification of Surgical Procedures). Grouping is done from the data that has been registered in the administrative data system for patients of hospital care, namely a code for diagnosis, codes for any other diagnoses and treatments, together with age, sex and the manner of discharge. The resource consumption per DRG is calculated in the CPP system (cost per patient).

DRG weight[6] is a relative measurement of care and treatment costs for an average hospital stay per each DRG. Higher weights indicate higher costs. The average cost for all hospital stays is given as DRG weight 1.0, and the weight for each DRG is obtained by dividing its average cost with the cost that corresponds to DRG weight 1.0. DRG point is actually only another name for DRG weight and is often used to describe how much medical care that has been "produced" at a hospital or within a region.

Swedish Association of Local Authorities and Regions (SALAR) published a report[7] that among other things presents consumption and costs per DRG concerning different age groups. The sensitivity analysis shows that the difference in average cost per age group is insignificant after adjusting for case-mix[8]. An even greater equalisation occurs if the extremely expensive cases are removed. The study also includes a comparison of consumed DRG points concerning age structure between the least favourable County Council and the average corresponding points for the entire country. The analysis shows that the county council that has the least favourable age structure can reduce costs per DRG

6 *Source: www.socialstyrelsen/epc/CPK*

7 *Att beräkna produktivitet i sjukvården. Beskrivning av metod för produktivitetsberäkningar och redovisning av resultat från en studie 2002. (translator's note: Calculating productivity in medical care. Description of methods for productivity calculations and presentation of results from a study in 2002).*

8 *The number of produced DRG points divided by the number of hospital stays.*

points by SEK 37 (0.1%) given that the county council has an age structure corresponding to the national average. The information allows the calculations to be classified as a B method.

However, after these calculations have been made, it is apparent that information on costs and activities are not connected, and the calculations that are presented here will therefore be adjusted when more correct information has been received.

Out-patient care

The calculations are based on a number of visits (not adjusted for quality) for a certain level of care. The information is broken down by visits made by different occupational categories. Presentation is made by visits to general practitioners and physicians by special area, nurses, other specialists and other care staff. It is assumed that a specialist/physician uses more resources (hourly pay) for visits than nurses or any other category of staff. Weighting factors[9] that SALAR recommends are based on what is known as expert assessment. Visits to other staff categories than doctors correspond to 40 percent of all visits to doctors. A home visit has been given the weight of two visits to an office/clinic, and contact by telephone the weight 1/3 of a visit to an office/clinic.

Information is thus available on the number of visits regardless of the type of treatment and the number of additional visits. As a result, the information can neither identify the various parts of a certain treatment nor the related additional visits for treatment. This limits the possibilities to observe changes in the quality of services. Thus quality adjustments are excluded from the material. This shortfall in the material is handled by assuming that a visit is equal to a complete treatment. In practice this assumption only applies to general practitioners, according to the manual.

In summary, it can be said that the method fulfils the requirements for the "B method", i.e. the acceptable alternative. Medical care services can be calculated by the different types of specialists and we assume that the number of first visits correspond to the number of complete treatments.

DRGs for out-patient care at hospitals

Development of DRGs for out-patient care at hospitals is going on. Since 2003, there have been defined groups for day surgery and endoscopic treatment (NordDRG-O). This expansion of NordDRG has resulted in 218 new DRG groups, available from 2003 onwards but of variable quality.

9 *Source: Statistik om hälso- och sjukvård samt regional utveckling 2001, Landstingsförbundet. (translator's note: Statistics on health and medical care and regional development in 2001, The Swedish Association of Local Authorities and Regions (SALAR))*

The Centre for Patient Classification has developed a secondary patient classification system[10] for medical out-patient care called "Secondary patient classification in out-patient care" which will be used in 2006. The registration includes out-patient care at hospitals and is based on treatments[11]. The new out-patient care groups are included as a part of NordDRG and cover 234 new groups. This information will eventually be used for the calculations.

Dental care

- Dental care is calculated on the total number of treated patients, divided into four different groups. The groups are
- A. General dental care for grown-ups
- B. Dental care for patients with special needs
- C. General dental care for children and young people
- D. Specialist dental care

The volume indices for each group are weighted together with the costs for each group. As we have found no indicators for quality adjustment this is a B method.

8. Model for culture and leisure activities

Activities within this area should be broken down into those who participate as a group and those who participate individually.

Libraries

Public libraries, school libraries and research libraries are the main types of libraries within this area. Statistics are available on the number of books and audio-video products loaned out. However, libraries are also involved with many other activities such as information services, story-telling for children, lectures, music evenings, drama for children, etc. While the number of book loans has decreased, there is a notion that other activities have increased (not confirmed). So far we have not been able to find information to measure these other types of activities.

Museums, theatres

Information is usually available on the number of performances and visits. However, in order to provide satisfactory methods, the number of visits should

10 *Secondary patient classification refers to a care contact that is assigned a certain category with the help of data from one or more primary classifications (directly observed information). Fyra år med CPK, Socialstyrelsen. (translator's note: Four years with CPC, the National Board of Health and Welfare)*

11 *Final report for SK-OP-projektet. Ny sekundär patientklassificering av öppenvård, Socialstyrelsen, artikelnummer: 2005-4-1, published in June 2005.*

actually be broken down into different categories such as the number of tickets sold in various price classes.

Another problem with information on visits to museums is that a number of museums (run by the government) have been free-of-charge since 2005. This has affected figures for visits, but not necessarily the production of presentations or exhibitions.

Leisure activities

There are no complete statistics for leisure activities at municipally-run operations on visits or tickets sold, such as single visits or season-tickets. Some types of operations such as swimming pools often have information, but there is no central collection in this area.

For some other municipal activities there is also a lack of relevant information on various services. Examples are parks, public leisure activities and supported study organisations.

Within the area of cultural and leisure activities, we have thus had problems in making calculations that fulfil requirements satisfactorily.

A few very preliminary results

The following table presents some very preliminary results from calculations made so far. As a comparison, volume changes are also presented that occur via the current calculations according to the cost method. The figures of change have been calculated using the previous year = 100. As described earlier, discussions with various authorities and other interested parties are going on, and these calculations can be seen as an initial attempt. Adjustments will be made with consideration to viewpoints and improved information. It should also be noted that all areas of individual public production are not included in the table. Compilations have now been made for almost 65 percent of value added in public authorities.

In some cases the calculations give a higher volume development and in some cases a lower one with the production method, compared to the cost method. It is difficult to see a clear trend. As the volume change in value added to a very large extent is based on hours worked in the cost method, a comparison between the two methods give some indication on productivity. The results then indicate that only for child care and undergraduate university education there is an increase in productivity for all the years studied. Since to a high degree the calculations are based on the number of individuals, the size of the groupings of years is of course a major determining factor for the volume change.

However, the information that the calculations are based on is not satisfactory in all respects. This is partly because it has been produced for other purposes than to make calculations of volume changes, which is a new way to use the information. It is therefore important to improve presentation and description of information based on activities, in order to improve the quality of the calculations. An increased grade of detail would also be desirable in order to break down production into more uniform sub-stages. As pointed out previously, volume indicators also need to have a clear relation to differentiated information on costs at a detailed level, so that the weighted total made from the various sub-outputs within an area is correct.

Further development of quality adjustments is another necessary prerequisite to increase quality. In order to calculate quality changes, a detailed description is needed of the contents of the services performed, and this is currently not available. We also find it difficult to make an assessment of the relevance of the calculated information, considering that the time period for which the calculations have been made is too short. It is thus way too premature to draw any definite conclusions of the material produced so far.

It is worth pointing out again that changes in the methods used can affect the results to a very large extent. As these results are preliminary they will certainly be revised as we continue our work with the aim of improving the methods.

The calculations presented in this report refer to publicly produced services on the country level. However, the method is also possible to apply to a more disaggregated situation. One prerequisite is of course that there is information on matching costs and activities. It is thus in principle possible to make calculations for various organisations and for individual activities.

References and further material

- Eurostat Handbook on price and volume measures in national accounts, 2001
- Summary accounts from municipalities and county councils
- The Swedish Financial Management Authority Documentation of central government net lending

Further material within this area produced by Statistics Sweden and others is also available. Reports previously published by the National Accounts on methods and calculations include:

- NR-PM 2001:25 – Översikt av de individuella tjänster som kan produceras av den offentliga sektorn; klassificering av producenter av sådana

tjänster till institutionell sektor och som marknadsproducent/icke marknadsproducent.
- NR-PM 2001:20 – Metoder för beräkningar av hälso- och sjukvård i fasta priser.
- NR-PM 2001:27 – Metoder för beräkningar av förskola och barnomsorg i fasta priser
- NR-PM 2002:08 – Utbildning i fasta priser
- NR-PM 2004:11 – Volymberäkningar av individuell offentlig konsumtion; utbildning, barnomsorg, äldreomsorg

Health and medical care
- ”Statistik om hälso- och sjukvård samt regional utveckling 2001”. Landstingsförbundet)
- ”Att beräkna produktivitet i sjukvården. Beskrivning av metod för produktivitetsberäkningar och redovisning av resultat från en studie 2002” SKL publikation
- ”Produktivitet och effektivitet i hälso- och sjukvården”, SALAR 2006
- ”Fyra år med CPK”. Socialstyrelsen.
- ”Slutrapport för SK-OP-projektet. Ny sekundär patientklassificering av öppenvård” Socialstyrelsen: artikelnummer: 2005-4-1. Publicerad i juni 2005.

Child care
- Skolverkets website (www.skolverket.se)
- ”Barnomsorg, skola och vuxenutbildning i siffror”, Skolverket

Education
- Skolverkets website (www.skolverket.se).
- ”Barnomsorg, skola och vuxenutbildning”, Del 1; Skolverket
- ”Utbildningsresultat samt Del 2; Barn, elever och personal”. Skolverket
- Högskoleverkets website (www.hsv.se) and databases
- Statistics Sweden’s publications of official statistics within the area
- Annual reports from Höskoleverket, Centrala Studiestödsnämnden, Nationellt centrum för flexibelt lärande, Myndigheten för kvalificerad yrekesutbildning, Folkbildningsrådet.

Culture
- Kulturrådets website (www.kulturradet.se)
- Sveriges Musik- och kulturskoleråd (SMOK)

- Material from the Swedish Association of Local Authorities and Regions (SALAR)
- Social protection Socialstyrelsens website (www.sos.se) and databases and publications of official statistics within the area
- ”Tid för vård och omsorg”, Socialstyrelsen
- Investigations and reports from various municipalities and county councils within elderly care
- Annual reports from Statens Institutionsstyrelse, Arbetsmarknadsverket, Riksförsäkringsverket och Försäkringskassan, Hjälpmedelsinstitutet
- Eurostat’s website includes several reports from different countries. The link is:
- http://forum.europa.eu.int/Public/irc/dsis/pnb/library. Then continue on to National Accounts and Workshop price and volume measurements Government output May 2005.
- The UK is also very active within this area. For a look at some reports, please visit: www.statistics.gov.uk/ukcemga.

Sweden's entrepreneurship challenge and possible policy responses

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Entrepreneurship has become a buss-word in policy strategies around the globe. Some authors are even referring to the current stage of development as an entrepreneurial economy or entrepreneurial capitalism (Schramm, 2005; Acs, 2001). Others name entrepreneurship as a key driver of growth (OECD, 2001). The raise of entrepreneurship related policies in many countries have also been noted in Sweden.

Swedish industrial policies have traditionally focused on large enterprises and individual sectors but the focus has shifted. "Old" Swedish Industrial policy was associated with a sector/company-oriented policy aimed at subsidising industries in recession (Lundström, 2002). Today Swedish policies are increasingly focused toward the processes that contribute to the creation and survival of companies. One of the current policy objectives for the Ministry of Industry Employment and Communications is: *"promote(s) the development of favourable conditions for enterprise, in order to promote new and growing enterprises"*. The policy strategy has entrepreneurship as one of six areas of action.[1] The policies under entrepreneurship include education in schools, subsidies to women and people from minority groups starting up their own firm and other actions aimed at getting more people to start new firms.[2]

Very little hard evidence is brought forward to support the policy objective (increase the start-up rate) and the related policies. Previous work based on the UK's experiences has shown that increasing start-up rates is relative easy but not a very cost efficient policy target (Storey, 1992). Furthermore, new data does suggest that EU on average does not have a start-up problem but a problem

1 *From the ministry's web pages: http://www.sweden.gov.se/sb/d/2112/a/19576*

2 *From the ministry's web pages: http://www.regeringen.se/sb/d/5709/a/46989*

relating to growth of new firms (Hoffmann, 2006). Finally, the newest research suggests that entrepreneurship is not only driven by the culture factors, which is Sweden's current policy focus (Kauffman, 2005).

This paper will - based on data and analysis - address two separate questions; 1) What should be the policy focus of the Swedish Entrepreneurship Policy? and 2) What would be the key policy areas to include in a Swedish Entrepreneurship Policy? The data and methods employed are taken from the Danish Entrepreneurship Index 2006 (EBST, 2006). The paper will also briefly address the possible links between entrepreneurship, innovation and growth.

What are the links between entrepreneurship and growth?

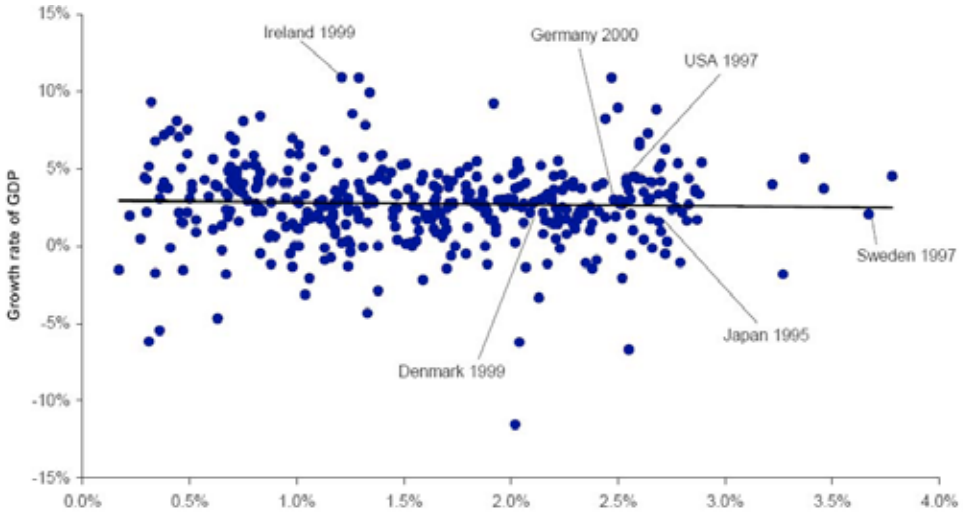
The effect of new firm entry and exit on productivity can be shown in a so-called growth accounting framework (OECD, 2003a). A detailed OECD decomposition of productivity growth in 8 OECD countries over a 10 year period showed that between 20 and 40 per cent of total labour productivity growth can be explained by new firm entry and exit. Normally, firms that exit the market have less labour productivity than their competitor in the industry, and thereby, their exit directly increases the average productivity within the industry. Firms that enter the market have a labour productivity near the industry average and only have, consequently, a small effect on labour productivity growth.

Effects on multifactor productivity (MFP) are different. Exiting firms have a limited role on MFP growth, while new firm entry contributes significantly to MFP growth. New firms can enter with new innovative management that utilises the factors of production better and thus increase MFP growth (OECD, 2005a).

Other studies confirm this connection between entry and productivity using different techniques. One study, for example, relates sectoral firm entry rates to sectoral productivity growth. This approach captures both the impact that firms have via their own productivity and any indirect effect on aggregate productivity that might occur, for instance, as a result of the competitive pressure created through firm entry (Brandt, 2004).

Finally, a new literature lining innovation, entrepreneurship and growth is currently quickly expanding. The key insight from that literature is that large investment in R&D needs to be supplemented by a vibrant entrepreneurship environment in order to affect growth. Previous studies have not been able to find a relation between investments in R&D and economic growth (Figure 1).

Figure 1 **Expenditures on R&D and economic growth in 29 OECD countries 1981–2000**



Source: OECD Statistical Compendium on CD, 2002:2/Acs, Audretsch, Braunerhjelm and Carlsson (2004).

A so-called knowledge filter exists between investments in R&D and economic growth. New studies show that entrepreneurship reduces the knowledge filter. Acs, Audretsch, Braunerhjelm and Carlsson (2005) find, for example, a strongly positive relationship between entrepreneurship and the stock of knowledge and economic growth, and that the relationship remains strong when controlling for institutional, market, and individual factors.

What are the key policy challenges for Sweden?

Entrepreneurship is not easily defined as is not a single event, but rather a process that transforms an idea into a firm. Many people leave the process before they even start a firm and most new firms exit due to failure, while others survive at, or near, the break even point. Only a small minority of new firms turn into high-growth firms, also known as gazelles.

The chosen definition of entrepreneurship should be compatible with the macro economic policy objective or the policy context (Storey, 2002). For example, a definition based on Schumpeter's work is often used if the policy objective is to promote innovation and growth (Schumpeter, 1949), whereas another common definition is based on Knight's work and is often used if the policy objective is to create jobs through self-employment (Knight, 1971).

The Swedish policy context is that of growth, as overall policy goal was to *"development of favourable conditions for enterprise, in order to promote new and growing enterprises"*. Consequently, this paper defines entrepreneurship as the

entry of new firms and *creation of high growth firms* to make the definition as close to the Swedish Government's overall goal. This is a definition closely linked to Schumpeter's work on entrepreneurs as innovators.

The objective of increasing the number of new firms must be seen in a comparative perspective, as the optimal level is unknown. New and existing firms are competing for the same talent and capital so it will be in-optimal if everybody was engaged in starting up a new firm. Carree et al (2004) show that, for example, countries having a self-employment rate deviating from a what the authors define as a 'natural' rate, given the level of economic development, suffer in terms of economic performance. Indeed, the authors conclude that growth is actually reduced by both a too high and too low self-employment rate. As the optimal start-up rate depends on the level of economic development, the start-up rates in Sweden should be similar to other OECD countries.

An optimal level of high-growth firms does not exist, as more firm sustainable growth is always better. The level of high-growth firms in Sweden will be compared to 16 other high-developed OECD countries.

Sweden's entrepreneurship performance can be illustrated by a set of performance indicators. The set include three indicators; the share of start-ups firms, the share of new firms with high-growth in turnover and the share of new firms with high growth in employment.

Measuring start-up rates

In Sweden, around 45 000 enterprises were started in 2005.[3] Over a ten-year period the number of start-up firms has been growing.[4] According to EUROSTAT the Swedish start-up rates (new entry divided by total number of firms) have been rather constant around 6.5%. The aggregated average covers rather large regional differences in start-up rates. The Stockholm and Uppsala counties (län) have an almost 50% higher start-up rate than Kronobergs län.[5] Most läns with low start-up rates are however small. More than 30% of all new firms are founded in Stockholm.

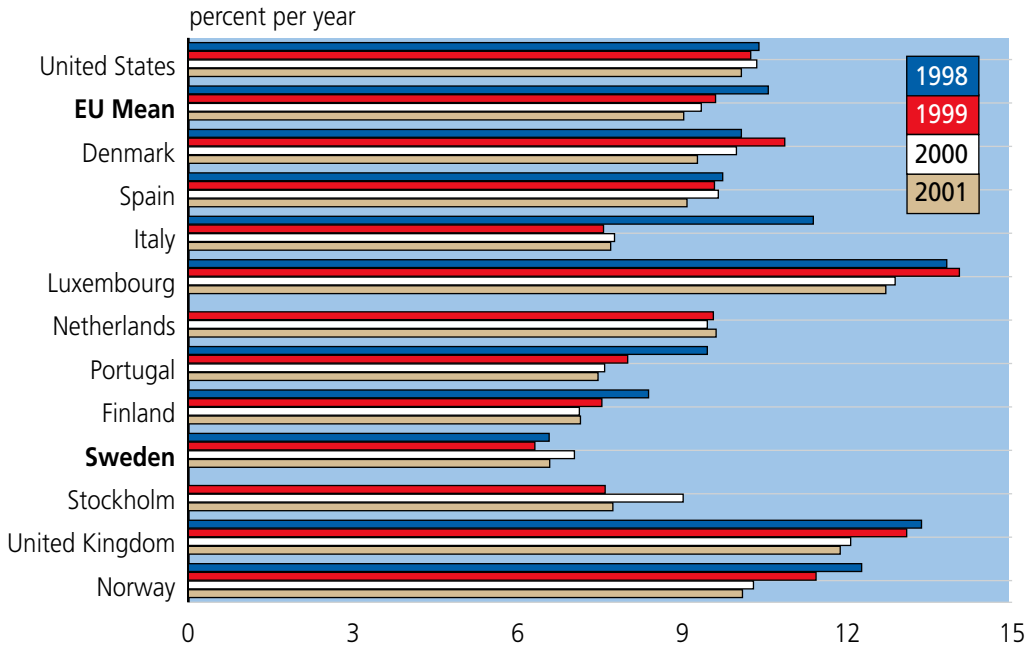
Swedish start-up rates are lower in an international perspective (Figure 2). Sweden is way below the EU average and the US. Even Stockholm – the Swedish top performing region – is below the EU average.

3 *Data available online: http://www.itps.se/Archive/Documents/Swedish/Publikationer/Rapporter/Statistik/ S2006/S2006_005.pdf*

4 *Data available online: http://www.scb.se/templates/tableOrChart____27185.asp*

5 *Data available online: Table 26a http://www.itps.se/Archive/Documents/Swedish/Statistik/Tabeller/Nystartade%20ftgstabeller/S2006_005/-%20Tabeller%20Nyeftg%2004%2005%20publ%20eksl%20T31.xls*

Figure 2 A Comparison of Business Start-up Rates



Sources: United States – Firm Size Data – Small Business Administration; EU – EUROSTAT Business Demography (The full EUROSTAT data set includes several other countries, but only those countries for which data was available for at least three of the above years are shown in this figure). The US data is based on a slightly different definition see Hoffmann 2006 for discussion.

http://www.itps.se/Archive/Documents/Swedish/Publikationer/Rapporter/Statistik/S2001/S2001_009.pdf

http://www.itps.se/Archive/Documents/Swedish/Publikationer/Rapporter/Statistik/S2002/S2002_008.pdf

The comparative low start-up rates in Sweden does suggest that policies aimed at increasing start-up rates might be appropriate. However, the low start-up rates could be due to industrial structure or barriers in the current business environment due to regulations or market failures.

Brandt (2004) examines the effects of industry structure and concludes"Accounting for industry, country and time-specific effects, explains more than 50 per cent of the variation in entry rates. Fixed effects for four countries, Belgium, Sweden, Finland and Portugal are estimated to be negative and statistically significant". Thus, the industry structure does play a large role in explaining differences among countries but even when corrected for industry structure Sweden does still have a significant start-up rate than comparable EU countries.

The barriers in the business environment and market failures will be examined in the section on policy challenges.

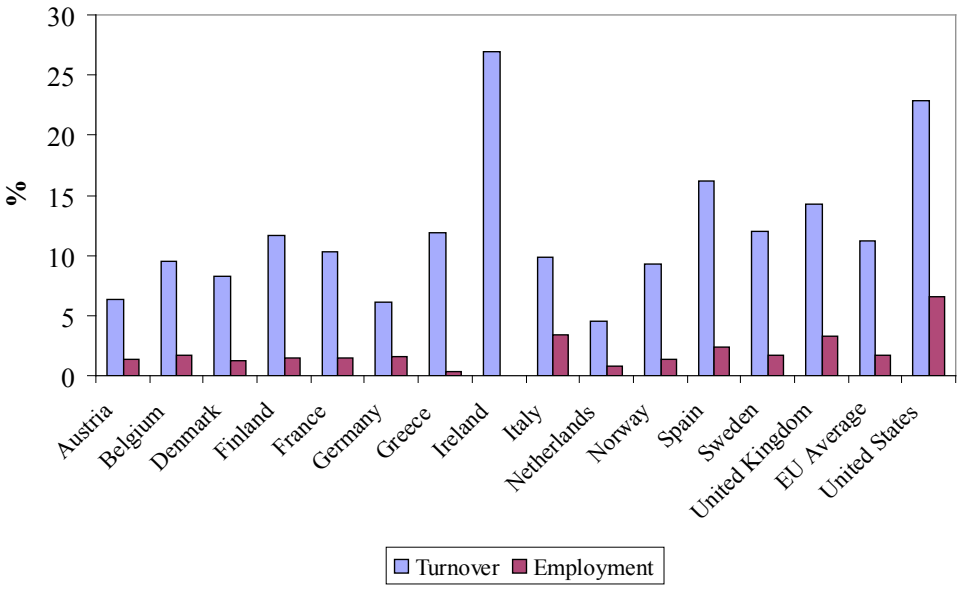
Measuring High-growth

No internationally accepted definition exists of what constitutes a high-growth firm. The literature offers several definitions inspired by the work of David Birch (Birch, 1987). This paper builds on Birch work and defines a high-growth firm as a firm with a growth rate (in either employment or turnover) higher than 60 per cent in the period from t to t+2 and a positive growth in both time periods of at least 20%. The definition is similar to Birch although the period is two years shorter due to problems in collecting panels of international comparable data.

The data comes from two databases - ORBIS and AMADEUS – provided by the electronic publishing company, Bureau van Dijk (BvD). At the moment, these databases are the best available for this paper's analysis as researchers are currently without access to register or census data in other countries. These databases have been used by several other researchers (see for example, Desai, Gompers and Lerner, 2003). The data also form the backbone of the Danish Entrepreneurship Index. All the details of the data is discussed in Hoffmann and Junge (2006).

The data clearly shows that EU countries lag behind the US in producing high-growth firms (Figure 3). Sweden performs around the EU average. The share of young firms that enters a high-growth process is about twice as high in the US as it is in the EU countries. Only Ireland produces similar high-growth rates to the US although the Irish data might be over estimating the Irish performance. While the focus here is on young firms (firms less than 5 years old in period t), the conclusion holds constant when including all firms. The results are robust changes in assumption and correction for differences industry, size and age structure across countries (Gabr, Hoffmann and Junge, 2006).

Figure 3 The Share of High-growth Firms among all new young Firms



Source: Own calculation based on Hoffmann and Junge, (2006).

Note: Appling Birch's definition to the data shows that the share of gazelles in this database is 3.2% for the time period 1999-2003, which is very similar to Birch's 3% (1995).

These data clearly highlight that Sweden like most other EU countries produces too few high-growth firms.

How good are swedish framework conditions for entrepreneurship?

Framework conditions conducive to entrepreneurship cover a wide range of areas. Everything from access to capital to a culture that motivates people to become entrepreneurs, reward entrepreneurial efforts and accept if things do not go according to plan. Turning this into policy is a challenge. How much capital is needed? What should the incentive structure be like? How are the necessary entrepreneurial skills nurtured? What is the impact of reducing entry barriers to new markets? The questions pertaining to framework conditions are endless.

No optimal method exists in answering these or related questions. However, Denmark has through several years tried to construct a concise framework for providing answers to these questions. The framework builds on the newest theory (Gabr and Hoffmann, 2006 and Hoffmann, 2006) and integrate all available international comparable indicators relating to entrepreneurship (Hoffmann *et. al*, 2005). By comparing the Swedish entrepreneurial framework conditions with

those of other OECD countries, this section provides a snapshot of Sweden as an entrepreneurial nation by answering two questions:

- How does the Swedish framework conditions compare to those of the most entrepreneurial countries?
- Are the changes in Swedish framework condition moving in the right direction vis-à-vis the top entrepreneurship countries as well as other European countries?

How does Swedish framework conditions compare to those of the most entrepreneurial countries?

The Danish Entrepreneurship Index builds on the basic assumption that entrepreneurship is created by a combination of three factors: opportunities, skilled people and capital. Opportunities are the ideas that create genuine value in the minds of other people, and they are essential for starting and growing businesses (European Commission, 2002 and Davidson, 1989). Skills not only entail basic industry knowledge required to succeed in a competitive environment, but also the ability to seize entrepreneurial opportunities (Reynolds, Hay and Camp, 1999 and Gavron et al, 1998). Skills include the competencies of the entrepreneur and also access to other competencies within the entrepreneurial infrastructure (Lee et. al, 2000). Capital is a necessity for firm expansion and growth. Most studies on entrepreneurship highlight capital as one of the most critical factors for success (EU, 2003). Capital covers all phases of business life, from access to early seed funds to access to the stock markets.

Furthermore, a combination of opportunity, ability and capital does not necessarily lead to entrepreneurship if costs, such as opportunity cost (e.g. forgone salary and loss of health insurance) and start-up cost, outweigh potential benefits. In this event, the opportunity should not be pursued following the rationale of basic economic theory. These incentives reflect the classic market clearing condition that marginal cost must equal marginal benefit in equilibrium. The incentive structure component in the model represents the various incentives and disincentives that impact the cost-benefit balance of the opportunity.

A final component in the Entrepreneurship Index is motivation/culture. Previous work shows that the willingness to pursue entrepreneurial activities relies only partly on the economic factors described above (Davidson, 1989). Personal motivation plays a decisive role as it is unique and involves a complex combination of factors, such as personal traits, risk aversion and sociological circumstances determined by the national culture. This model's understanding of motivation is based on cognitive theory, which has its roots in psychology (Wood and Bandura, 1989).

Each of the five factors (skills, opportunities, capital, incentives and motivation) is affected by a series of policy areas. The Danish Index focuses on 24 policy areas, which are organised in relation to the factor they affect most based on qualitative judgement in order to communicate the results in an easily comprehensible manner (Figure 4). The 24 areas in the model should cover all policies affecting entrepreneurship, implying that any policy aimed at affecting growth by stimulating entrepreneurship should belong to one or more of the policy areas. Various aggregation and dis-aggregation of the 24 policy areas can decrease or increase the number of policy areas. The organisation of factors does not play any role in the analytical results as each policy area is analysed independently of the other areas. A full description of the policy areas is given in Gabr and Hoffmann (2006) and EBST (2005).

Figure 4 Overview of the Main Policy Areas at the Micro-level

Total measure of the business environment to entrepreneurship				
Opportunities	Capital	Ability	Incentives	Motivation/culture
Entry barriers/ deregulations	Loans	Trad. business education	Personal income tax	Entrepreneurial motivation
Access to foreign markets	Wealth and bequest tax	Entrepreneurship education	Business tax & fiscal incentive	Initiatives towards specific groups
Technology transfer	Business angels	Restart possibilities	Social security discrimination	Communication about heroes
Private demand factors	Venture capital	Entrepreneurship infrastructure (public)	Administrative burdens	
Procurement regulation	Capital taxes	Entrepreneurship infrastructure (private)	Labour market regulations	
	Stock markets		Bankruptcy legislation	

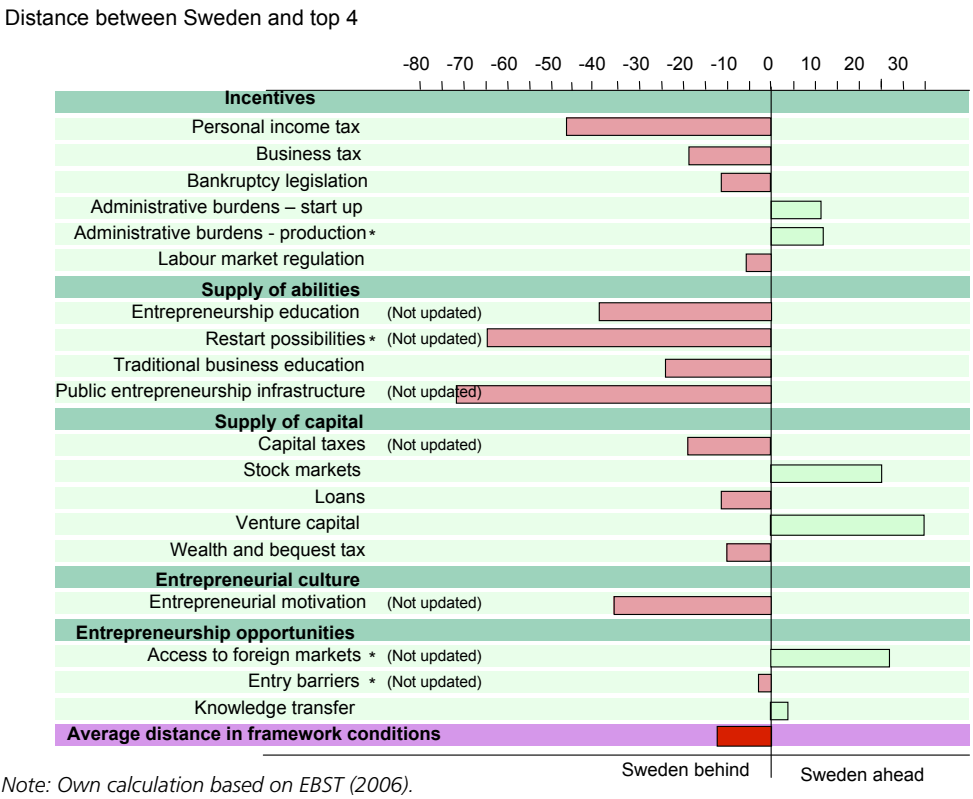
Not all policy areas can be quantified, but a quality assessment of available indicators has highlighted 61 indicators, which can be used to quantify 18 of the policy areas (Annex 2). Normalised composite indicators are calculated for each country for the 18 policy areas.

Four countries (Canada, Finland, Korea and the US) seem to have superior performance in terms of entrepreneurship according to the performance indicators

presented in the previous section and the analysis presented in Hoffmann 2006. Comparing Sweden's business environment for entrepreneurship to average business environment in the four top performing countries shows large differences (Figure 5). The numbers are normalised so the best performing country is assigned value of 100 and the worst performing country is assigned a value of 0.

A more detailed look shows that Sweden trails the four best countries on 13 policy areas, whereas the business environment is superior to the top performing countries in 5 policy areas (Figure 5). The largest problems are in taxation, entrepreneurship education, bankruptcy legislation, public advice system and entrepreneurship motivation. Sweden's bankruptcy legislation does for example provide the worse conditions in the OECD for restarting a business after bankruptcy. The good performing areas relate to equity financing and administrative burdens.

Figure 5 Benchmarking Sweden's Business Environment for Entrepreneurship

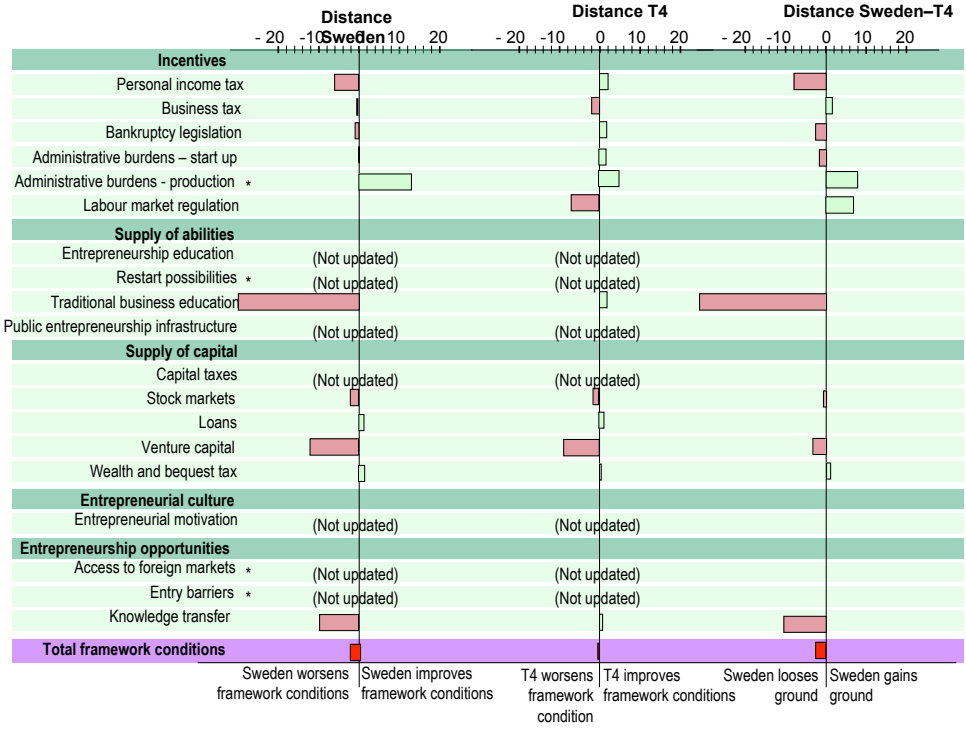


Note: Own calculation based on EBST (2006).

Changes in the Swedish framework conditions

The Swedish business environment is falling further behind the top performing countries (Figure 6). A comparison with the older indicators shows that the business environment in Sweden is getting less entrepreneurship friendly over time and that the distance to the top-performing countries therefore is increasing. The reduction is the traditional business sector education does however seem too large and must be due to problems in the underlying data.

Figure 6 **Changes in the Sweden business environment compared to top-4**



The conclusion for the policies seems rather straight forward. Sweden is far behind and is loosing ground. Reforms are needed, but where?

What should Sweden do?

A simple conclusion as to the prioritisation of resources would be to highlight policy areas where Sweden trails the top-4 and are not catching-up. However, it is possible to refine the analysis. Not all of the selected policy areas are equally important to entrepreneurship performances. A range of methods have been developed to show the relative importance of the various policy areas. Methods are still being developed, and any meaningful break down of policy areas

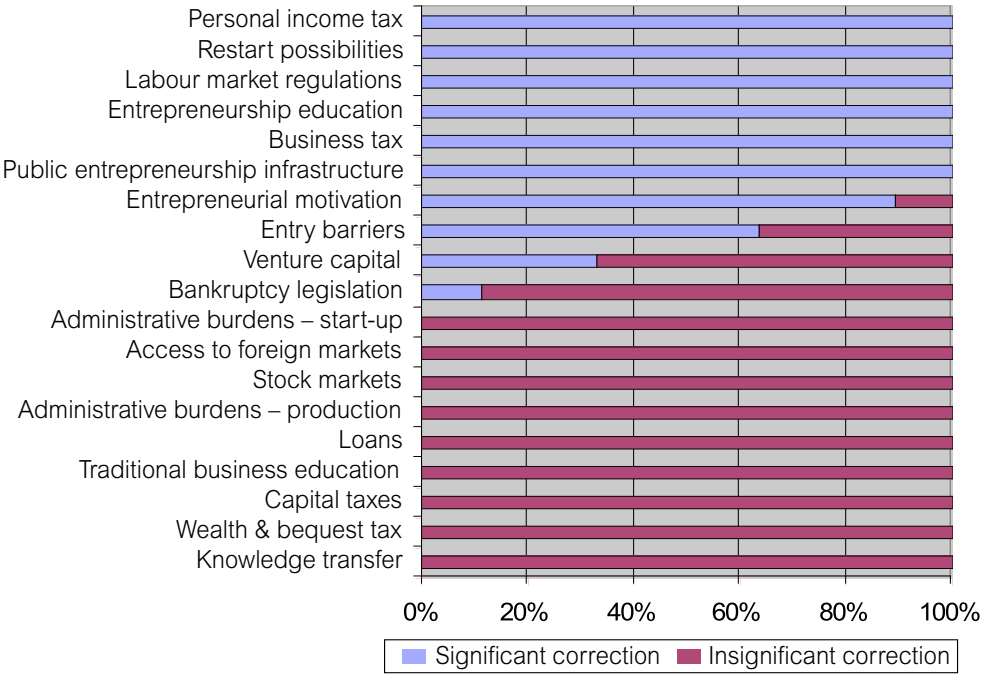
should be supplemented by qualitative assessments and the inclusion of various entrepreneurship studies.

Hoffmann (2006) applies a method that divides policy areas into four separate boxes. A high correlation between policy area indicators and entrepreneurship activity implies that the policy in question is highly important to entrepreneurship activity. If the top-performing countries have particularly strong framework conditions in specific policy areas it is taken as an indication that the policy area(s) in questions are highly important.

Using correlation analysis to determine relative importance

The correlation between performance and a policy indicator depends on the weights assigned to each indicator in each policy area. Instead of assuming a given weighting scheme, this analysis is based on a Monte Carlo Simulation, where weights are allowed to vary between 0 and 1 for each indicator. The simulation was then repeated 10 000 times. This calculation shows a very stable result for 15 areas (Figure 7).

Figure 7 **The share of outcome with significant and insignificant correlation with performance**



Source: Own calculation based on EBST (2006).

Note: Figure shows the share of times that the correlation between a given policy area and performance was significantly different from zero at the 5 per cent level. The weights for the underlying indicators were allowed to vary between zero and one.

Six areas (personal income tax, restart possibilities, labor market regulation, entrepreneurship education, business taxes and public infrastructure) are significantly correlated to the performance indicators in more than 99 per cent of the simulations. This implies that weights do not play a role in the correlation. Regardless of weights these areas are positively correlated with performance. The additional sensitivity – were countries are removed one at a time – shows that the result for public infrastructure is very sensible to the inclusion of Ireland.

Eight areas (technology transfer, wealth and bequest tax, capital taxes, traditional business education, access to foreign markets, loans, administrative burdens and stock markets) are always insignificantly correlated with performance regardless of weight used. The four remaining areas remain more or less undetermined.

Using benchmarking techniques to determine relative importance

Highly prioritised policy areas in the top performing countries could potentially be more important to performance than others. A simple method based on the average ranking of the top-performing countries is used to divide the policy areas into important and not important areas.

Table 1 Top-4 countries' prioritisation of policy areas

Policy areas	Rank of the average value of the top-4 countries
Knowledge transfer	8.3
Entry barriers	7.5
Access to foreign markets	12.5
Loans	8.5
Venture capital	8.0
Stock markets	9.3
Wealth & bequest tax	11.5
Capital taxes	14.3
Restart possibilities	7.3
Entrepreneurship education	3.0
Traditional business education	9.3
Public entrepreneurship Infrastructure	4.7
Personal income tax	6.3
Business tax	5.8
Bankruptcy legislation	7.8
Administrative burdens - start-up	10.0
Administrative burdens – production	9.5
Labour market regulation	7.8
Entrepreneurial motivation	4.7

The US has the best business environment for entrepreneurship followed by the UK, Canada, Ireland and Korea. The four top-performing countries consequently

have the most conducive business environment for entrepreneurship. The ranking of the four top-performing varies among the policy areas. The lowest average rank is in the area of capital taxes, where the average value of the top-4 countries is equal to countries ranking in the middle of the 30 OECD countries. The highest rank is in entrepreneurship education, where the average of the top-4 countries equals the 3-highest ranked country.

Across all policy areas the top-4 countries rank around 8. Policy areas with a higher rank than 8 are assumed to be higher prioritized than the other areas. Eight policy areas (entry barriers, Entrepreneurship education, Public entrepreneurship Infrastructure, Personal income tax, Business tax, Bankruptcy legislation, Labour market regulation and Entrepreneurial motivation) have higher ranks (Table 1).

Bringing the analysis together

Each of the two methods above highlighted some areas that seem more important than others for performance. Seven areas, entrepreneurship education, business taxes, restart possibilities, personal income taxes, culture/motivation, labour market regulation and entry barriers, are high-priority areas and are highly correlated. This suggests that these seven areas are particularly important to entrepreneurial performance.

Table 2 Which policy areas should Sweden improve?

Selecting important policy areas		
	Low correlation with performance	Significantly correlated with performance
High priority among top-4	***Government programs*** Bankruptcy legislation	***Entrepreneurship education*** ***Business tax*** ***Restart possibilities*** ***Personal income tax*** ***Culture/motivation*** Labour market regulation Entry barriers
Low priority among top-4	Stock markets ***Capital taxes*** ***Trad. business education*** Loan capital Venture capital Administrative burdens Wealth- and bequest tax Access to foreign markets Knowledge transfer	

Note: The policy areas are ranked by applying two criteria: i) The boxes on the right hand side are all significantly correlated with performance indicators at a 5 percent level, ii) The top hand boxes are highly prioritised among the top-4 countries, i.e. the average value for the top-4 are is higher than the average for all framework conditions among the top-4 countries.

The colours illustrate differences between the Swedish framework conditions and the top-4. A green colour indicates that Sweden's framework conditions are superior, yellow shows Sweden trailing by 10 to 20 percent, while the colour red shows areas where Sweden trails the top-4 by more than 20 percent.

Source: own calculations based on EBST (2006).

Sweden is lacking far behind the top-4 countries in five of the seven critical policy areas and Sweden is also behind on the last two although the distance to the best is smaller (Table 2 and Figure 5).

Sweden does only have five areas were they have a business areas, which is comparable to the best countries. These areas do seem to be less important for performance.

A quality evaluation of the data suggests that most of the important policy areas are measured by accurate indictors, with the exception of taxation where not all aspects were adequately covered (Hoffmann et al, 2005). Furthermore, additional analyses are needed in the area of entrepreneurship education before policies can be suggested. Thematic studies confirm the results of this analysis and show large differences in the emphasis put on entrepreneurship teaching and attitudes in European and US universities (EBST, 2005).

Conclusion

Entrepreneurship is assumed to be a key driver of knowledge based growth. This present a considerable challenge for Sweden, as Sweden is lacking in both dimensions of entrepreneurship performance: the *start-up rates* and *share of new firms with high growth* are low. The analysis of their business environment also shows deep-seated problems. Sweden only has five policy areas which quality can be compared to the top performing countries. All of these policy areas seem to be less important for performance. Sweden is way behind the top-4 countries (Canada, Ireland, the US, Korea) on all seven policy areas that were found to be significant for performance.

The low entrepreneurial performance in Sweden is in light of the new theories of knowledge filters especially worrying. Sweden has some of the highest investments in R&D in the OECD and some of the worst entrepreneurship performance. If the new theories are right then Sweden can dramatically improve its return on R&D investment by stimulating entrepreneurship.

The current policy focus in Sweden has to be broadened in order to improve the situation. Currently, Sweden focuses on culture changing initiatives. These

initiatives might improve the situation but the analysis presented in this paper suggests that Sweden also should examine restart possibilities, entry barriers, taxation and labour market regulation. A note of caution should be added. Sweden will have to figure our how to improve in these areas based on the functioning of its economy. Sweden can get inspiration from top-performing countries, but the initiatives have to be tailored for the Swedish context.

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Annex 1 Data Description

This annex presents a recapitulative table giving a broad overview of the indicators used to define the framework conditions of the business environment. The indicators marked by a * is significant corralled with the performance indicators.

Table A1 Indicators of Framework Conditions

Factors	Policy area	Indicator Source & Internet link
Opportunities	Tech-transfer Regulation	
		University/industry research collaboration WEF: The Global Competitiveness Report **Technological cooperation** IMD, World Competitiveness Yearbook
	Entry Barriers	
		Barriers to competition - OECD-index OECD,Summary indicators of product market regulation with an extension to employment protection legislation, p. 25 og 75 http://www.olis.oecd.org/olis/1999doc.nsf/c16431e1b3f24c0ac12569fa005d1d99/5ef586bbe13dd52ac125684a003a8da0/$FILE/00075836.PDF **Public ownership - OECD-index** OECD,Summary indicators of product market regulation with an extension to employment protection legislation, p. 25 og 74 http://www.olis.oecd.org/olis/1999doc.nsf/c16431e1b3f24c0ac12569fa005d1d99/5ef586bbe13dd52ac125684a003a8da0/$FILE/00075836.PDF **Public involvement in business operation** OECD,Summary indicators of product market regulation with an extension to employment protection legislation, p. 25 og 74 http://www.olis.oecd.org/olis/1999doc.nsf/c16431e1b3f24c0ac12569fa005d1d99/5ef586bbe13dd52ac125684a003a8da0/$FILE/00075836.PDF
	Access to Foreign Markets	
		Share of new enterprises with exports* FORA **Access to capital markets** IMD, World Competitiveness Yearbook **Export credits and insurance** IMD, World Competitiveness Yearbook

Capital	**Loans**	
	Extent of guarantees EU Commission. p.38 http://europa.eu.int/comm/enterprise/enterprise_policy/analysis/doc/smes_observatory_2003_report2_en.pdf	
	Private credit The World Bank, Doing Business http://rru.worldbank.org/DoingBusiness/ExploreTopics/	
	Interest rate spread The World Bank, Doing Business	
	Cost to Create Collateral The World Bank, Doing Business http://rru.worldbank.org/DoingBusiness/ExploreTopics/	
	Legal Rights Index The World Bank, Doing Business	
	Country credit rating IMD, World Competitiveness Yearbook	
	Venture Capital	
	Venture capital (early stage) OECD, Science, technology and industry. Venture capital: trends and policy recommendations, p.7. http://www.oecd.org/dataoecd/4/11/28881195.pdf	
	Venture capital (expansion stage) * OECD, Science, technology and industry. Venture capital: trends and policy recommendations, p.7. http://www.oecd.org/dataoecd/4/11/28881195.pdf	
	Exit	
	Capitalisation of secondary stock markets* OECD, Science, technology and industry. Venture capital: trends and policy recommendations, p.25 http://www.oecd.org/dataoecd/4/11/28881195.pdf	
	Market capitalization of newly listed companies relative to GDP World Federation of Exchanges, Annual report and statistics 2004 http://www.world-exchanges.org/publications/WFE%202004%20Annual%20Report%20and%20Statistics.pdf	
	Capitalisation of primary stock market The world Bank http://www.worldbank.org/research/projects/finstructure/structure_database.xls	
	Turnover in primary stock market The world Bank http://www.worldbank.org/research/projects/finstructure/structure_database.xls	
	Buyouts OECD, Science, technology and industry. Venture capital: trends and policy recommendations, p.7. http://www.oecd.org/dataoecd/4/11/28881195.pdf	
	Wealth and Bequest Tax	
	Revenue from bequest tax OECD 2003, Revenue Statistic	
	Revenue from net wealth tax OECD 2003, Revenue Statistic	
	Top marginal bequest tax rate OECD, Directorate for science, technology and industry, Industry issies taxation, SMEs and entrepreneuship. http://www.olis.oecd.org/olis/2002doc.nsf/43bb6130e5e86e5fc12569fa005d004c/2137ebc4eaa738a5c1256c10004e37ec/$FILE/JT00130282.PDF	
	Capital Taxes	

	Taxation of dividends – top marginal tax rate OECD, Directorate for science, technology and industry, Industry issies taxation, SMEs and entrepreneuship. http://www.olis.oecd.org/olis/2002doc.nsf/43bb6130e5e86e5fc12569fa005d004c/2137ebc4eaa738a5c1256c10004e37ec/$FILE/JT00130282.PDF **Taxation of dividends – top marginal tax rate for the self-employed*** OECD, Directorate for science, technology and industry, Industry issies taxation, SMEs and entrepreneuship. http://www.olis.oecd.org/olis/2002doc.nsf/43bb6130e5e86e5fc12569fa005d004c/2137ebc4eaa738a5c1256c10004e37ec/$FILE/JT00130282.PDF **Taxation of stock options** Eurostat, Competitiveness and benchmarking enterprise policy results from the 2002 scoreboard. http://europa.eu.int/comm/enterprise/enterprise_policy/better_environment/doc/enterprise_policy_scoreboard_2002_en.pdf **Taxation of capital gains on shares – short term** OECD, Directorate for science, technology and industry, Industry issies taxation, SMEs and entrepreneuship. http://www.olis.oecd.org/olis/2002doc.nsf/43bb6130e5e86e5fc12569fa005d004c/2137ebc4eaa738a5c1256c10004e37ec/$FILE/JT00130282.PDF **Taxation of capital gains on shares – long term** OECD, Directorate for science, technology and industry, Industry issies taxation, SMEs and entrepreneuship. http://www.olis.oecd.org/olis/2002doc.nsf/43bb6130e5e86e5fc12569fa005d004c/2137ebc4eaa738a5c1256c10004e37ec/$FILE/JT00130282.PDF
Abilities	**Restart Possibilities**
	Length of time that creditors still have claims on a bankrupt's assets * OECD, Science, Technology and industry outlook. Drivers of growth: Information. Technology, Innovation and entrepreneurship http://www1.oecd.org/publications/e-book/9201131e.pdf
	Entrepreneurship Education
	Entrepreneurship education at primary education* Global Entrepreneurship Monitor http://www.gemconsortium.org/ **Entrepreneurship education at higher education*** Global Entrepreneurship Monitor http://www.gemconsortium.org/
	Traditional Business Education
	Quality of management schools WEF: The global competitiveness report -
	Entrepreneurship Infrastructure
	Government programs Global Entrepreneurship Monitor http://www.gemconsortium.org/
Incentives	**Personal Income Tax**
	Highest marginal income tax plus social contributions* OECD, Taxing Wages 2011- 2002. http://emlab.berkeley.edu/users/webfac/saez/e230b_s04/OECD01_02taxingwages.pdf **Average income tax plus social contributions*** OECD, Taxing Wages 2011- 2002. http://emlab.berkeley.edu/users/webfac/saez/e230b_s04/OECD01_02taxingwages.pdf
	Business Tax and Fiscal Incentive

SME tax rates*
OECD, Directorate for science, technology and industry, Industry issies taxation, SMEs and entrepreneuship.
http://www.olis.oecd.org/olis/2002doc.nsf/43bb6130e5e86e5fc12569fa005d004c/2137ebc4eaa738a5c1256c10004e37ec/$FILE/JT00130282.PDF

Taxation of corporate income revenue
OECD 2003, Revenue Statistic 1965- 2002

Bankruptcy Legislation

Actual cost to close a business
The World Bank, Doing Business
http://rru.worldbank.org/DoingBusiness/ExploreTopics/ClosingBusiness/CompareAll.aspx

Actual time to close a business
The World Bank, Doing Business
http://rru.worldbank.org/DoingBusiness/ExploreTopics/ClosingBusiness/CompareAll.aspx

Administrative Burdens

Starting a business number of procedures
The World Bank, Doing Business
http://rru.worldbank.org/DoingBusiness/ExploreTopics/StartingBusiness/CompareAll.aspx

Starting a business number of days
The World Bank, Doing Business
http://rru.worldbank.org/DoingBusiness/ExploreTopics/StartingBusiness/CompareAll.aspx

Starting a business cost
The World Bank, Doing Business
http://rru.worldbank.org/DoingBusiness/ExploreTopics/StartingBusiness/CompareAll.aspx

Regulatory and administrative opacity
OECD,Summary indicators of product market regulation with an extension to employment protection legislation, p. 25 og 75
http://www.olis.oecd.org/olis/1999doc.nsf/c16431e1b3f24c0ac12569fa005d1d99/5ef586bbe13dd52ac125684a003a8da0/$FILE/00075836.PDF

Enforcing contracts - number of procedures
The World Bank, Doing Business
http://rru.worldbank.org/DoingBusiness/ExploreTopics/EnforcingContracts/CompareAll.aspx

Enforcing contracts time
The World Bank, Doing Business
http://rru.worldbank.org/DoingBusiness/ExploreTopics/EnforcingContracts/CompareAll.aspx

Enforcing contracts procedure complexity
The World Bank, Doing Business
http://www.doingbusiness.org/ExploreTopics/EnforcingContracts/CompareAll.aspx

Starting a business - minimum of capital required
The World Bank, Doing Business

Enforcing Contracts - Cost (% of debts)
The World Bank

Labour Market Regulation

Flexibility of hiring
The World Bank, Doing Business
http://rru.worldbank.org/DoingBusiness/ExploreTopics/HiringFiringWorkers/CompareAll.aspx

Flexibility of firing*
The World Bank, Doing Business
http://rru.worldbank.org/DoingBusiness/ExploreTopics/HiringFiringWorkers/CompareAll.aspx

Rigidity of Hours*
The World Bank, Doing Business
http://rru.worldbank.org/DoingBusiness/ExploreTopics/HiringFiringWorkers/CompareAll.aspx

Number of administrative procedures when recruiting first employee
EU

Number of administrative procedures when recruiting additional employee
EU

Firing Costs*
The World Bank, Doing Business

Motivation

Motivation

Cultural and social norms*
Global Entrepreneurship Monitor
Schøtt, Thomas (2005B). Iværksætterkulturen i Danmark og andre lande
http://www.sam.sdu.dk/~tsc/CESFOkultur1.doc.

Entrepreneurial motivation
Global Entrepreneurship Monitor
Schøtt, Thomas (2005B). Iværksætterkulturen i Danmark og andre lande
http://www.sam.sdu.dk/~tsc/CESFOkultur1.doc.

Selfemployment preferness*
Eurobarometer
http://europa.eu.int/comm/public_opinion/flash/fl160_en.pdf

The wish to own one's own business
Eurobarometer
http://europa.eu.int/comm/public_opinion/flash/fl160_en.pdf

Desirability of becoming selfemployed*
Eurobarometer
http://europa.eu.int/comm/public_opinion/flash/fl160_en.pdf

Attitude towards risk*
Eurobarometer
http://europa.eu.int/comm/public_opinion/flash/fl160_en.pdf

Globalisation and Productivity

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Introduction

The current phase of globalisation is characterized by the globalisation of value chains as production processes are increasingly becoming geographically fragmented. ICT-technologies have made it possible to slice up the value chain and perform activities that previously had to be executed at the same place in any location that can help to reduce costs. Intermediate and final production can be outsourced abroad, giving rise to increased trade through exports and imports. Moreover, the development of global value chains has made trade and FDI increasingly interdependent, as production has become more fragmented across borders and import and export flows of intermediates have grown in size.

Several empirical trends in trade and FDI characterize these trends: a decline in the 'production depth' in favour of a larger use of intermediates, manufacturing exports and imports of individual countries are increasingly moving together and are growing faster than production, much manufacturing trade occurs within the same industry or even within a firm and this intra-industry trade has become more vertical, international sourcing within economies has grown rapidly as evidenced by the increasing share of imported intermediate inputs in production.

The growth of international outsourcing involves the sourcing of inputs internationally through arms-length relationships as well as within firms. Within this global value chain, multinational firms play a prominent role as they have a global reach that allows them to coordinate production and distribution across many countries and shift their activities depending on changing demand and cost conditions. Corresponding to the strong increase of FDI, foreign affiliates have become increasingly important in host countries where they account for a growing part of turnover, value added and employment. Cross border trade between multinational companies and their affiliates, often referred to as intra-firm trade, accounts for a large share of international trade in goods.

Not all manufacturing industries are affected to the same extent by economic global integration. High technology products, in particular, have become more complex and companies increasingly source some components from other firms. What is new is the rapid globalisation in services. Technological progress in ICT, together with the ongoing liberalization of trade and investment in services, have increased the tradability of many services and created new kinds of tradable services: IT support, R&D functions, back office functions, call centres and software programming. Like China in manufacturing, India has increased very fast its market share in software and IT-enabled service.

The global engagement of firms is in general thought to be positively related to productivity performance. Numerous studies have documented that internationally engaged firms, e.g. through exporting or importing and/or having affiliates abroad, tend to have higher productivity. Foreign affiliates make also an important contribution to labour productivity growth in host countries. Apart from the direct impact of foreign affiliates on productivity growth, the presence of foreign affiliates may also put pressure on domestic firms to enhance their performance.

The overall economic performance, however, depends upon the flexibility and resilience of the economy in the structual adjustment to changing comparative advantage occuring with globalisation. Globalisation of value chains has several impacts on economic performance, affecting employment, productivity growth, prices and wages, and these impacts may vary across activities, regions and different social groups. Increasing international integration invariably leads to winners and losers because of the changing allocation of production and value added. It is thus imperative for national economy to swiftly make use of dislocated resources in more productive activities and minimise transition costs, in order to attain full benefit of globalisation in terms of economy-wide productivity growth. Prolonged transiton might also lead to social and political opposition to rapid economic integration, driven by the distributional impacts of changes in the pattern of production.

The remainder of this paper is organized as follows. In the next section, Section 2, we overview recent growth of global value chains. In Section 3, we present empirical evidences for the widely shared view that the global engagement of firms is in general positively related to productivity performance. In section 4, we examine preceding studies on a decomposition of productivity growth and extract implication on bridging micro-level (i.e. firm- or establishment-level) productivity and economy-wide performance. Finally, in Section 5, we summarize our results and discuss the policy implication of our findings.

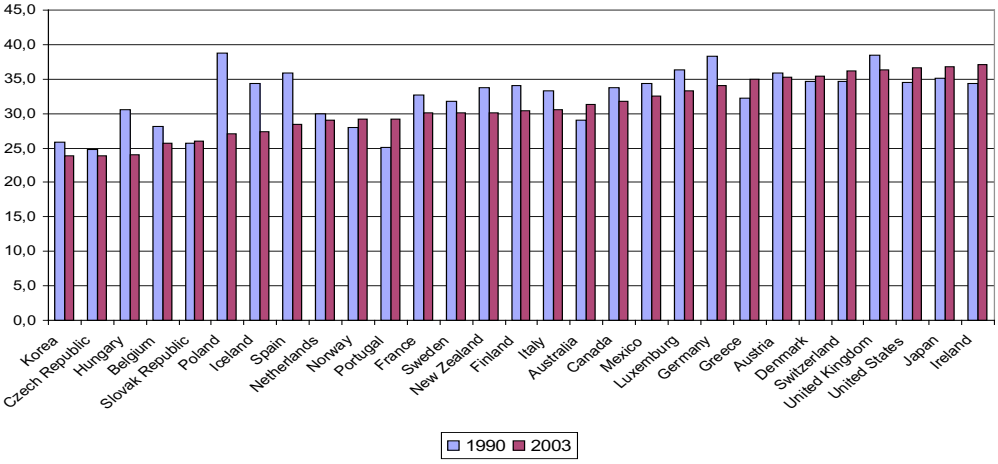
Globalisation of Value Chains

Growth of global value chains and offshoring

Despite common perceptions that global value chains and offshoring have become much more important, it is difficult to quantify exactly their extent, as information on how much of the production process of companies is shifting abroad is not readily available. Several empirical trends in trade and FDI characterize however the increasing importance of the globalisation of value chains in a more indirect manner:

Firstly, a decline in the'production depth'in favour of a larger use of intermediates is observed in most OECD countries as the share of manufacturing value added in production is decreasing (Figure 1). In Australia, Ireland, Japan, Norway, Portugal, Switzerland and the US, the value added per unit of output increased however. This change in the ratio of value added to production is the direct result of a greater use of intermediate inputs in the production process, and can be due to outsourcing, be it domestically (for example from manufacturing to services sectors, see below) or internationally.

Figure 1 **Production depth (value added over production in %), 1990 and 2003**

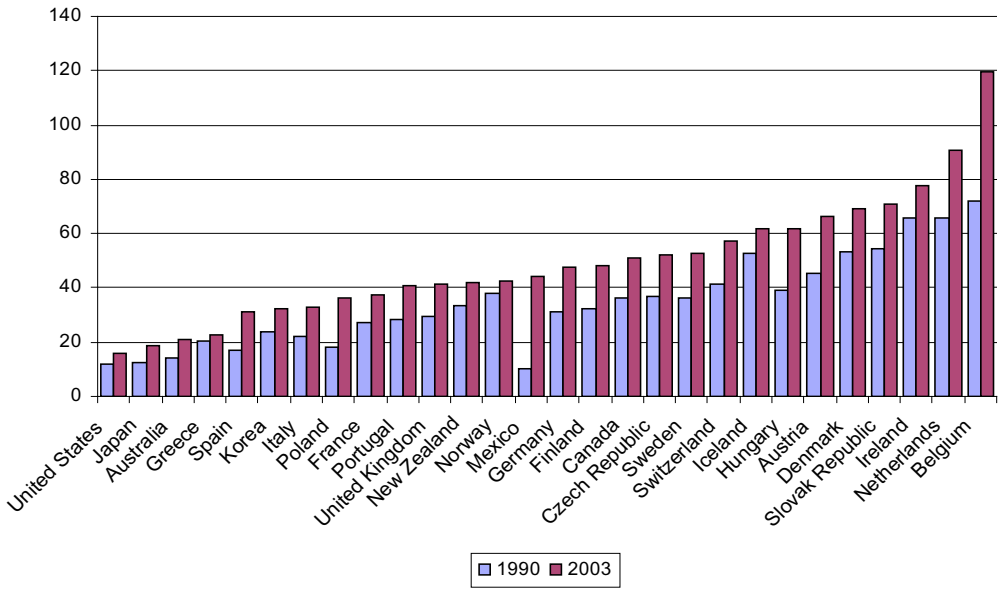


Note: Australia: 1990 and 1999; Canada Switzerland, Spain, Ireland, Iceland, Sweden: 1990 and 2002; Czech Republic: 1993 and 2003; Germany: 1991and 2003; Greece: 1995 and 2003; Hungary: 1992 and 2003; Korea: 1994 and 2003; New Zealand: 1993 and 2001; Poland: 1992 and 2002; Slovak Republic: 1997 and 2001.

Source: OECD STAN Database.

Secondly, manufacturing exports and imports of individual countries are increasingly moving together and are growing faster than production, indicating that international interactions through trade between countries are growing very rapidly (Figure 2). This observation is consistent with the growing vertical integration of production as international production sharing results in (parts of) products be manufactured in one country, and then exported to (imported by) other countries.Very high growth in exports and imports was recently recorded in Mexico, Hungary, Poland and some other countries that have been increasingly integrated in the global economy. Moreover, in most OECD countries the value of exports and imports is substantially larger than the value added in export industries, also indirectly suggesting the increasing slicing up of the value chain. The high export/production ratios of Belgium and Netherlands are due to re-exports as these countries following the importance of the distribution and trade sector. Recent research indicates that 40% of total exports in the Netherlands should be considered as re-exports (i.e. the re-export of imported goods without being significantly processed).

Figure 2 Share of exports in manufacturing production



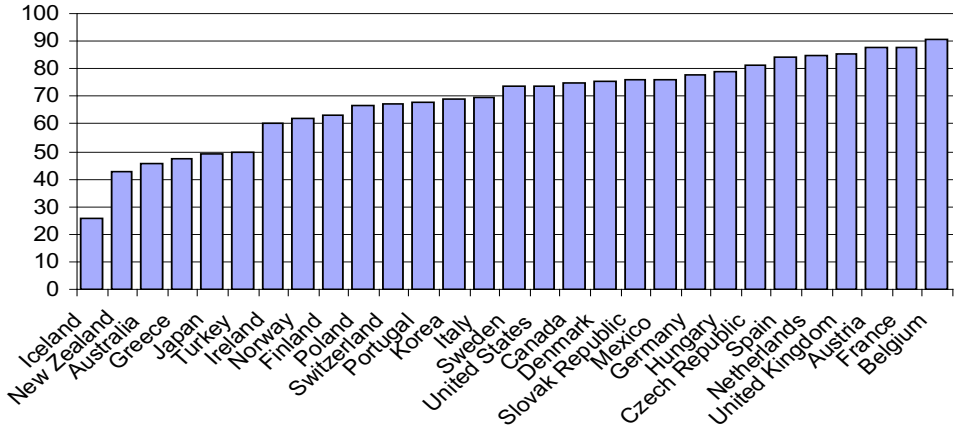
Note: Australia: 1990 and 1999; Canada Switzerland, Spain, Ireland, Iceland, Sweden: 1990 and 2002; Czech Republic: 1993 and 2003; Germany: 1991and 2003; Greece: 1995 and 2003; Hungary: 1992 and 2003; Korea: 1994 and 2003; New Zealand: 1993 and 2001; Poland: 1992 and 2002; Slovak Republic: 1997 and 2001.

Source: OECD STAN Database.

Thirdly, much manufacturing trade occurs within the same industry or even within a firm, resulting from the integration of manufacturing production throughout the value chain. Such simultaneous exports and imports within the same industry are generally labelled as intra-industry trade. It typically occurs among rich countries with similar levels of development which are geographically close, and is often regarded as a corollary of smooth economic integration.

But intra-industry trade is becoming increasingly vertical in nature, indicating that it increasingly involves the trade in goods of different quality, including the trade in intermediate goods at various stages of production. Vertical specialization of production across countries is mainly driven by comparative advantage for example, the use of cheap unskilled labour for assembly purposes or of specialized personnel for research and development.

Figure 3 **Manufacturing intra-industry trade as a percentage of total manufacturing trade, average 1996-2003**



Note: The extent of intra-industry trade is commonly measured by the Grubel-Lloyd index. This index takes the minimum value of zero when there are no products in the same class that are both imported and exported, and the maximum value of 100 when all trade is intra-industry. For the industry i of a country k with the rest of the world, this index is:

$$IIT^k = \left[1 - \frac{\sum_i \left|\left(X_i^k - M_i^k\right)\right|}{\sum_i \left(X_i^k + M_i^k\right)}\right] \bullet 100$$

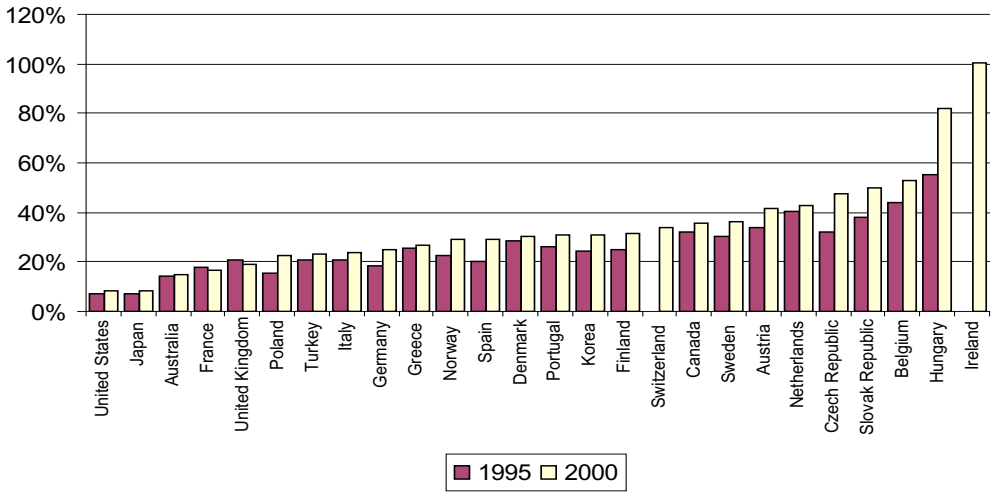
Source: OECD STAN Database.

Finally, the international sourcing within economies has grown rapidly as evidenced by the increasing share of imported intermediate inputs in production, information which can be derived from input-output tables. The information in

I/O-tables provides excellent information as a substantial part of these I/O tables covers imported intermediates, showing the value of intermediate goods and services that have been imported from outside the country. A key advantage of using I/O tables is to avoid the (sometimes arbitrariness of) classification schemes that divide goods into intermediate and other categories. Input-output tables do not have this problem, because they classify the use (as an input into another sector's production or as final demand) of each sector's input. Another advantage is that the tables include services sectors.

The international production sharing has resulted in ever growing volumes of intermediate inputs being exchanged between different countries at different stages of the manufacturing process. This growth in international sourcing reflects the organization of production processes on an increasing global scale, and is consistent with the increase in FDI flows. Figure 4 shows the average ratios for the total economy of imported to domestic sourcing of inputs for the mid-1990s and 2000. Except for France and the United Kingdom, the ratio of imported to domestic input has increased in all countries, showing the growing importance of intermediate inputs in international trade and the increasing importance of international outsourcing (through arms-length contracts or within multinational firms).

Figure 4 **Ratio of imported to domestic outsourcing of inputs (in %), 1995 and 2000**



Source: OECD, Input-Output Tables Database

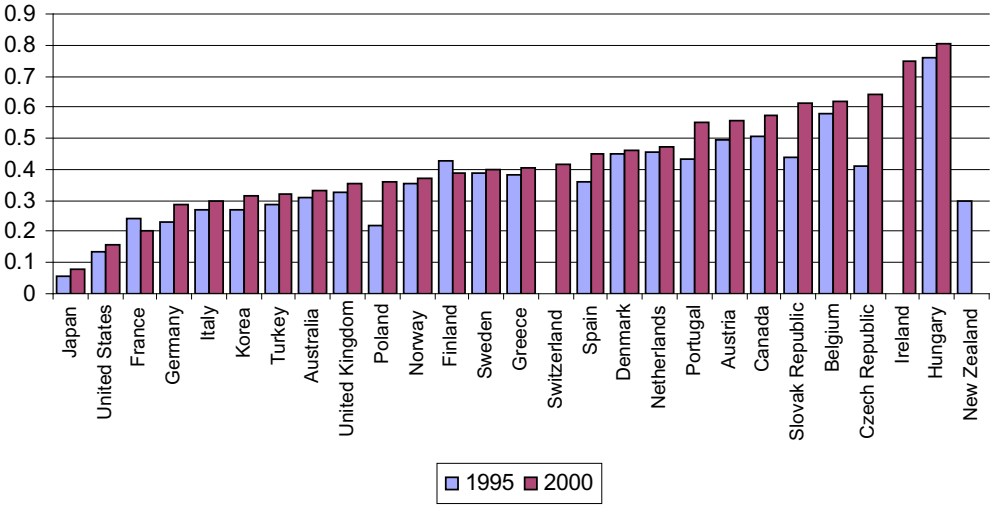
International outsourcing has often been empirically measured by the so-called Feenstra and Hanson outsourcing indicator (1996, 1999). They estimate offshore outsourcing as the share of imported intermediate inputs over total costs, which for each industry i can be written as

$$Outsourcing_i = \sum_j \left(\frac{X_i^j}{Y_i} \right) \left(\frac{M_j}{D_j} \right)$$

where X_i^j is input purchases of good *j* by industry *i*, Y_i is total non-energy input used by industry *i*, M_j is import of good *j*, and D_j is the domestic demand of good *j*. Based on this measure they also calculate a "narrow" measure of outsourcing by restricting attention to those inputs that are purchased from the same industry as that in which the good is being produced. Evidence on this 'broad' measure shows that offshoring has increased in all OECD countries (Figure 5 and 6). Smaller countries typically report higher international outsourcing indicators, notably Ireland, Belgium and Hungary. Japan and the US are found to offshore relatively little compared with other countries.

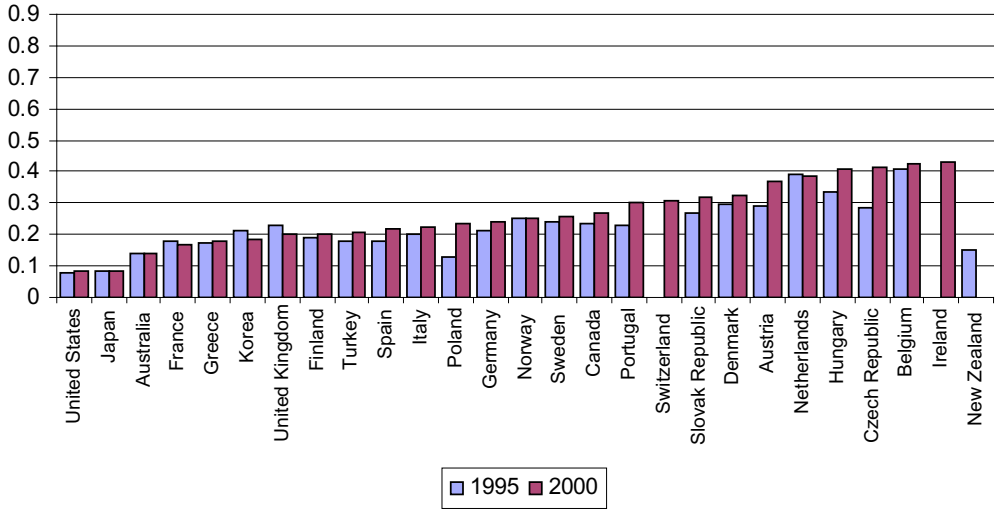
International outsourcing of intermediates is more prominent in higher technology industries than in lower technology industries (higher technology industries are defined as high and medium-high technology industries, while lower technology industries are defined as medium-low and low technology industries). In most OECD countries the international outsourcing indicator is higher in the group of higher technology industries than in the group of lower technology industries. Further on, comparing 2000 to 1995, it becomes clear that international outsourcing of intermediates has increased stronger in higher technology industries in most OECD countries (Figure 5 and 6).

Figure 5 **International outsourcing indicator, high technology manufacturing, 1995 and 2000**



Source: OECD, Input-Output Tables Database.

Figure 6 **International outsourcing indicator, low technology manufacturing, 1995 and 2000**



Source: OECD, Input-output tables

Productivity Gain of Globalisation

Positive effects of offshoring on productivity

Globalisation of activities and global engagement of firms are in general thought to be positively related to productivity performance. Numerous studies have documented that internationally engaged firms through exporting/importing and/or having affiliates abroad has positive performance characteristics. Exporting plants are found to be more productive, have a larger size and greater capital intensity, while multinational firms are reported to pay also higher wages and to be more innovative. Offshoring of activities is one specific form of global engagement and is likewise expected to have positive effects on firm productivity.

The impacts can be several. First, offshoring of less efficient or costly activities to other, more efficient and low-cost producers, could help firms specialise and focus on their core competences and could lead to significant productivity gains. Second, firms might be pressured to increase efficiency and innovative activities if they operate in a globally competitive market. For example, an OECD study based on firm-level evidence found that firms exposed to international competition through trade or FDI were more likely to adopt information and communications technology than firms that operated in a more sheltered environment. Such pressure could arise from engaging in exporting activities, by being in a market with significant imports, or by being exposed to activities of foreign affiliates of multinational enterprises.

The offshoring of services may have wider impacts than manufacturing offshoring since services are intermediate inputs to the production of goods and services. Here offshoring firms derive gains from two sources – lower costs of each input and a broader variety of inputs (see Appendix for simple model of productivity gain from service offshoring). Further on, global outsourcing in services will increase competition in services markets and shifting resources to more efficient use, resulting in higher productivity. The size of these positive effects is directly related to the increasing importance of the service sector to GDP in many advanced countries.

The evidence on the productivity impacts of globalisation emerge from a wide range of studies. Mann (2005) computed specifically the productivity increases of IT offshoring for the US. Offshoring in the IT industry led to an annual increase in productivity of 0.3% for the period 1995 to 2002 which translates into a cumulative effect of $230 billion in additional GDP. The offshoring of IT services resulted in lower prices for customized software and services and because of the

high price elasticity of demand, these lower prices led to an enhanced IT use in most industries and aggregate productivity growth.

The empirical evidence generally supports the theoretical insight that productivity benefits from offshoring, especially from the offshoring in services. This may be explained by the fact that material outsourcing is generally of a much larger magnitude than services outsourcing, and gains to such activities could therefore already be close to its optimum level. Offshore outsourcing of services, on the other hand, is growing from a much smaller level.

Plant-level estimates for Ireland (Görg and Hanley, 2003) and to some extent the United Kingdom (Girma and Görg, 2004) show indeed little evidence of a productivity impact from material offshore outsourcing in the electronics manufacturing industries. In contrast, Görzig and Stephan (2002); Görg and Hanley (2004) and Criscuolo and Leaver (2005) all provide evidence of a positive productivity impact of services outsourcing at the plant level. Amiti and Wei (2006) find also that service offshoring has a positive impact on productivity in the US as it accounts for around 11% of labour productivity growth; the positive effects for material offshoring are found to be less supportive.

Further on, the positive effect appears to be shaped by the global engagement of firms but the results appear rather mixed and seem to contradict each other to some extent. Criscuolo and Leaver for the United Kingdom found that firms that were only engaged in global transactions through offshoring experienced larger impacts of offshoring on productivity than firms that were already globally engaged through exporting or multinational links. Girma and Görg found however that foreign ownership re-enforces the effects of outsourcing (of materials and services combined) on productivity. Similarly, Görg et al. find that the productivity effects of material offshore outsourcing are of a similar positive magnitude regardless of whether the plant is foreign or domestically owned (as long as it is an exporting company) but that there is no productivity impact if the plant only operates domestically. From this, it seems that being active on the global scene when offshore activities are initiated is important for enhancing productivity concerning material sourcing, whereas this does not appear to be the case with respect to services. In fact, the opposite becomes true and could be an indication of much stronger diminishing returns to offshoring with respect to services compared to materials.

Egger and Egger (2005) study the effects of international outsourcing of materials inputs for different groups of workers and find that material outsourcing has a negative effect on the productivity of low-skilled workers in the short run but a positive effect in the long run. They found that international outsourcing

contributed to 3.3% of real value added per low-skilled workers in the EU from 1993 to 1997. They attribute the negative short-run effect to imperfections in the EU labour and goods markets.

The contribution of multinational firms to productivity

The productivity in host countries benefits substantially from the presence of subsidiaries of foreign MNEs, since foreign affiliates are on average more labour productive than the average domestic firm. This productivity advantage remains after controlling for industrial composition of the foreign affiliates sector (foreign affiliates are typically more present in high productive industries) directly contributing to the productivity level in host countries.

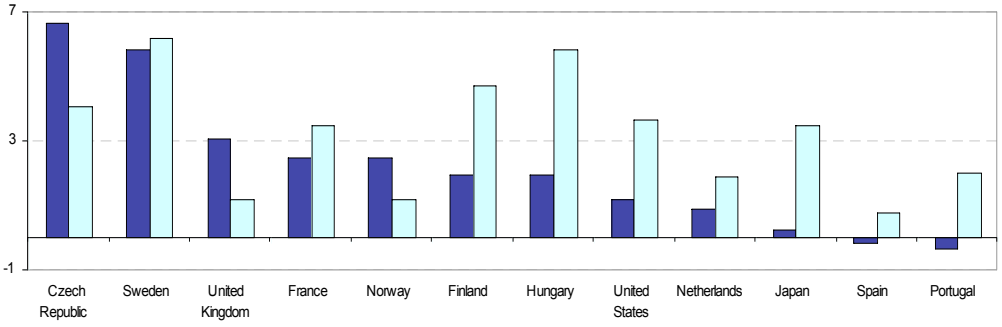
Foreign affiliates make also an important contribution to labour productivity growth (Figure 40). In both the manufacturing and services sector the contribution is largest in the Czech Republic and Sweden and smallest in Japan and Portugal (Criscuolo, 2005). For France and the United States the foreign affiliates' contribution to labour productivity is much smaller in the service sector than in the manufacturing sector.

In the manufacturing sector, the average contribution of foreign affiliates to annual productivity growth ranges from 6.7% in the Czech Republic to -0.4% in Portugal. For three countries, Czech Republic, United Kingdom and Norway, the contribution of foreign affiliates is larger than the labour productivity growth in the total manufacturing sector. This is due to a sharp growth in the foreign affiliates' share of employment in the Czech Republic and Norway and to the negative productivity growth of domestic firms in the United Kingdom. In the majority of cases, the contribution of foreign affiliates comes from the "between" effect, i.e. the sharp growth of the share of foreign affiliates' employment (Figure 7). In the service sector, the contribution of foreign affiliates is much smaller than in the manufacturing sector ranging from 1.2% in the Czech Republic to -0.2% in Portugal. As in the manufacturing sector, the between effect accounts for most of the contribution of foreign affiliates to productivity growth in the service sector, with the exception of Hungary.

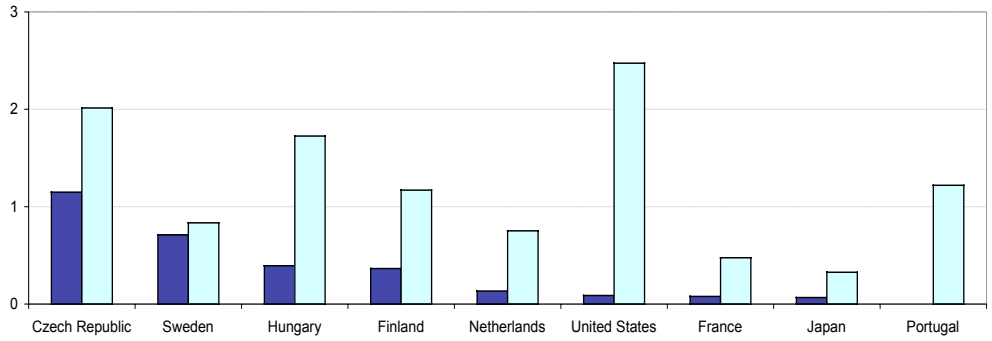
These results only concern the direct impacts of foreign affiliates on productivity growth. Several other studies have also shown that the presence of foreign affiliates may put pressure on domestic firms to enhance their performance, thus enhancing productivity growth in domestic firms. Also the spill-over from knowledge from foreign affiliates to local domestic firms may result in a better performance of the domestic industry.

Figure 7 **Average contribution of foreign affiliates to annual productivity growth, 1995-2001**
Percentage points

Manufacturing sector



Service sector



1. Or nearest available year: Czech Republic 1997-2002; United Kingdom 1995-1999; Finland 1995-2002; Hungary 1996-2002; Spain 1999-2001 and Portugal 1996-2002.

2. Or nearest available year: Czech Republic 1995-2002; Sweden 1997-2000; Hungary 1998-2002; Netherlands 1997-2001; Japan 1997-2000 and Portugal 1996-2002.

Source: OECD, AFA, FATS and STAN databases, June 2005 in Criscuolo (2005).

Decomposition of Aggregated Productivity Growth

Productivity gains in internationally engaged firms have various effects upon other firms in the economy through forward and backward linkage and competition within the same market segment. Aggregated productivity dynamics is determined by such an interaction.

In order to investigate the relationship between aggregated productivity dynamics and micro-level productivity growth, it is necessary to decompose the aggregated productivity figures and exploit the micro-level productivity estimates. We here define the aggregated productivity in year t, Ω_t as a weighted average of establishment-level productivities ω_{ft}. It is given by:

$$\Omega_t = \sum_{f \in F} s_f \omega_f \qquad (1)$$

where s_{ft} denotes establishment f's sales share in year t. F is the set of all the establishments existed at least either in the beginning or the end year of the observation period. As Foster, Haltiwanger and Krizan (2001) showed, aggregated productivity growth can be decomposed as follows:

$$\begin{aligned}\Omega &= \sum_{f \in F} s_{f,t-1} \Delta\omega_f + \sum_{f \in F} \Delta s_f \omega_{f,t-1} + \sum_{f \in F} \Delta s_f \Delta\omega_f \\ &\quad + \sum_{f \in N} s_{ft} (\omega_f - \Omega_{t-1}) - \sum_{f \in X} s_{f,t-1} (\omega_{f,t-1} - \Omega_{t-1})\end{aligned} \qquad (2)$$

where N is the set of establishments that newly entered and X is the set of establishments that exited.

The first term in the decomposition $\sum_{f \in F} s_{f,t-1} \Delta\omega_f$ is called "within effect" representing contribution of within establishment productivity growth to the aggregated productivity growth. The productivity increase due to the reallocation from less productive establishment to more productive ones is captured in the "reallocation effect", the summation of the second term $\sum_{f \in F} \Delta s_{ft} \omega_{f,t-1}$ ("between effect") and the third term $\sum_{f \in F} \Delta s_{ft} \Delta\omega_f$ ("covariance effect"). The fourth and fifth terms, respectively, represent the contribution of entry and exit. Table 8 shows cross-country comparison of productivity decomposition in recent studies for the U.S., Canada, the U.K., South Korea, and Japan, compiled by Fukao, Kim, and Kwon (2006). Most important findings from this table can be summarised as follows.

Table 8 Average contribution of foreign affiliates to annual productivity growth, 1995-2001

Source	Country	Period	Annual productivity growth total	Contribution of each effect
				Within effect
			(%)	
			a=b+c+f	b
Panel A. TFP Growth				
Ahn, Kwon, & Fukao (2004)	South Korea	1990-98	3,51	1,42
				(40%)
Foster, Haltiwanger, & Krizan (2001)	U.S.	1977-87	1,02	0,49
				(48%)
		1977-82	0,54	-0,05
				(-9%)
		1982-87	1,46	0,76
				(52%)
		1987-92	0,66	-0,04
				(-6%)
Disney, Haskel, & Heden (2003)	U.K.	1980-92	1,06	0,05
				(5%)
		1982-87	3,08	1,26
				(41%)
Fukao, Kim, & Kwon (2006)	Japan	1981-90	1,81	1,18
				(66%)
		1990-2003	1,12	0,55
				(49%)
Panel B. Labour Productivity Growth				
Foster, Haltiwanger, & Krizan (2001)	U.S.	1977-87	2,13	1,64
				(77%)
		1977-82	0,51	0,62
				(122%)
		1982-87	3,73	3,10
				(83%)
		1987-92	1,43	1,34
				(94%)
Baldwin & Gu (2003)	Canada	1973-79	2,15	1,66
				(77%)
		1979-88	1,41	1,44
				(102%)
		1988-97	2,91	2,85
				(98%)
Fukao, Kim, & Kwon (2006)	Japan	1981-90	4,44	3,34
				(75%)
		1990-2003	2,41	1,15
				(48%)

Notes: The entry and exit effects in Ahn, Kwon, & Fukao (2004) and Fukao, Kim, & Kwon (2006) include the sector switching effects. Values in parentheses denote the share of each effect in productivity growth. The decomposition of productivity is based on the method of Foster, Haltiwanger & Krizan (2001).

Reallocation effect subtotal	Between effect	Covariance effect	Net entry effect subtotal	Entry effect	Exit effect
c=d+e	d	e	f=g+h	g	h
0,08	-0,28	0,36	2,01	1,95	0,06
(2%)	(-8%)	(10%)	(57%)	(56%)	(2%)
0,27	-0,08	0,35	0,27		
(26%)	(-8%)	(34%)	(26%)		
0,45	-0,18	0,63	0,14		
(83%)	(-33%)	(116%)	(26%)		
0,48	-0,26	0,75	0,20		
(33%)	(-18%)	(51%)	(14%)		
0,47	-0,26	0,73	0,23		
(71%)	(-39%)	(111%)	(35%)		
0,43	0,16	0,28	0,57		
(41%)	(15%)	(26%)	(54%)		
1,48	-0,09	1,57	0,37		
(48%)	(-3%)	(51%)	(12%)		
0,13	-0,14	0,28	0,49	0,73	-0,24
(7%)	(-8%)	(15%)	(27%)	(40%)	(-13%)
0,31	-0,04	0,35	0,27	0,60	-0,33
(28%)	(-3%)	(31%)	(24%)	(53%)	(-29%)
-0,13	0,17	-0,30	0,62		
(-6%)	(8%)	(-14%)	(29%)		
-0,22	0,43	-0,65	0,10		
(-43%)	(84%)	(-127%)	(20%)		
-0,07	0,49	-0,56	0,71		
(-2%)	(13%)	(-15%)	(19%)		
-0,23	0,47	-0,70	0,30		
(-16%)	(33%)	(-49%)	(21%)		
-0,05	1,47	-1,52	0,54	0,24	0,30
(-3%)	(68%)	(-71%)	(25%)	(11%)	(14%)
-0,30	0,23	-0,53	0,28	0,15	0,13
(-22%)	(16%)	(-38%)	(20%)	(11%)	(9%)
-0,37	0,27	-0,64	0,42	0,26	0,17
(-13%)	(9%)	(-22%)	(15%)	(9%)	(6%)
-0,46	-0,01	-0,45	1,56	1,97	-0,41
(-10%)	(-0%)	(-10%)	(35%)	(44%)	(-9%)
0,28	0,30	-0,02	0,98	1,54	-0,56
(11%)	(12%)	(-1%)	(41%)	(64%)	(-23%)

Source: Fukao, Kim & Kwon (2006)

1. The within effect was pro-cyclical and made the largest contribution to overall productivity growth in boom periods. In recessionary periods, the reallocation effect dominates in all countries with an exception of Japan.
2. The reallocation effect, whereby high productivity establishments increase market shares and relatively low productivity establishments lose theirs, contribute positively to aggregate productivity in all periods an all countries. Sum of reallocation effect and net entry effect, which can be interpreted as reflecting the creative destruction processes, is larger than the within effect in all countries except for Japan.
3. In all periods and all countries, the net entry effect is positive, suggesting that productivity grows as less productive establishments exit and more productive ones enter. It is noteworthy that the net exit effect was negative in Japan and its magnitude was steadily growing. It may be interpreted as a hollowing-out effect caused by increasing foreign direct investments of productive large firms.

Those studies show rich nature of productivity dynamics and while they do not directly address to the linkage with globalisation. Since it is an aggregated productivity that matters in sustainable improvement of national living standard, we need further work to bridge establishment-level productivity growth with aggregated productivity and economic performance.

According to proceeding studies, new establishments gradually expand their size and productivity (learning effect), and exiting firms have lower performance several years before their exit (shadow-of-death). Most of the productivity decomposition capture those effects in the"within effect". Careful treatment of vintage of establishments would lead to new findings in the interaction between within effect and entry and exit.

Interaction between productivity growth of individual establishment and those of its rivals in the same market would be also an interesting theme of research. Adding an average productivity performance of rival firms in the equation would give us a new insight in our interpretation of reallocation effect.

Further micro-data mining incorporating broad data-sets on establishment -level business performances and additional information on firm-level activities such as foreign direct investment and sourcing of intermediate inputs would enrich our understanding not only on productivity gains occurred in the establishments engaging in globalising activities but also on their external effect to the other players in the economy.

Conclusion

The globalisation of value chains raises major policy challenges for OECD countries. One major challenge is to adapt to the changes that are driven by globalisation and by other factors, such as technological and demographic changes. These policies are familiar and include policies to improve the functioning of labour and products markets and to open markets to international trade and investment. The second challenge is how to continue moving economic activity (production) in OECD economies further up the value chain to ensure that OECD economies can continue to compete and prosper in the global environment. Well-functioning markets are key to the upgrading process, as this will help move resources from firms and industries that are no longer able to compete in the global market to firms that are successful. Moreover, moving up the value chain thus implies a continuous process of change, innovation and productivity growth.

The policies to foster and support this process accept that the globalisation of value chains is occurring and that it is an irreversible process that is driven by companies that aim at entering new, rapidly growing markets and that want to enhance efficiency and innovation. Moreover, the steps outlined above are active policies, aimed at achieving the broadest possible benefits from globalisation and adjusting to its consequences.

The third key challenge for policy makers involves how to avoid a political backlash against globalisation. Most analysis shows that there are considerable long-term benefits to globalisation and further economic integration. These benefits include higher standards of living for a growing share of the global community, greater product diversity, lower prices and higher productivity. Moreover, any negative impacts on employment have thus far shown to be relatively small, in particular when compared to overall churning in the labour market, and could be addressed by effective labour market policies. Nevertheless, public perceptions as regards globalisation are not positive, which may be due to the short-term – and often highly visible – employment losses that are likely to occur in specific regions and industries, typically particularly affecting low-skilled workers. Other concerns related to globalisation are linked to the potential environmental impacts of continued globalisation, as well as to concerns about some world regions, notably Africa, that seem in particular danger of being left behind in the globalisation process. Addressing these challenges is not straightforward and will require that governments accompany the globalisation process with policies to spread the benefits of globalisation as broadly as possible. Moreover, it will be important to support those social groups and countries that may not gain in the globalisation process. Addressing other global concerns, notably global environmental

challenges such as climate change, are also key in making globalisation being regarded as an opportunity, rather than a threat.

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Appendix.Globalisation of business services and productivity

Here we illustrate the potential productivity gain from business service outsourcing with a simple model. Firms derive gains from outsourcing business services from two sources – lower costs of each input and a broader variety of inputs. This can be represented by the following equations:

$$B = \left[\sum_{i=1}^{N} b_i^{\rho} + \sum_{j=1}^{M} b_j^{*\rho} \right]^{1/\rho} \qquad C_b = \left[\sum_{i=1}^{N} p_i^{1-\sigma} + \sum_{j=1}^{M} p_j^{*1-\sigma} \right]^{1/(1-\sigma)}$$

The first equation represents total business services, denoted B, as an aggregate of a number of differentiated individual services, denoted b, of which N are produced locally and M are imported, and ρ represents the substitution parameter. The second equation represents the dual cost function where p represents prices of local business services while p* denotes the price of imported business services. In the latter equation, $\sigma = (1/(1- \rho))$ and is the elasticity of substitution between any two services – that is, the degree to which any two services may be substituted for one another. The elasticity of substitution for services is always larger than one and it is often assumed to be between two and five (see, for instance, Markusen, Rutherford and Tarr (2004) and Decreux and Fontagné (2006)).

What is notable with these functions is that the B-aggregate increases with the number of differentiated business services even when the aggregate value of business services remains constant. This property captures the notion that, for instance, when constructing a yacht it is better to have one man-month input from each of an architect, an engineer and a designer than three man-months of an engineer only. By the same token, the cost index for business services declines with the number of inputs. The larger is σ, the smaller the effect of an increase in the number of inputs. This is reasonable, since σ tells us that many business services are close substitutes. In other words, the more similar the business services the less is the gain from adding a new variety.

Feenstra et. al. (1999) show how the two aggregates above relate to total factor productivity and total costs in a sector in which the final product is produced by assembling inputs only (with no value added). We follow this approach and construct scenarios that yield a rough estimate of the gains from trade in business services. We chose two industries, "machinery and equipment" and "radio, television and communication equipment" in the United States, France, Ireland and Japan as examples.

To make the analysis tractable, we first discuss the gains from expanding product variety, holding prices of each input constant. Next, we hold the number of varieties constant and analyse the impact of lower prices (e.g., due to a shift in sourcing of imports to developing countries). From Feenstra et. al.'s work we know that the productivity gains from imports can be measured as follows :

$$TFP = \frac{1}{\sigma - 1} \mathrm{h} \left(\frac{n+m}{n} \right)$$

In our case, business services are one of many inputs in the cost function, and we must adjust this by the share of business services in total costs. The cost shares are calculated from the dual of a KLEM-type production function. The production function takes the form:

$$Y = K^{\alpha} L^{\beta} G^{\varepsilon} S^{\varphi} B^{\gamma}$$

where $\alpha + \beta + \varepsilon + \phi + \gamma = 1$. Y represents gross output, K stands for capital, L signifies labour, G denotes material inputs, S represents services other than business services and B symbolises business services. The parameters α, β, ε, ϕ and γ simply show the share of each input in gross output – that is, the cost share coefficients represent the input required per unit of industry output – and they vary between sectors and countries.

The data sources do not report the number of varieties, and we therefore need to construct proxies. Previous studies on the gains from expanding variety in goods have used the number of 6-digit sectors in which a country produces (or exports) as a proxy. For services this is not feasible, since both production and export data are given at an aggregate level and business services are much more heterogeneous than goods. An alternative option that gives us a sense of the dispersion of variety between countries is to use an index in which we set the number of varieties in the United States to 100. In other countries, the number of domestic business services will be 100 times the country's production of business services relative to the United States. Normalising the number of business services to 100 in the United States yields an index of 35 in Japan, 1 in Ireland and 13 in France, rounded to the nearest integer.

We now conduct a simple analysis of possible gains from trade in business services. First, the impact of expanding variety with one index unit is assessed using two different assumptions of the elasticity of substitution, one at each end of the spectrum of elasticities commonly found in the literature. The results are presented in Table 7.

Table 9. Productivity gains as a result of a one index unit expansion of product variety

	Scenario 1, σ =2		Scenario 2, σ=5	
	Machinery	Radio	Machinery	Radio
US	0.08	0.12	0.02	0.03
France	1.14	1.16	0.28	0.29
Ireland	2.61	15.66	0.65	3.91
Japan	0.18	0.31	0.05	0.08

A one-unit increase in product variety means extending the local range of services by the equivalent of one percentage point of the U.S. range of varieties. This would obviously amount to a 1% increase in the United States, while it would double the variety in Ireland. Due to diminishing returns to diversity, an extra unit will have very different productivity effects in the four countries. In the United States, the productivity gains for the two downstream industries would be a tenth of a percentage point or less. In contrast, Irish productivity could increase by as much as 16 percentage points when $\sigma = 2$.

The second experiment that we make simulates the cost effect of lower prices of business services through the sourcing of such services from lower-cost countries. An OECD study (2004) finds that about 20% of most services produced in OECD countries could be outsourced. So let us assume that 20% of the business services currently sourced locally in the four countries are imported instead. In 2000, OECD countries accounted for a large portion of the imports of business services in France (82%), Ireland (78%), Japan (72%) and the United States (80%). In our scenario, we reduce this share to 70% for all four countries. Finally, research by McKinsey Global Institute (2003) suggests that business services from developing countries cost about 40% less than in OECD countries, so this is the final assumption that we use in the construction of the scenario. The cost reductions that would result from this experiment are reported in Table 10.

Table 10. Cost saving from shifting sourcing of business services

	USA		**France**		**Ireland**		**Japan**	
	Machinery	Radio	Machinery	Radio	Machinery	Radio	Machinery	Radio
Cost savings (% of total cost)	0.2	0.3	0.4	0.4	0.1	0.7	0.2	0.3

The cost reductions are not large – less than 1% in all four countries in both sectors. The largest cost savings are in the radio, television and communication equipment sector in Ireland. The costs savings would of course be larger if we assumed that developing countries took a larger market share, but since business services are a relatively skills- and IT-intensive sector, this may not be realistic. The largest gains from trade in business services are therefore likely to come from expanding product variety or, in other words, access to more specialised business services.

Does Sweden give away its TFP for free?

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Background

After a period of more than 20 years of stagnation, Sweden has for over 10 years now been experiencing rapid growth in its business sector. But its terms of trade have deteriorated and the ranking among OECD and EU countries by GDP per capita has not improved substantially. The exchange rate is also still very low in spite of the fact that Sweden exports 25 percent more than it imports and its positive balance of payment has last year gone up from a good 4 percent of GDP to 7 percent. The objective of this study is to look into this growth performance and throw a little light on this paradox.

Introduction

Almost 50 years ago Robert Solow[1] started up a new era in growth measurement by publishing his article on economic growth and technological development in the US economy. He used the technique of Growth Accounting to break down growth in US labour productivity into components. His results indicated that almost all growth in the US economy was due to technological developments and very little to capital deepening. This inspired Zwi Griliches and Dave W. Jorgensen[2] to try to improve the capital measurements. Another important contribution was made by Denison[3] who tried to incorporate a measurement of the improvement in labour quality. This period of rapid development of the neoclassical growth theory and use of the Growth Accounting technique lost momentum due to researchers' increasing interest in short term questions, a lack of adequate data and the fact that growth was treated as exogenous in the neoclassical world, so these theories could not explain growth in itself.

This changed drastically when Romer[4] published his breakthrough article in 1986, where he finally incorporated endogenous growth in the model. This started up

1 *We want to thank Paul Schreyer at the Statistic Directorate OECD, Henrik Sejerbo Sörensen at Statistics Denmark and Jukka Jalava at Statistics Finland for valuable comments.*

a new field of growth literature, which was called "new" or "endogenous" growth theory. But still the neoclassical growth theories have their supporters. Even if these theories cannot explain the driving forces behind different growth rates, they can still answer important questions, like if there is a tendency towards convergence (see among others Barro and Sala-i-Martin.[5]) The technique of decomposing economic growth by Growth Accounting has been widely used during the last decade with many important contributions, not least by Dale W. Jorgensen[6], who is still very active in this field.

An important trigger has been the improved growth performance of the US economy. It ceased to lose ground to the European economies around 1995, as had been the case since the Second World War, and outperformed them thereafter.

The new development in the research field together with the increasing importance of the European growth problem has also led the EU Commission together with Eurostat to act. They have commissioned for the development and analysis of a comprehensive long time series for most European countries.

The OECD has always had economic growth on its agenda, and has recently created a productivity section on their website on growth accounting, with both methodological papers and a database. In the Nordic countries Statistics Denmark has led the way and has published multifactor productivity growth figures on a very detailed industry level as early as 2004.[7].

What we want to achieve

At Statistics Sweden this kind of work is still on an experimental level, but two studies made by external researchers have already been published in this field. All this work inspired us to go on with our own experiments in the growth accounting field. This resulted in an in-house study[8] which was published late 2005, where we tried to go beyond the value added and capital stock approach and used the KLEMS method. This means that growth of gross output is decomposed instead of growth in value added. In this attempt capital services were used as measurement of capital input instead of capital stock. The capital service concept is an important improvement since a stock concept is changed into a more appropriate flow concept. This concept also markedly appreciated the relative cost of ICT investments compared to other capital types, especially buildings, since the depreciation rate is much higher and its price developments are much lower. The other major difference is the use of the KLEMS concept which means that intermediate input also becomes an input variable. Compared to this study we have now calculated the TFP on a more disaggregated level, which allows us to create aggregates according to some interesting variables such as R&D

intensity, ICT intensity and Human Capital level. This gives us some indications of what the driving forces are behind the TFP growth. These calculations are of course a test to see if there are any spills over effects since all these investments and inputs are already incorporated in the TFP estimates.

We have also tried to measure some of the effects of the globalisation through the mechanism of international specialisation. The specialisation leads to a productivity increase which gives better rewards to producers, their employees and customers. This analysis has been done by comparing the TFP and price changes for different industries to see if there is any relationship. We have also tried to calculate the export and import of TFP for Sweden even if this calculation is based on the rather dubious assumption that the imports of goods and services have been produced in industries with the same TFP developments as their Swedish counterparts.

TFP developments in the Swedish business sector

Our aim in this part of the study is to calculate the growth in total factor productivity, TFP, for 50 industries in the Swedish business sector. The calculations are carried out by the use of the KLEMS model. This means that we incorporate input of capital together with input of labour and intermediate consumption in the production function.

Further, we will use the calculated TFPs for all the industries in order to calculate total factor productivity estimates for the total business sector and other major aggregates in the Swedish business sector. This will be conducted by aggregating the industries' TFP using *Domar* weights.

All data on production, capital stocks, hours worked and intermediate consumption are collected from National Accounts, Statistics Sweden. The indicator on labour quality is based on data from a micro database with register data. See Appendix 1.

Using sectoral output as a measure on production we are netting out an industry's production of a particular intermediate which is consumed with in that same industry, *i.e.* intra-industry deliveries. While netting intra-industry deliveries of intermediate inputs from the output side we have to do the same on the input side. Therefore input of intermediate products also is calculated net of inputs produced within the industry. The production function is described in equation 1.

$$S_i = Y_i - M_{ii} = K_i + L_i + M_{ij'j \neq i} \qquad (1)$$

S_i is sectoral output of industry i, Y_i is gross production and M_{ii} equals consumption of intermediate inputs produced within the industry. K_i and L_i represents input of capital and labour respectively and $M_{ij, j \neq i}$ is input of intermediates net of inputs produced within the industry.

The model consists of input of capital services of machinery excluding ICT, transport equipment, ICT and structures. As a measure of labour input, hours worked are used together with a measure of labour quality. Intermediate input is divided in the input of energy, materials and services.

For the calculations of TFP we have chosen to work on a 2-digit ISIC level. The time period studied is 1994 to 2005 as a consequence of available data. Gross production has only been available until the year 2004. For the year 2005 gross production for each industry has been estimated using the growth in value added.

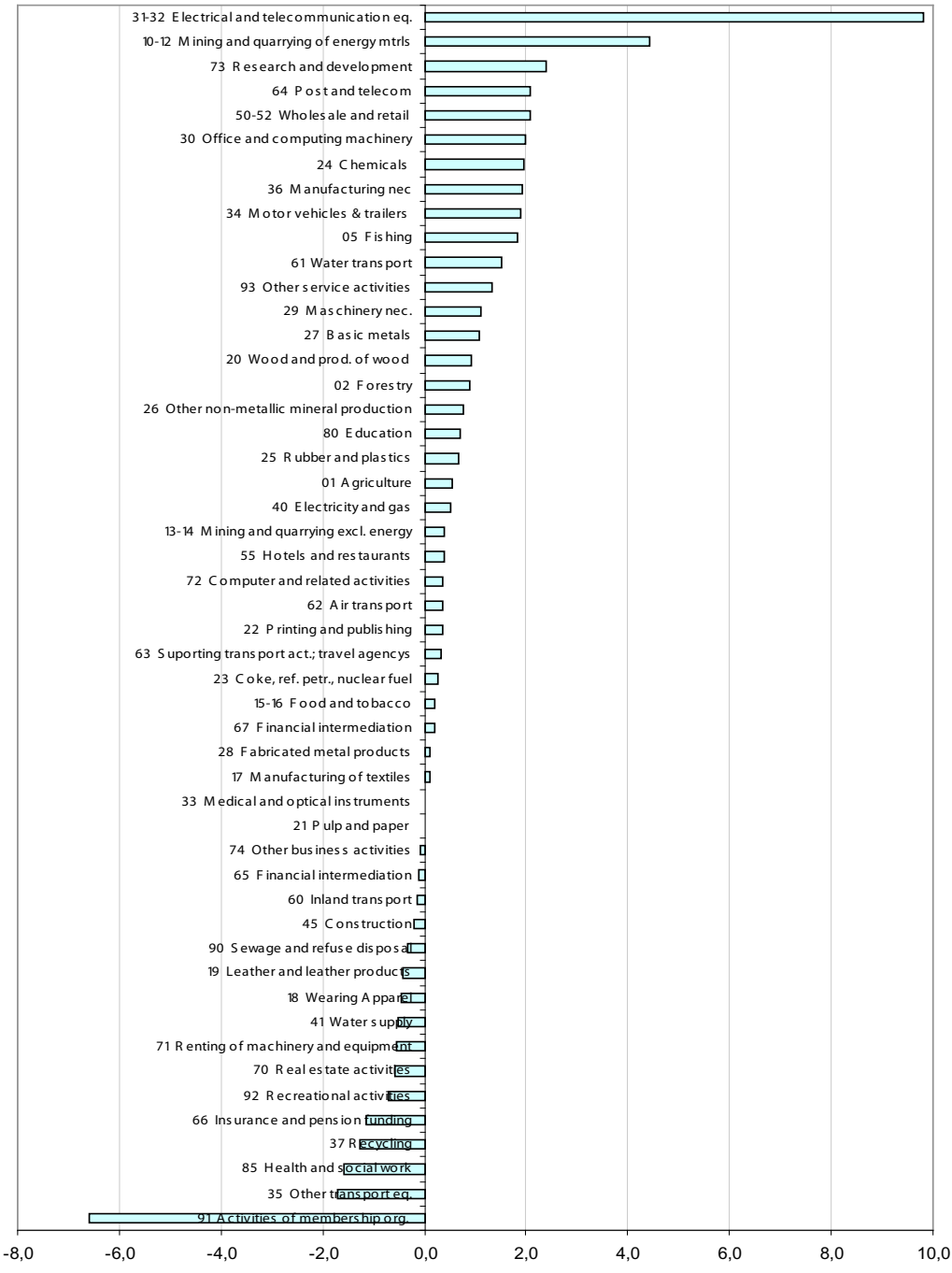
Figure 1 displays the calculated average TFP for the 50 industries in our study. The average TFP for all industries ranges from -6.6 percent for *Membership organisations for the business sector nec (not elsewhere classified)*, to 9.8 percent for the aggregate of *Electrical and Telecommunication equipment*. These two industries are the two extremes on each side of the productivity growth spectra in this study.

The explanation behind the very low estimate of TFP for the *Membership organisations nec* industry lies probably in the major change in their role, which has led to a dramatic decrease in production. That is, it seems that they no longer sell so many different services to their members but instead depend on their membership fees. This means that they nowadays have a wage cost that is more than twice their value added in current prices. This, in combination with a constant input of labour has caused the low estimate on average TFP.

In the *Electrical and Telecommunication equipment* aggregate, growth in TFP is at or close to a two-digit level almost every year during the whole period. The only mayor exception is the year 2001 in which TFP growth is negative at -17.4 percent. The main reason behind this extremely low estimate is of course that the ICT-bubble bursted that year.

The result of the calculations is that 32 industries had a positive average growth in TFP during the period 1994-2005, 16 industries had a negative growth leaving two industries with zero TFP growth. For the majority, 48 industries, TFP ranges from -1.7 percent to 4.4 percent. The resulting yearly TFP for all industries is displayed in appendix 2.

Figure 1. Average TFP for the total business sector 1994–2005



Source: Statistics Sweden

TFP at intermediate level

To study productivity at a more aggregated level, the TFP's calculated at industry level are aggregated using *Domar* weights. The idea behind *Domar* weights is to take into account both the productivity growth within individual industries and the indirect effects of productivity streaming upwards. These indirect effects come about when industries benefit from more efficiently produced intermediate inputs from other industries. These cumulative gains in productivity are accounted for by the fact that the sum of the *Domar* weights exceeds unity.

Domar weights are normally used in aggregating to the total business sector. In this study, aggregating to the total business sector and to intermediate levels, we estimated the *Domar* weights somewhat differently.

When aggregating to the total economy the *Domar* weights are calculated as

$$\delta_i = Y_i / \Sigma V_i \qquad (7.2)$$

Where δ_i is the *Domar* weight for industry i, Y_i is sectoral output and ΣV_i is sum of value added for the total business sector.

Our set of *Domar* weights, when aggregating to intermediate levels, is calculated for each industry in respective aggregate as

$$\delta_i = Y_i / S \qquad (7.3)$$

Where δ_i is the *Domar* weight for industry i, Y_i is sectoral output and S is the sectoral output for the intermediate aggregate.

In this study the industries TFP's are aggregated into six intermediate aggregates and to the total business sector. The result for the *Construction* sector will also be displayed (even though no aggregation is necessary in this case).

Using our methodology one has to bear in mind that the effects of some industries on aggregated TFP are likely to vary between aggregating at an intermediate level and at the total level. This will be true if one industry totally dominates an aggregate in combination with a high or low average TFP for that particular industry. As a result, comparisons of the level of productivity growth between intermediate aggregates and the total level might not be meaningful. Nevertheless, comparisons between intermediate aggregates such as the *Goods* Sector and the *Service* Sector should be both possible and meaningful.

The results would then anyway be useful in order to observe trends in TFP growth in respective sector. Further, the results would also be useful as an indicator of which sectors that have played important roles on the growth in TFP at the total business sector level.

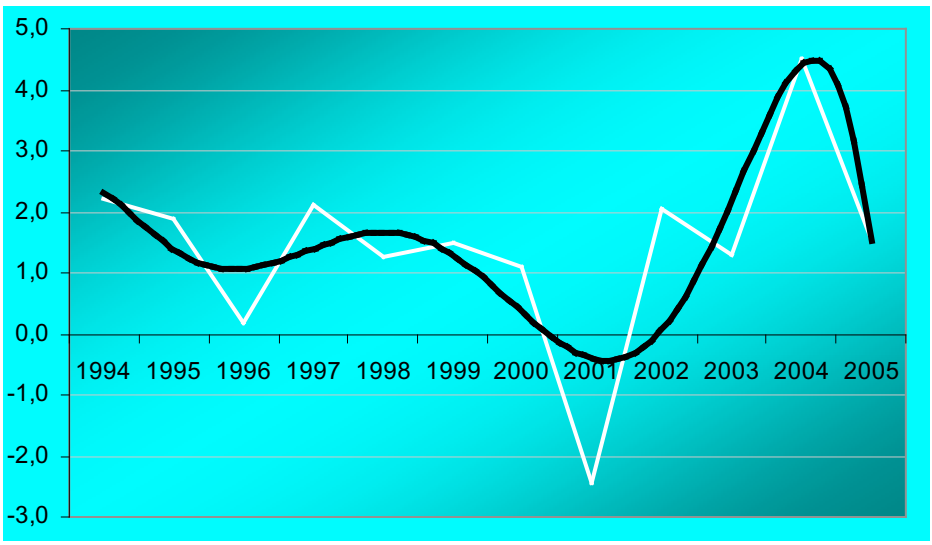
Table 1 displays the aggregates for which the calculations are been made.

Table 1 Definition of aggregates

Total Business Sector	ISIC 01-95
Goods Sector	ISIC 01-45
Service Sector	ISIC 50-95
Manufacturing Sector	ISIC 15-37
Construction Sector	ISIC 45
Distribution Sector	ISIC 50-52, 60-64
Financial and Business Service Sector	ISIC 65-67, 70-71, 73-74
Other Services Sector	ISIC 55, 80-95

With the exception of the year 1996, the growth in productivity in the total business sector was very stable and at a reasonably high level from 1994 to 2000 (figure 2 with the actual observation in white and smoothed with a six period polynom in black). In 2001, a year marked by the crisis in the telecommunication sector and the ICT sector, the growth rate became negative. This is also the only year with a negative growth in productivity for the total business sector during our estimation period. After 2001, there is quite a dramatic upsurge in the growth rate during the years 2002 to 2004. At the end of the period in 2005, productivity growth falls back to a more average level of 1.5 percent.

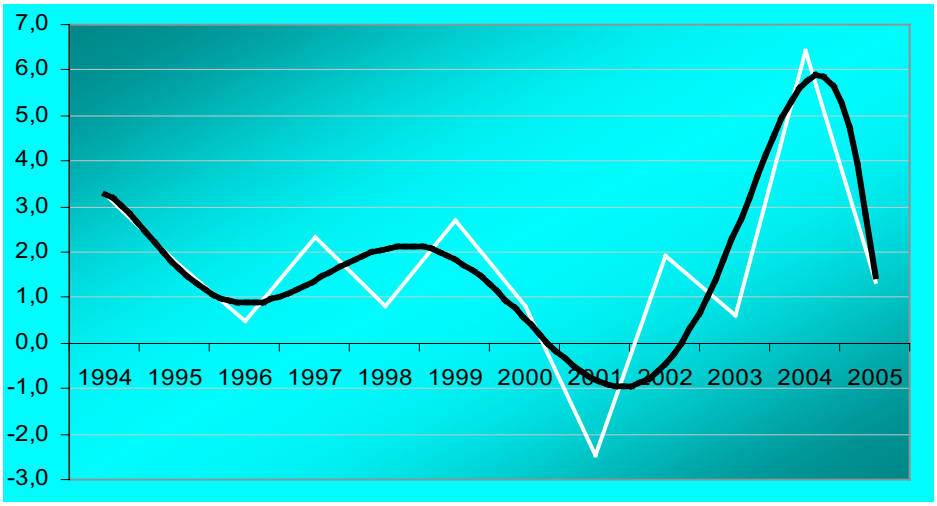
Figure 2 TFP for the Total Business Sector 1994–2005



Source: Statistics Sweden

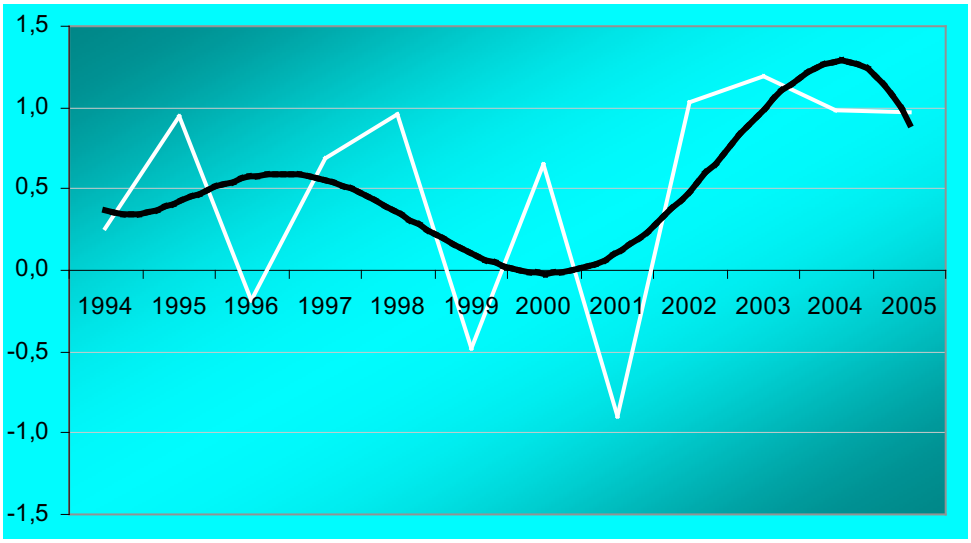
The trend and the level of the growth rate is very similar between the Goods Sector and the Total Business Sector. The major difference is that the growth rate is higher in 2004 in the Goods Sector due to the effects of the *Electrical and Telecommunication equipment* aggregate.

Figure 3 TFP for the Goods Sector 1994–2005



Source: Statistics Sweden

Figure 4 TFP for the Service Sector 1994–2005

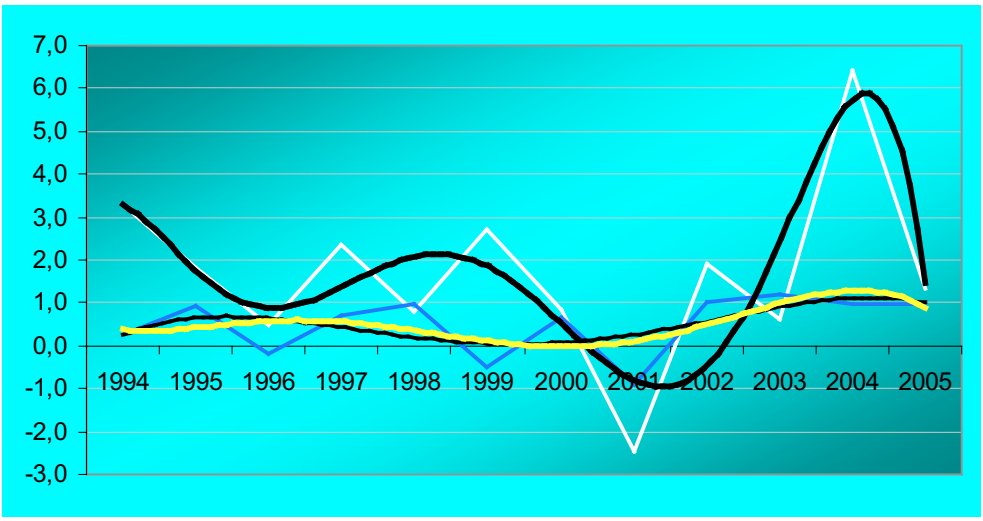


Source: Statistics Sweden

The level of the TFP growth in the Service Sector is low during the period until the year 2001. The average level is significantly lower than in the Goods and in the Total Business Sector. This is probably the case in reality as well, but the result may be distorted by the lack of relevant indices for the Service Sector. Due to this lack of relevant indices, wage indices have been used for deflating gross production. Rising wages in the service sector have then led to a possible underestimation of the productivity growth. During the last four years work on creating producer price indices for the service industries has led to a marked difference in the measures of development of the production of services. This is a process that is still ongoing. In this sector productivity growth is negative for three years

In order to get a better view of the differences in the TFP growth between the Goods and the Service Sector the results are compared in figure 5. It is obvious that they have had very different development both in level and in their growth patterns.

Figure 5 TFP for the Goods and the Service Sector 1994-2005



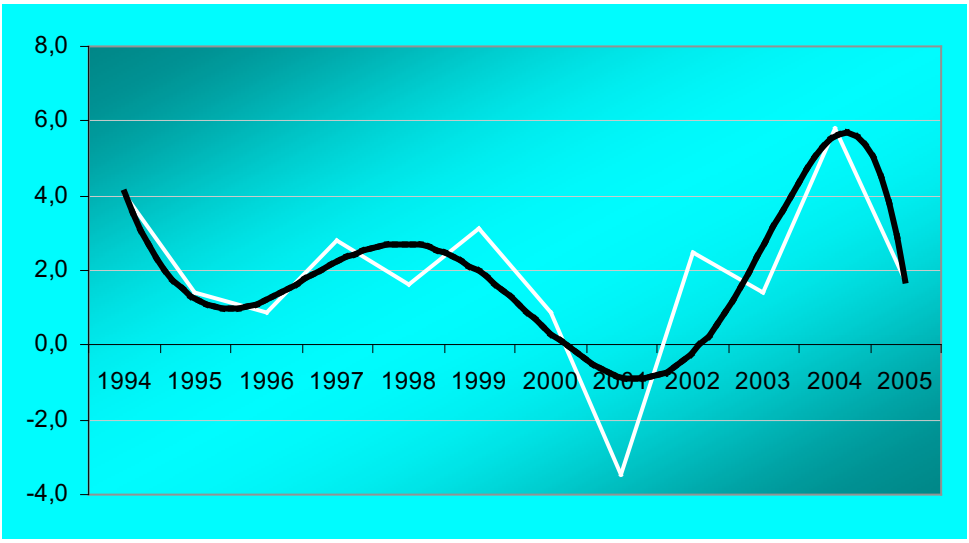
Source: Statistics Sweden

The growth in TFP in the Manufacturing Sector is of natural causes very similar to the growth in the Goods Sector, since it constitutes a very large part of it.

However, one has to bear in mind that the *Electronics and Telecom* Sector is rewarded with a large *Domar* weight in this aggregate. In combination with high average TFP growth, this large *Domar* weight causes a possible overestimation of the TFP growth for the whole sector. Again, we see the significant rise in TFP growth from year 2002 and onwards.

In the Construction Sector the growth in productivity has been negative for several years. This is probably the effect of low level of competition, regulations in both labour and product markets and high entrance barriers.

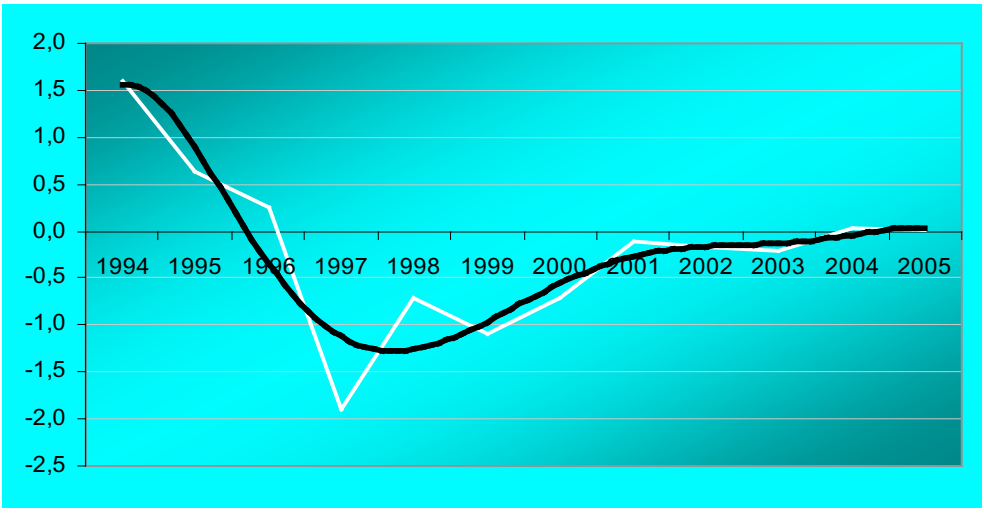
Figure 6 TFP for the Manufacturing Sector 1994–2005



Source: Statistics Sweden

Starting with positive but diminishing growth in 1994 to 1996 growth in TFP has been negative from 1997 to 2003. The trend though, has been positive from 1997 and from year 2004 productivity growth has been positive close to zero.

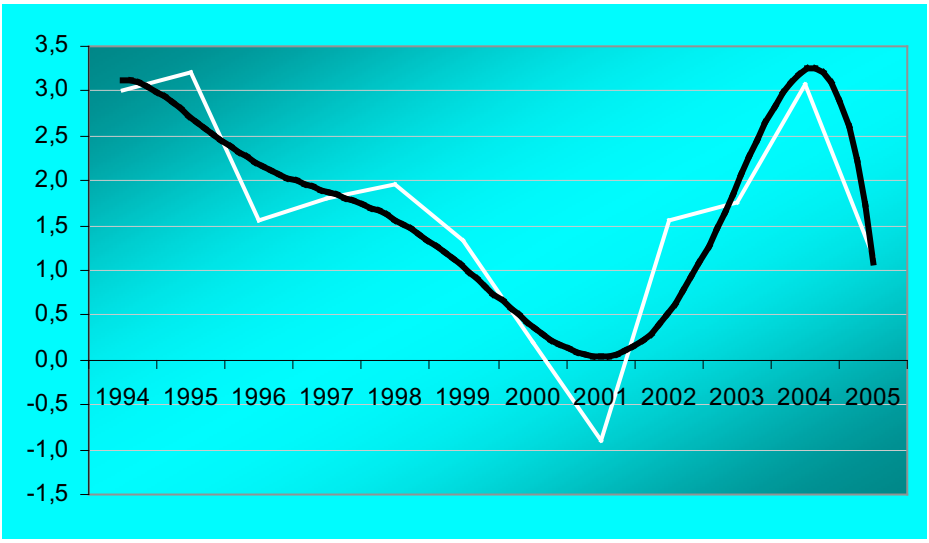
Figure 7 TFP for the Construction Sector 1994–2005



Source: Statistics Sweden

This rise in TFP growth during the last year probably reflects the boom, driven by low interest rates which together with some other factors have resulted in high demand on both dwellings and office buildings the *Construction* sector in Sweden has expired. Starting at high but diminishing rates of productivity growth, the Distribution Sector hit bottom in 2001. From that time on productivity rates grew higher during the following three years. The growth rate in 2005 is according to the result still on a reasonably high level. The good TFP growth in the distribution industry is in accordance with the US and Canadian experience even if it has a different pattern with productivity improvements in the existing forms and not so much from new players as in for example Canada[9]

Figure 8 TFP for the Distribution Sector 1994–2005

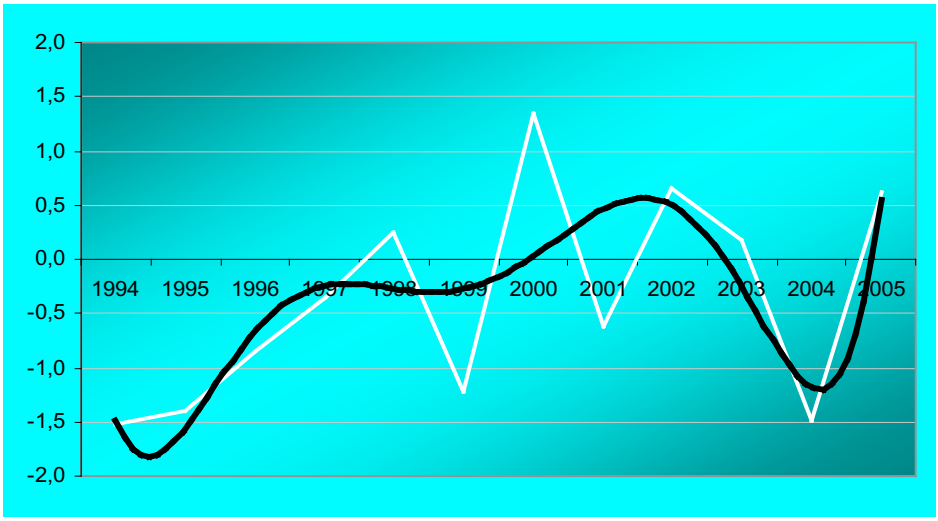


Source: Statistics Sweden

In the Finance and Business Service Sector the trend in TFP growth is positive during almost the whole period with the exception of the year 2004.

During the late 1990s, except in 1998, the growth in productivity was negative but ascending. From the year 2000 the productivity rates have been on a higher level. The result for the year 2004 is affected by the *Real Estate* industry which constitutes almost half of this aggregate

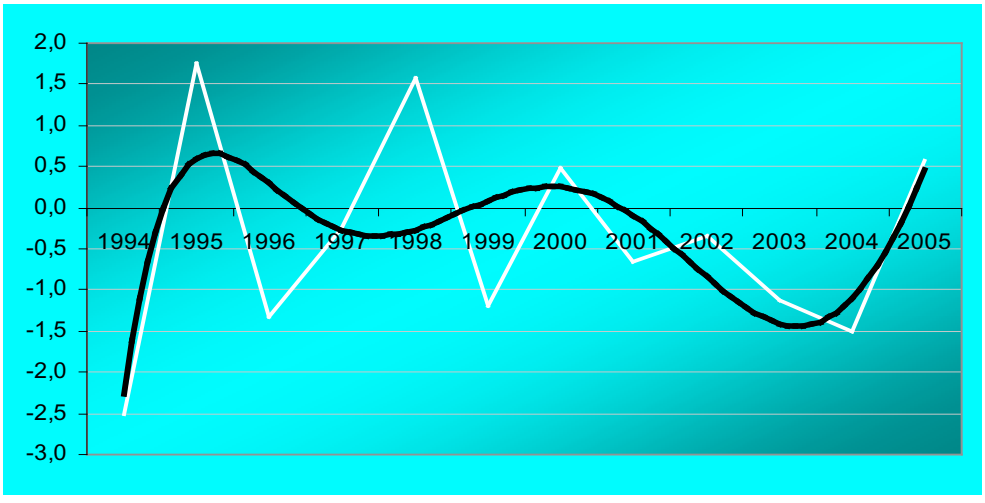
Figure 9 **TFP for the Finance and Business Services Sector 1994–2005**



Source: Statistics Sweden

The fall in prices of real estate and the banking crisis in the beginning of the 1990s are, with most certainty, reflected in the low and negative TFP growth during that same period.

Figure 10 **TFP for Other Services 1994–2005**



Source: Statistics Sweden

The growth rate of productivity in the sector of *Other Services* has been very volatile during this period. Several years has displayed negative rates of productivity growth. There is also no sign of a trend in the TFP growth. These industries are very important as intermediates in most other industries and their low productivity developments have thus a major impact on these. However their productivity increases are probably underestimated due to high price deflators especially during the period up to the very last years, when better deflators have been introduced successively.

Overall, our results show a strong resurgence in the productivity growth from the low point in 2001 in all of the main sectors. In comparison with our earlier study this new set of TFP estimates coincides very well at the intermediate level, according to trends and relative levels of average growth in productivity between the major sectors.

What is behind the TFP development?

In order to further analyse the concept of total factor productivity we studied the relationships between TFP and ICT intensity, labour quality and investments in research and development, R&D, respectively.

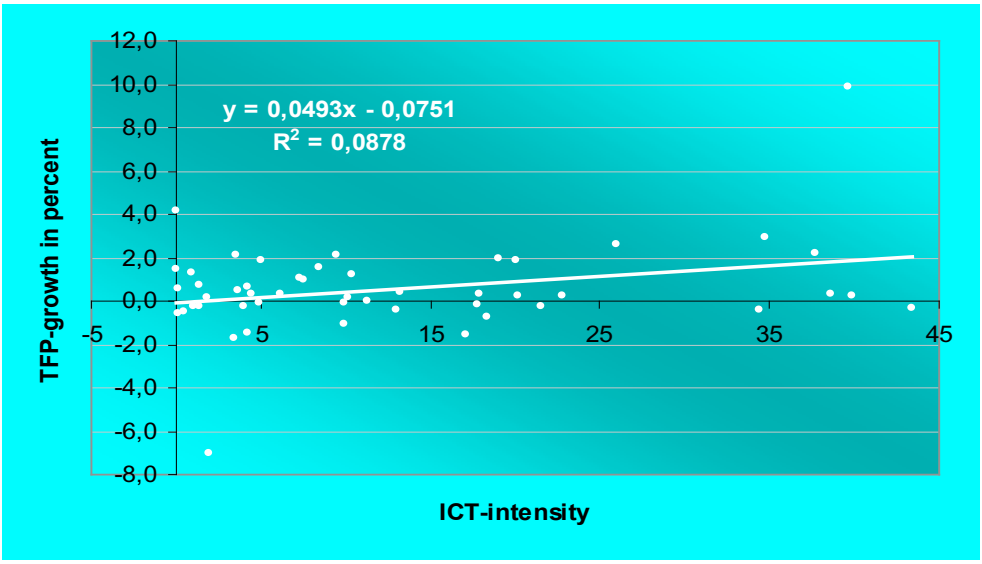
ICT intensity

To evaluate the impact of ICT on TFP we first constructed an indicator of ICT intensity. This indicator was estimated by dividing the stock of ICT capital by value added for each industry using values for the year 2003.

In order to evaluate the strength of the relationship between ICT intensity and TFP, average TFP for the period 1994-2004 for each of the 50 sectors was plotted against our measure of ICT intensity. The result is displayed in figure 11.

What we find is a weak but significant and positive relation which shows that if the ICT intensity is raised 10 percentage points, average TFP is raised 0.49 percentage points. The R-square is almost only 0.09 which indicates a low level of explanation.

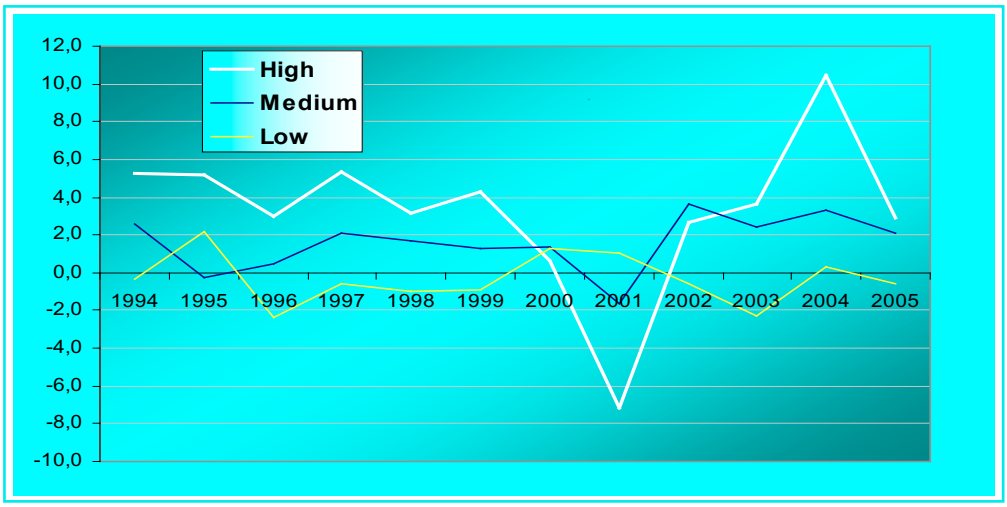
Figure 11 **Average TFP 1994-2004 and ICT intensity 2003.** ***In percent***



Source: Statistics Sweden

Next, all industries were ranked according to this ICT intensity measure and divided into three equally large groups referring to high, medium and low ICT intensity.

Figure 12 **Average TFP for the period 1994–2005**
Industries divided according to ICT-intensity



Source: Statistics Sweden

Average TFP for each group was then compared against each other over the period 1994-2005. The results are displayed in figure 12.

The result clearly indicates that industries with high ICT intensity also have been more successful in raising their productivity. During almost the entire period the group with the highest ICT intensity shows higher rates of productivity. We also see that the group with the lowest ICT intensity shows the lowest rates of productivity. Average TFP for the three groups for the whole period is 3.3 percent, 1.6 and -0.3 percent respectively. The year 2001 are clearly marked by events in the telecommunication sector.

Labour quality

We also studied the relationship between labour quality and the growth in TFP. Our measurement on labour quality is based on how the market values different education orientations and levels as well as age and ethnicity. Se Appendix 1.

Figure 13 **Average TFP 1994–2004 and Labour Quality 2003**

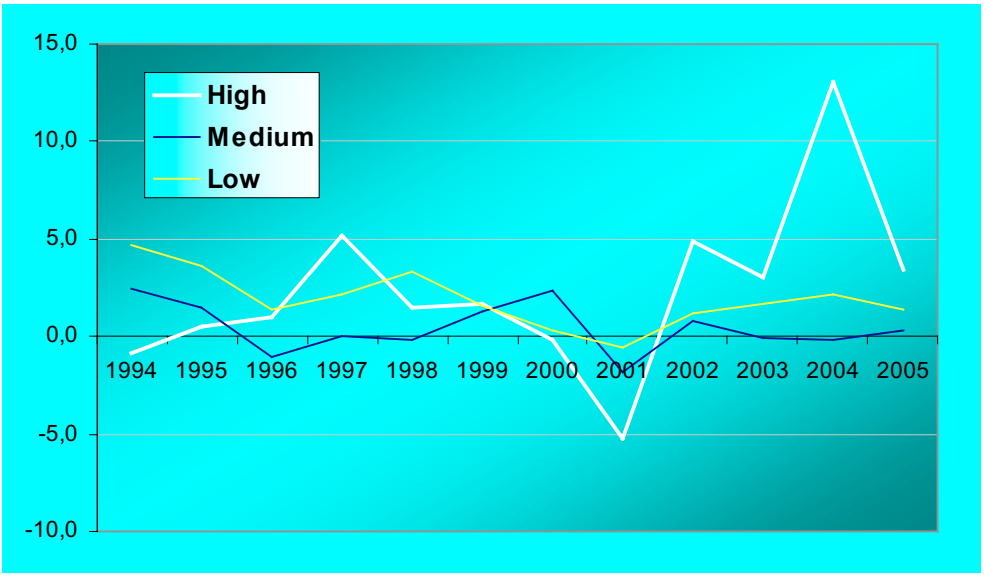
Source: Statistics Sweden

Figure 13 describes the relation between labour quality and average TFP. On the Y-axis we have average TFP for the period 1994-2004 and on the X-axis we have the measure of labour quality for the year 2003. Our estimations indicate a very weak positive relationship between labour quality and TFP with the R-square

value at only 0.016. This means that our model captures all effects of labour quality and that there hardly exists any spill-over effects.

Following the method described above the 50 industries were again ranked according to our measure of labour quality. The data set was then divided into three groups reflecting the composition of the labour force in each group. The average TFP for each group was then compared against each other over the period 1994-2005. The result is displayed in figure 14.

Figure 14 **Average TFP for the period 1994–2005**



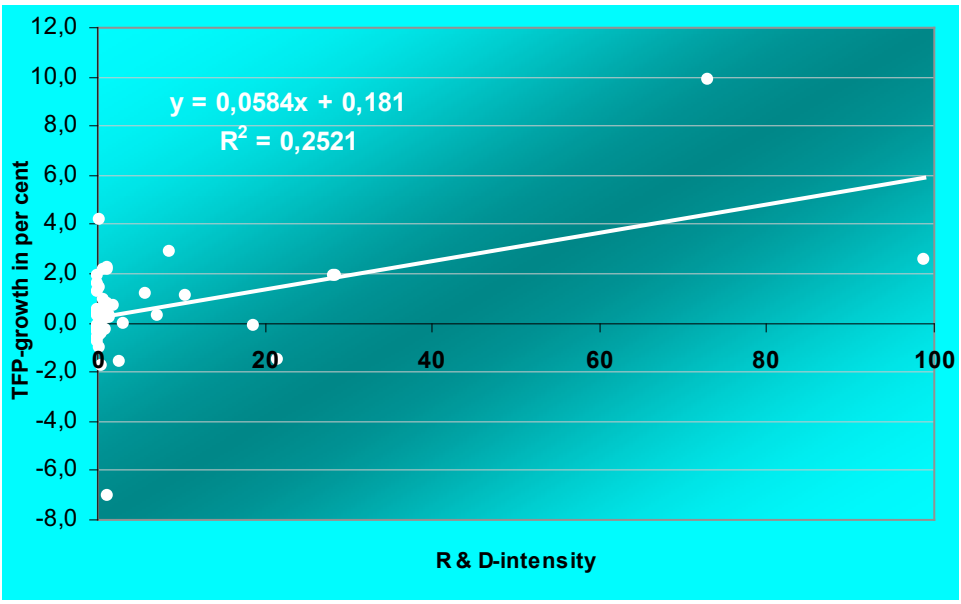
Source: Statistics Sweden

During this period we see that the group including the highest rewarded employees, shows the largest average TFP for most of the years. This is especially true during the years 2002 to 2005. In six of the years this group shows the highest rates of TFP. The average TFP for the three groups for the whole period is 2.3 percent, 0.5 and 1.9 percent respectively. Obviously, the relative high TFP in the year 2004 has a large effect on the average TFP for the whole period for the group with the more productive employees. One reason why the industries with rather low qualified personal beat the medium group in TFP-development is that it includes more manufacturing industries.

Research & Development

Finally we constructed a measure of research and development intensity for all industries according to their investments in R&D relative to their value added. Again, the relationship between average TFP for all industries during 1994-2004 and the share of investments in R&D was examined.

Figure 15 Average TFP 1994–2004 and R&D intensity 2003



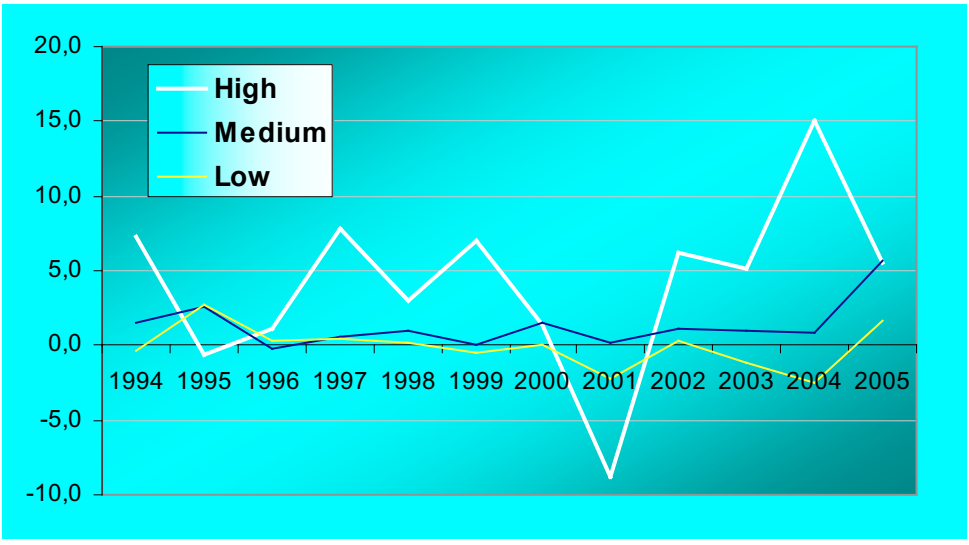
Source: Statistics Sweden

According to our results there is a weak but significant and positive relationship. If the R&D intensity would be raised 10 percentage points, the model implies that average TFP would be raised 0.58 percentage points. The result is obviously affected by the two extreme values of the *Research and Development* Sector and the *Electronical and Telecommunication* Sector.

Finally, three groups were formed according to each industry's investments in R&D relative to their value added. Figure 16 displays the comparison of the three groups average TFP over the period 1994-2005.

Also in this case, the group with the highest ranked industries has been more successful in raising their productivity. In almost all years this group has a higher productivity growth than the other two groups. The medium intensity group also beats the industries with the least share of research and development investments most of the years. Average TFP for the three groups for the whole period is 4.1 percent, 1.2 and -0.3 percent respectively.

Figure 16 Average TFP for the period 1994–2005



Source: Statistics Sweden

So far the influence on the TFP growth of R&D, labour quality and ICT has been studied separately. This means that we do not know what the impact of each variable is when the others are held constant. To really test if there are any spill-over effects of these knowledge economy indicators we have to calculate there partial influence on the TFP holding the other variables constant. This was done by estimating a simple OLS regression has been estimated with a dummy for the service industries. Three of the variables became significant on at least the 2 percent level, and around a third of the differences in TFP (R^2adj=0.36) are explained. However, the coefficient for the labour quality became not too surprisingly non significant. Apparently there is no indication of any spill over effects from the labour quality.

As was very clear from our analysis earlier the service industries have lower TFP growth. Actually they have 1.1 percent lower TFP-growth per year given the other variables. The coefficient for R&D intensity indicates that an increase of 10 percent of the value added gives an increase in TFP-growth rate by 0.5 percent per year, and an increase of 10 percent of the proportion of ICT-capital in relation to the value added gives almost the same effect or 0.46. Apparently there are substantially spill-over effects both on R&D as well as on ICT-investments.

The Swedish trade balance in TFP terms

Technical change and competition are the main driving forces

Total factor productivity is often called technical change; this implies that innovation is the main force behind the TFP growth. Important factors that are involved in the creation of an innovate environment are research, ICT use and human capital. As already mentioned, this was the reason why we studied the relationship between these factors and TFP development on the industry level. In figure 7.11 it was possible to see a relationship between R&D intensity and TFP growth. The observations in this figure were however industries, not single firms.

But let us look at the situation for a single firm. If it is operating in a perfect market all the benefits of a TFP increase would go to the customers. However if the products is not homogenous and differ between firms, as it does in at least in most high tech industries, this is not the case. And if a firm is really innovative and does not just spend a lot of money on R&D, it will increase the value of its products and services or improve its production and distribution, if its innovation has more of a product orientation or process orientation. If the firm is a true monopolist or has more limited monopoly power, in scope or time, based on patents or on the advantage of being first in the market, the firm can expect to benefit a lot from its innovation. But if its position in the market is weaker due to strong competition by other innovative firms, the rewards will be just a fraction of the total benefits of this innovation to society. A market where there are many examples of both these alternatives is the market for ICT goods and services.

In the 1960s IBM had a very large market power and huge profits, as Microsoft in the 1990s and Google in recent years. But most of the submarkets of the ICT market are characterized by fierce competition, where a firm's innovative ability does not guarantee large profit margins. Those who have benefited most from the rapid technological developments are the customers who have continuously received better products and services for the same or lower prices.

In an industry that is less dynamic and where fewer innovations are taking place, the customer can normally not expect falling prices even if the competition is intense. But if such a market undergoes a dramatic change, for example opens up to international competition, the prices can fall even on a rather stagnant and not so innovative market as the Swedish food market. When Sweden joined the EU the Swedish food producers, both the farmers and the food processing industry, suddenly had to compete with other European firms. And in recent years new players have entered in the national distribution market in the form of foreign

grocery chains that have established themselves in Sweden. Both these major changes in the competitive environment have led to lower prices for the Swedish consumers. During the 1980s the CPI for food increased by 0.7 percent more per year than the total CPI, but after 1990 it has increased by 1.7 percent less. So there are two major forces that influence price development: technical changes and competition in the market.

Who benefits most from TFP growth?

It is not only a continuous fight between producers and their customers of how much each should benefit from technological development. It is also in fact a competition among nations. If for example a country produces a lot of IT hardware it could in a world with imperfect markets be expected to benefit from the rapid productivity growth that gives a boost to their GNI. This is of course true in volume terms with fixed prices, but is not as self evident when it is measured in current prices. And the transactions between countries is done in current prices. If a country's trade balances, it does so in current prices. The country has to buy its imports with the euros it receives from its export. If international competition is fierce, the national firms have to charge lower prices than they could this year in order to sell their products to other countries next year also. This means that they cannot distribute as large sums to their employees and their owners as they otherwise could have done. In turn their employees and owners cannot buy as many foreign consumer goods as if their employer could have been able to keep the price level from this year.

In the trade battle between nations it is of utmost importance for a country to sell its products for as much money as possible and buy as cheaply as possible. If a country's export is dominated by products and services that are produced by industries with high TFP growth sold on very competitive markets, it will have to sell them at decreasing prices and thus give away a large part of the rapid TFP increase to customers in other countries. But on the other hand it is of course an advantage to specialise in high tech industries with a high TFP growth since this increases the growth rate of the country. The trick is to produce products with high TFP growth rates with rather weak competition or use a lot of them in your own country. But it is definitely an advantage to import a lot of products and services with high TFP growth sold on very competitive markets.

The input of goods and services also matter

The prices of goods and services are not only dependent on the changes in the internal process of the firm that sells them, that is, the development of its value added. The income from sales, or gross production, depends thus on the value added, or the contribution that a firm does itself to all the inputs that it buys from

other firms, as well as inputs such as: raw materials, intermediate goods, energy and services. For companies that produce goods, their value added are in general worth considerably less than half of the value of the finished good. Value added is more important for many service firms, but for all firms the inputs bought from other firms are of great importance.

The change of the prices of the goods or services that a certain industry sells therefore depends not only on the TFP growth of its own industry but also on the TFP growth of all the industries that it uses as inputs. For example if the price of crude oil increases, some industries like the petroleum refineries that use crude oil as an input are faced with increasing costs. Since they do not add much to the value of their inputs and thus can not absorb any of this cost increase, they pass them on to their customers. Among these customers, the land transport industry and the real estate business are important. The land transport industry has good TFP growth and does not need to pass on so much to their customers. On the other hand, the real estate firms have difficulties to improve their productivity.

In order to incorporate all these linkages it is necessary to use the inverse of the input-output matrix. This matrix gives us the required information if we reduce each element in the diagonal vector by 1. We will therefore multiply this version of the inverse of the I-O-matrix with the vector with the growth rates of the Gross Production TFP. This transaction will give the TFP of the inputs of each industry. Then the TFP for the value added of an industry will be weighed together with this input TFP to get a new gross production measurement with respective weights for the value added and the inputs for each industry.

$$TFP_{GPNEW} = (1-(VA/GP))x\,[(I-O)_{Adjust}^{-1} x TFP_{GP}]+(VA/GP)xTFP_{VA} \quad (7.4)$$

There $(VA/GP)xTFP_{VA=}TFP_{GP}$

TFP_{GPNEW} = A 1x57-vector with the growth rates for the new measurement, which is defined in the equation above for Total Factor Productivity for Gross Production for each sector

TFP_{GP} = A 1x57-vector with the growth rates for Total Factor Productivity for Gross Production for each sector

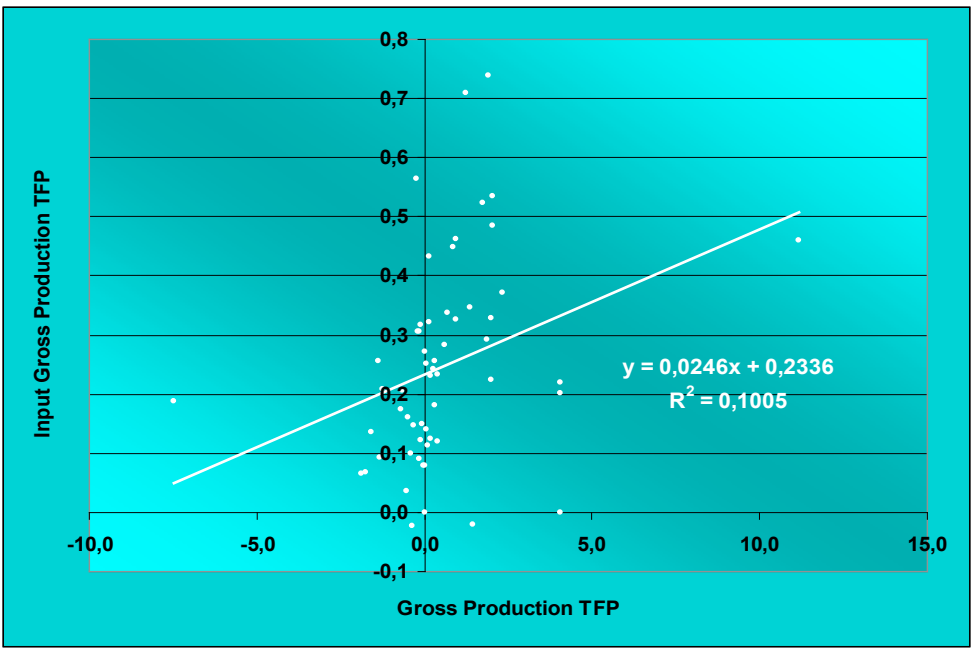
TFP_{VA} = A 1x57-vector with the growth rates for Total Factor Productivity for Value Added for each sector

$(I-O)_{Adjust}^{-1}$ = The inverse of the input-output matrix with an adjusted diagonal vector, and thus a 57x57 matrix

(VA/GP) = The value added part of the gross production

Ideally an I-O matrix for every year from 1993-2002 should have been used, but since there are only matrixes for 1995 and 2000, we have chosen to use the year 2000 version for the whole period. In figure 17 the relationship between the traditionally calculated TFP for different industries and the input TFP for the same industries is shown. Two things are apparent, the relationship between the two measurements is very week and the average values for the inputs are much lower. The last mentioned is due to the fact that production from industries that is used intensely as inputs have generally low and in some cases even negative TFP developments. Actually the industry that has the by far the largest average weight, the business consultancy industry, has a negative TFP.

Figure 17 **The relationship between the input TFP and the Gross Production TFP**



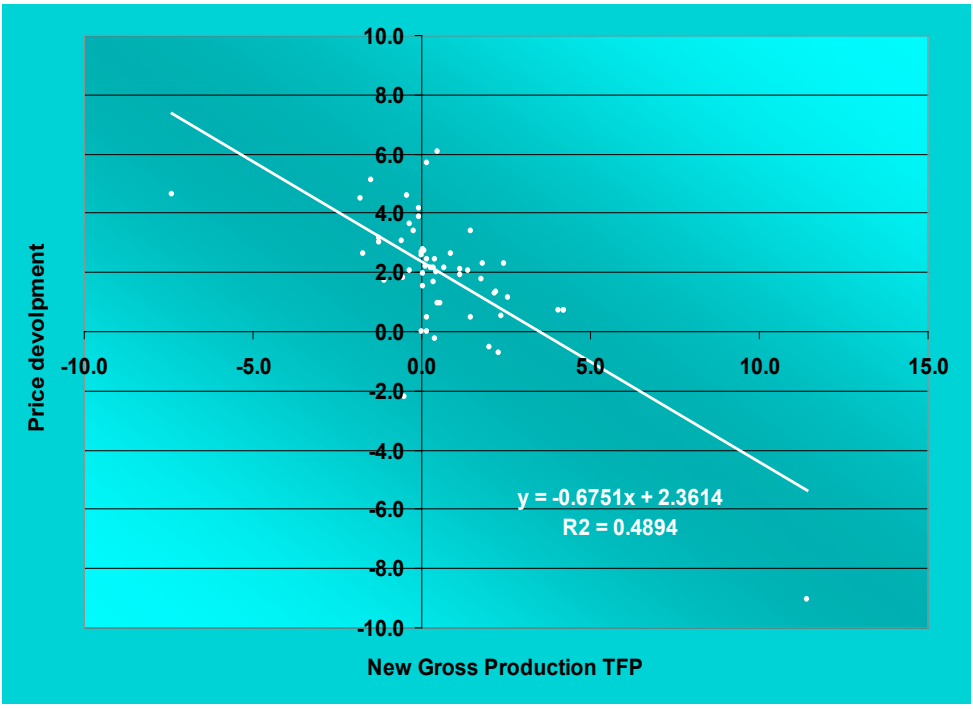
Source: Statistics Sweden

The same is true for two of the other three industries with very high weights, land transport and real estate services. The only exception is trade, which has a relative high positive TFP. In addition, some industries with rather low weights but with large negative TFP-developments drag the average down. This means that the New Gross Production TFP is not that much larger than the traditional Gross Production TFP. But these TFP growth rates are based on our national data, and especially the inputs of goods are imported to a large extent. This creates a

major problem, since we do not have access to a comprehensive set of TFPs for Sweden's major trading partners. In this exercise we are limited to use the TFP growth rates for the same industries in Sweden as proxies.

They should in most cases give us a reasonably good approximation since in the integrated world of today technological progress should be more or less the same the world over, especially in the goods producing industries, while the service industries are still mainly national.

Figure 18 The relationship between the new gross production TFP and Prices 1993–2003



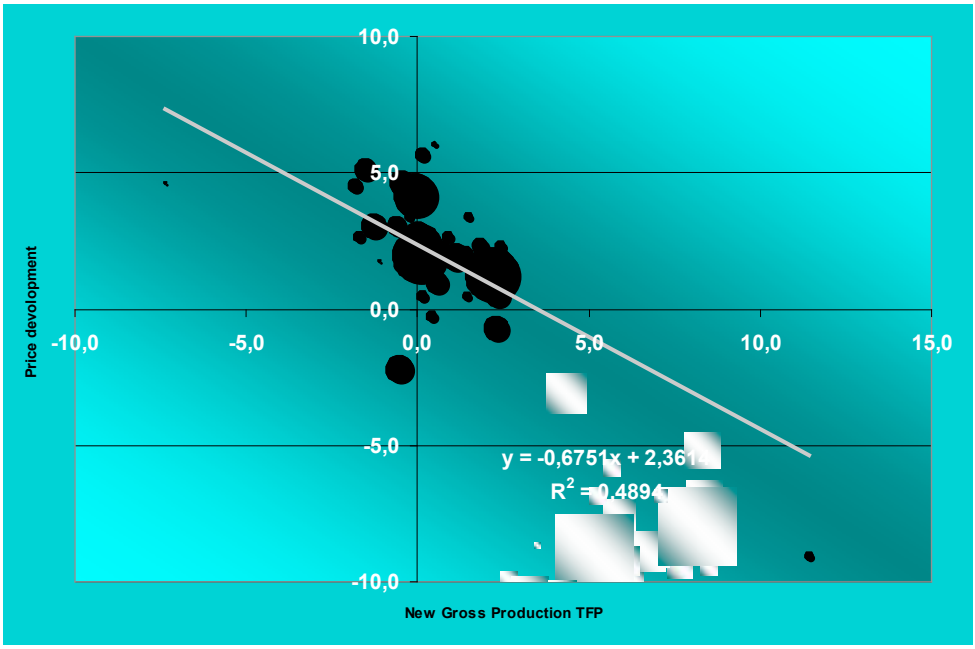
Source: Statistics Sweden

However there is a reason why a country imports a certain type of good from a particular country. And this reason is of course that the latter country is in relative terms a competitive producer of this type of goods. If some countries have a comparative advantage in producing certain types of goods, they probably also have done well in the TFP field, so all the TFP growth rates are definitely not the same. But this kind of data should soon be available from the EUKLEMS project[10].

As can be seen in figure 18 the relationship between the prices and TFP is quite clear but not very strong. And apparently a couple of extreme observations have strengthened it markedly. If these observations are excluded the R^2 drops to a just over a third of its original value. However, taking the result as it is it tells us that an increase of the TFP growth rate by 1 percent per year gives a price increase of 0.675 less percent per year. That means that two thirds of the benefits of technological change are on average passed on to the buyers. As already mentioned, with perfect markets all the improvements of the TFP should be passed on to the customers so 1 per cent higher TFP would result in a 1 per cent lower price development. This is apparently the case of the reasons already described.

Figure 19 The relationship between the new gross production TFP and Prices 1993–2003

Source: Statistics Sweden



Compared to the similar Canadian[11] calculation there is a marked difference especially taking into account the importance of the extreme observations in the Swedish case. The Canadian data is based on a very long time period, namely from 1961 to 1995, and the traditional gross production concept. The correlation coefficient of in this dataset is 0.8 compared to 0.7 for the full Swedish data with the same TFP-definition. Their result is also not as dependent on some extreme

values as in the Swedish case. This gives an indication that the competition in the Canadian market is generally than in the Swedish market.

However, the differences in importance between industries are quite large in Sweden. As an illustration of this fact a new version of figure 18 is shown in figure 19 where the industries are marked with spheres that are proportionate to their relative share of the value added of the whole business sector. In this picture the relationship seems to be stronger if the importance of the observations is taken into account. Still there is a marked difference between the Swedish and the Canadian results.

Swedish export and import of TFP

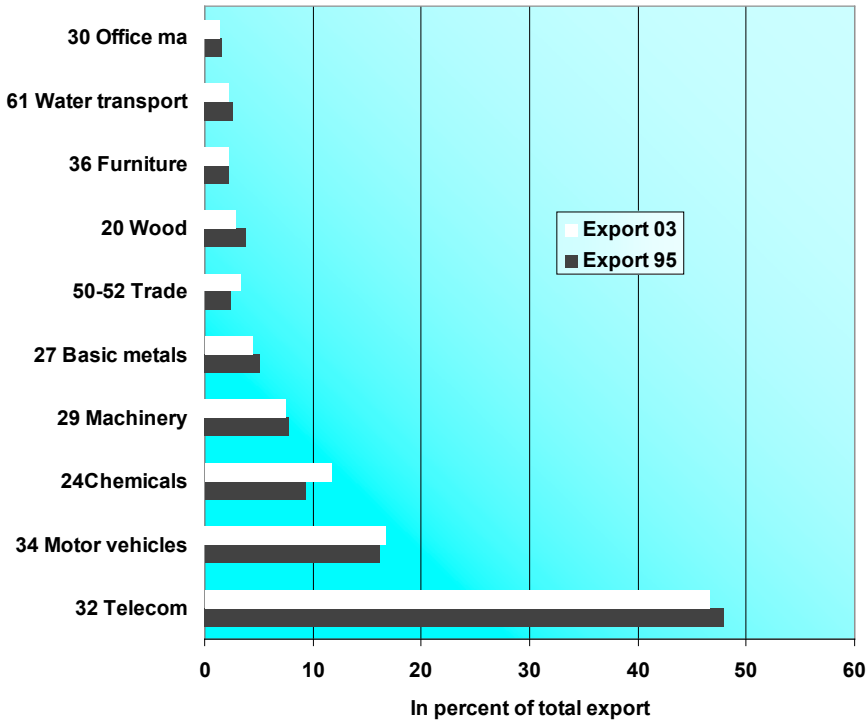
It is not only companies and industries that have to give away some of their productivity increases to their customers; nations must also do so. We will try to get some indications on how the Swedish trade balance looks in this perspective.

The Swedish trade data in current prices for 1995 and 2003 is taken from the supply-use tables. The different industries' weights in the total export for each year have been multiplied by the average growth rates of the new gross production total factor productivity for the period 1993-2003.

Almost all the total TFP export has been created by just a handful of industries, since the 10 most important ones accounted for around 99 percent of the export of TFP both in 1995 and 2003. It is the same industries both years, and the only change in the ranking is that water transport and wood products have dropped one position while trade and furniture have gained one. The Swedish telecom product industry alone stands for well over forty percent in both years, and two other industries contribute more than 10 percent and one just somewhat less in 2003. That means that these four industries represent over 80 percent of the Swedish export of TFP both in 1995 and 2003. All of these three important engineering industries have almost the same weight both years.

The chemical industry has, however, especially due to its pharmaceutical part, increased in importance. The traditional industries such as the wood industry, the basic metal industry and the furniture industry are on the list but with slightly decreasing weights over time. The last industry on the top ten list, the computer industry, is of a completely different type. The Swedish specialisation in the ICT production field is very obvious with telecom product industry at the top and computer industry ranked as the 10th.

Figure 20 **Swedish Export of TFP for the important industries.**
In percent of the total Export of TFP

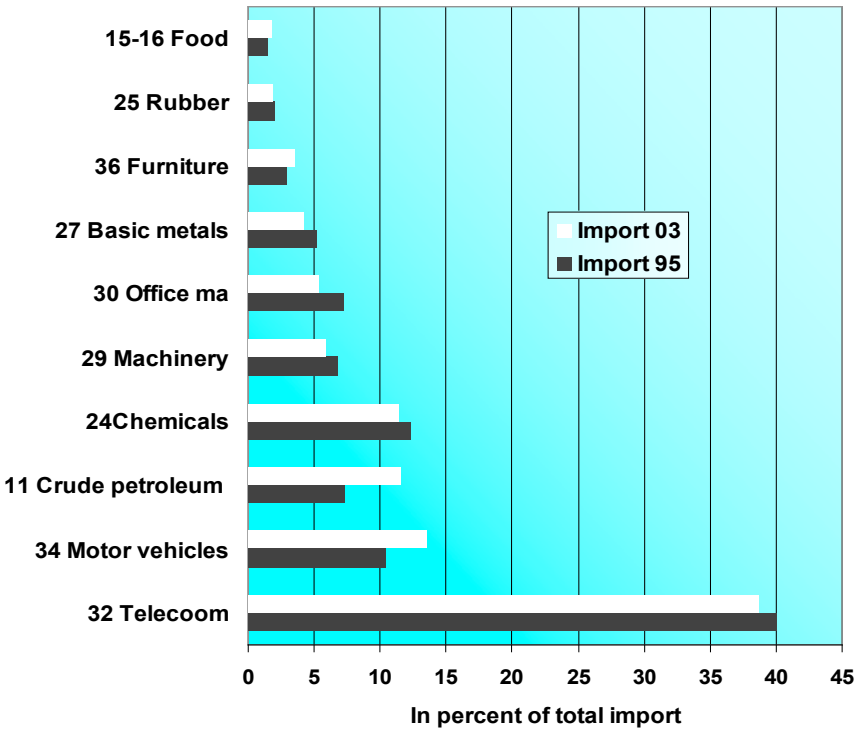


Source: Statistics Sweden

Most of the industries that are large TFP exporters are also the industries from which Sweden imports a large part of its TFP. But this is a very tentative conclusion since the TFP measurements, as already mentioned, is based on the performance of these sectors in Sweden.

On the import side the telecom product industry is also by far the most important one, and even if its importance has been reduced somewhat from 1995 to 2003, it still stands for well over a third of the TFP import single-handedly. Furthermore, the second most important industry is the same as on the export side, namely the motor vehicle industrywhich like the chemical industry and crude oil industry has a weight over 10 percent.

Figure 21 **Imports of TFP distributed over the most important industries.**
In percent of the total import of TFP



Source: Statistics Sweden

That gives an aggregate of the four major TFP import industries nearly the same dominance as the four major exporters of TFP, with a weight of 70 percent in 1993 and 75 percent in 2003. Two engineering industries follow: the machinery industry which after the specialisation of the Swedish machinery industry during the 1980s has become a major import product for our country, and the office machine industry which is much more important for the TFP import.

All these engineering industries and the chemical industry which are high up on both the export and import lists are characterised by extensive inter-trade due to a high degree of specialisation among the OECD-countries.

The industries that only appear on the import list, besides the crude oil industry, are the last two, namely the rubber and plastics industry and the food industry. The first mentioned of these is yet another expression of the fact that the Swedish economy has traditionally been based on steel and wood and not on coal, which is the historic base for almost all chemical- related industries. The very scarcity of

people living on Swedish soil is proof, if anything, that the comparative advantage of Sweden does not lie in agriculture and thus not in food production. So it is no surprise that the food industry emerges on the import list.

We have now come to the question if Sweden is a net exporter of TFP or a net importer. The average of "New Gross Production TFP" is rather similar for both the Swedish export and import in 1995 as well as in 2003.

Table 2 Swedish export and import of TFP 1995 and 2003

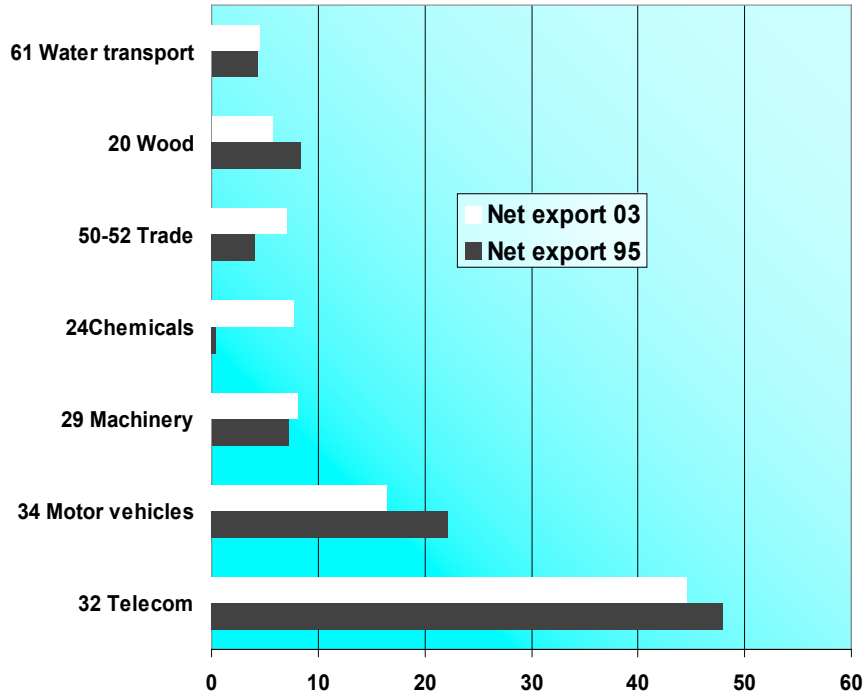
	Export TFP 1995	Import TFP 1995	Export TFP 2003	Import TFP 2003
Average TFP in percent per year	1.84	1.69	1.74	1.62

Source: Statistics Sweden

However, there is a difference and this is positive both years. The difference has nevertheless decreased somewhat from 0.15 to 0.12 percent per year. This means that Sweden exports more TFP than it imports, but the difference is limited. Still, Sweden is giving away a lot of TFP in another sense since the relative net export as a percentage of the import was 24 percent in 1995 and 22 percent in 2003.

If you want to measure the relative importance of the different industries of the net export of TFP it is not self evident how you should calculate it, since there are some industries that have a negative TFP net export, even if they are fewer than those that have a positive one. And a couple of industries have a positive net export of the TFP due to a combination of a negative TFP and a negative net export, among them the clothing industry. So our choice is to distribute the total net export over the industries which have both a positive TFP growth and a positive net export.

Figure 22 Net export of TFP
Source: Statistics Sweden



We then come up with a short list of the eight industries that are representing at least around 5 percent or more of the net export in 2003. This show a the not very surprising result; the telecom product industry is by far the most important one, followed by the motor vehicle industry that had half the weight of the telecom product industry in 1993 and a third in 2003. The machinery industry then follows, which is an engineering industry that has more than kept its relative importance. The most dramatic change is the emergence of the chemical industry as a net exporter. The service industry trade has also increased in importance which is not the case for the other service industry on the list, water transport.

The handful of industries where Sweden is a net importer of TFP is dominated by the oil industries, mainly the petroleum refineries but also the crude oil industry which has increased dramatically in importance. This is of course a very shaky conclusion since our Swedish Crude Oil industry is not a big one and does not produce any crude oil but other products that are included in this industry. As a result TFP growth for this industry probably differs a lot from that of the countries we do import from. The only other important industry on the import side is the computer industry. This industry in Sweden is small and not very dynamic. Its TFP

is just a third of the other ICT-producing industry, the telecom product industry. If we instead had used the TFP from our national telecom product industries as a proxy for the TFP, the effect on our net import of computers would have offset two thirds and not just one seventh of the impact of the telecom product industry in 2003. On the other hand the telecom product industry has just partly recovered from the crisis of 2001-2002 so its net export should be much higher 2004-2005.

Our very tentative conclusion is then that Sweden does not export TFP to any significantly larger extent than it does import, but due to the fact that Sweden has a large trade-surplus. But since our terms of trade have somewhat deteriorated during the last decade our specialisation is apparently not optimally seen from this perspective. But this is not a major explanation of the paradox of a good growth performance and an underevaluated currency.

Appendix 1. Theory and model outline

As already been mentioned, we will take a KLEMS point of view in our productivity analysis. That means that the effects of input of capital (K), labour (L) and intermediate input on production was incorporated. The intermediate input was broken down into input of energy (E), materials (M) and services (S).

The production function expresses the relationship between the factor inputs and the output in the economy. Let gross output be a function of capital, labour and intermediate input. A is an index of the level of technology in the economy.

$$Y = AK^{\alpha}L^{\beta}M^{\gamma} \qquad (1)$$

A is commonly referred to as total factor productivity, TFP, or multi factor productivity. Changes in *A* shift the production possibility curve making it possible to produce more without changing the factor inputs.

Growth accounting is a technique commonly used in productivity analysis. This method allows the growth in production and labour productivity to be decomposed into growth of the factor inputs and growth in total factor productivity, TFP. Studying the production function, estimates on growth in production and growth in factor inputs is normally not a problem to obtain. Using growth accounting, total factor productivity is that part of growth in output that cannot be explained by growth in the input factors. While having estimates on growth in output and input factors TFP is estimated residually.

While using the production function stated above standard neo-classical growth assumptions was used as; constant returns to scale, perfect competition and profit-maximizing firms. All of this meant that factor inputs were rewarded by the size of their marginal productivity. The growth in TFP was assumed to be Hicks-neutral. Assuming constant returns to scale yields the coefficients to sum to one; $\alpha + \beta + \gamma = 1$.

The equation (1) was reformulated in a growth oriented way. By taking the logarithm and the first difference of the production function we express all variables in terms of rates of growth and get:

$$\Delta \ln Y = \alpha \Delta \ln K + \beta \Delta \ln L + \gamma \Delta \ln M + \Delta \ln A \qquad (2)$$

Δ refers to the first difference, i.e. $\Delta x \equiv x_t - x_{t-1}$.

Studying the model it is clear that growth in gross output is possible only by raising the input of one of the input factors or by raising the level of technology in the economy, that is, the total factor productivity, TFP. By expressing the production function in growth rates (log differences) the growth in Y is split up in the share weighted growth in capital, labour, intermediate consumption and TFP.

Using this model enables us to study the share weighted growth in GDP. In so doing estimates on the weights of the factor inputs is needed. By taking the starting point in the firms profit maximization function, the quantities of capital services, labour and intermediate inputs are chosen so as to minimize total costs and maximize profits. Let Π denote the profit, Y is production, wL is the total cost of labour, rK is the total cost of capital and pM is the total cost of intermediate inputs.

$$\Pi = Y - \omega L - rK - pM \qquad (3)$$

While maximizing Π subject to $Y = AK^{\alpha}L^{\beta}M^{\gamma}$ it can be shown that

$$\alpha = \frac{rK}{Y} \qquad (4)$$

$$\beta = \frac{\omega L}{Y} \qquad (5)$$

$$\lambda = \frac{pM}{Y} \qquad (6)$$

The weights of the factor inputs, α, β and γ, are represented by each factor's share in total production.

Assuming perfect competition, there are no profits other than the remuneration to labour, capital and intermediate input. Hence the value of output can be expressed as:

$$Y = \omega L - rK - pM \qquad (7)$$

Then we see that the weights are represented by each factor inputs share in total cost.

In the empirical analysis below different types of capital was being used. Splitting capital into these subcategories yields:

$$\alpha \Delta \ln K = \sum_j \alpha_j \Delta \ln K_j \qquad (8)$$

where α_j represents each capital's share in total capital costs:

$$\alpha_j = \alpha \frac{r_j K_j}{\sum_j r_j K_j} \qquad (9)$$

Since we were interested in the effects of different types of labour the set of labour were divided into a number of categories. Assume in this case that A is the set of different labour types, and L_a the quantity of labour of type $a \in A$.

$$\beta \Delta \mathrm{h}\ L = \sum_{a \in A} \beta_{ait} \Delta \mathrm{h}\ l_{ait} \qquad (10)$$

Here l_{ait} is the share of category a in total labour, and the β_{ait} -coefficients represent each types share in total labour cost:

$$\beta_{ait} = \beta_t \frac{\omega_{ait} L_{ait}}{\sum_a \omega_{ait} L_{ait}} \qquad (11)$$

Data

In our empirical analysis we studied the growth in TFP both on gross production and on value added. We used data from the national accounts on capital stocks, worked hours and intermediate input. The data on labour is derived from RAMS, register-based labour market statistics at Statistics Sweden. But on crucial part of the data was missing, genuine ICT-investment data. These were instead estimated from the production and import and export statistics in order to estimate the amount of the different ICT-goods and service that was supplied to the Swedish domestic market.

Capital Services

As mentioned earlier we will in this empirical analysis use the flow of capital services streaming from capital rather than the value of the capital stock itself. By taking into account the heterogeneity of capital and those different types of capital have different marginal productivity; we get a more effective measure of the capital input in production.

The value of the flow of services from the stock is a better measure of the input in production than is the value of the stock itself. Over time there should be a substitution of capital towards capital with higher marginal productivity. For example as prices on ICT capital are falling industries tend to invest more in this cheaper and more productive capital.

Consider the capital stock K_t. The capital stock is estimated by using the traditional PIM-method.

$$K_t = K_{t-1}(1-\delta_{t-1}) + I_t \qquad (12)$$

Here δ is the value of depreciation in period t-1 and I is the value of investment in period t.

The value of the stock is estimated at the beginning of the year. Assuming that new investments becomes available for production in the middle of the year we express capital services as

$$C_t = a(0.5K_t + 0.5K_{t+1}) \qquad (13)$$

The capital service flow is assumed to be proportional to the average of the current and lagged capital stock where α denotes the proportionality constant[12]. The flow of capital services is then estimated by using asset specific user costs to weight the growth in each type of capital and to account for the substitution between them.

User cost

The flow of capital services is weighted with the user cost of each type of capital. The user costs are, under certain assumptions, equal to the marginal productivity of capital. User cost can be seen as the cost of borrowing capital and investing in a capital good, renting it out, and collecting a rent.

The estimation of the user cost can be made more or less complex regarding tax regulations. In this study we are relaxing all effects of taxes.

The components of user cost are the rate of alternative investments, depreciation and the change in the price on investment goods. There are different options of choosing the rate of return. In this study we used the endogenous internal rate of return derived from the national accounts. By relating gross operating surplus to the capital stock, the rate of return was derived. This was done for each of the sector aggregates in the study. The rate of depreciation was estimated per sector and type of capital. Changes in prices on investment goods were derived from implicit price indices on investments in the national accounts.

In a very simple form the user costs were estimated as:

$$\mu_t = r_t + \delta_t - \Delta p_{t,t-1} \qquad (14)$$

where μ is the user cost, r is the rate of return, δ is the rate of appreciation and Δp is the rate of price change in new investment goods.

The estimated user costs are then used to calculate the weights by which the flows of services are aggregated. The weights are defined, for a capital good C_k as:

$$\upsilon_{k,j,t} = \frac{\mu_{k,j,t} C_{k,j,t}}{\sum_k \mu_{k,j,t} C_{k,j,t}} \qquad (15)$$

Labour composition

The effect of the labour input on production is not only a question of quantity but also of quality, or more correctly on its composition. The method which has been used is a traditional market oriented one. The working population has been split into many subgroups according to four different characteristics. For each of the subgroups we calculated the average incomes from both the employed and the self-employed.

If the labour market functions well, the average income for each subgroup is the market's valuation of the different categories as labour inputs. This is in accordance with a long tradition represented by Jorgensen[13] and Bureau of Labour Statistics[14] both of which have somewhat different approaches for the US labour market. This has been further developed on US and Canadian data by Gu and Maynard[15]. The income means are then treated as the market valuation of different categories of labour in respective workplaces. In most workplaces there are of course only a small number of these categories represented. But with the help of average prices it is possible to calculate a synthetic labour cost or labour composition indicator for the whole workplace. It is necessary to go via the workplace level since this is the unit that has an industry definition, not the individuals. They get an industry connection by their workplace. The workplaces can then be aggregated to industries on different aggregation levels.

Instead of creating an average for the whole time period we want to take account of the changes that take place in the valuation of different types of labour over the years. To take account of the changes over the years in relative prices is rather uncommon in the literature, but has been used by the researchers mentioned earlier at Statistic Canada[16]. To be able to follow the changes in the labour market over the years in a meaningful way, it is necessary to deflate these mean incomes for different categories with the general wage increase; otherwise the labour composition indicator, which is based on the mean incomes, includes both inflation and real wage increases.

For this purpose the structure from one year, that is, the relative size of each category, is combined with the earnings for each category the following year. This is then aggregated to a fictive average earning of that year which is divided with the factual mean earnings of the last year. The increase in average earnings is then treated as a common price index that is used to deflate the incomes of each subgroup. The resulting changes of the deflated prices of a subgroup over the years is then only reflecting the market's relative appreciation, or its depreciation, of the value of this group as labour input compared with all other subgroups.

The characteristics that have been used are the traditional ones: age, education and ethnicity with one exception, i.e. gender is not included. The choice of the different categories for each variable is based on how they are valued on the market. The education variable is split into two dimensions: orientation, and levels. There are five different levels but only two fields: 1) the technical and natural science orientation and 2) all other orientations together. The levels starts with primary (level 1 and 2) and lower secondary, and end with post graduate education (level 6). Concerning age, the workforce is split in as many as six categories, but of these the first and the sixth are very infrequent on the Swedish

labour market. These categories are namely those who are 16-20 years of age, and those who have reached the age of 67. The ethnicity variable is based on the countries where people are born. Those with an origin outside of Sweden are divided in four groups.

We have also limited the calculation to the private business sector since we are just studying this sector. It is also known that the public sector is paying less for the same competence. We have chosen broad education categories for the education orientations, since if they are narrower they tend to become more sector-specific.

Appendix 2. Developments 1993–2005

Table 1. Growth in Gross Production decomposed

ISIC	Gross Production	Total Capital Services	ICT Capital Services	Other Capital Services	Labour Services	Intermediate Input	TFP
01	0.30	-0.03	0.00	-0.03	-0.38	1.16	-0.44
02	-0.24	0.07	0.00	0.07	-0.03	-0.92	0.63
05	-1.31	0.09	0.45	-0.36	-1.07	-0.02	-0.31
10-12	9.60	-0.76	0.00	-0.76	-0.73	1.94	9.15
13-14	3.32	0.02	0.03	-0.01	0.13	1.46	1.71
15-16	0.80	0.26	0.14	0.12	-0.15	0.73	-0.04
17	1.55	-0.06	0.01	-0.07	-0.46	2.77	-0.7
18	-1.33	-0.24	0.02	-0.26	-0.89	1.56	-1.76
19	-0.06	-0.22	0.01	-0.23	-0.93	1.29	-0.19
20	3.41	0.20	0.07	0.13	0.30	1.35	1.56
21	0.55	0.20	0.07	0.12	-0.03	2.13	-1.75
22	0.36	0.20	0.26	-0.06	-0.54	0.41	0.28
23	8.36	0.22	0.09	0.13	0.06	0.62	7.46
24	5.43	1.16	0.12	1.04	0.31	2.66	1.31
25	4.31	0.23	0.03	0.21	0.45	2.41	1.21
26	1.41	-0.07	0.01	-0.08	-0.21	0.71	0.98
27	3.70	0.02	0.03	-0.01	-0.39	4.43	-0.36
28	3.99	0.74	0.25	0.50	0.69	2.78	-0.22
29	4.93	0.10	0.09	0.01	0.35	3.58	0.89
30	-3.27	-0.41	0.00	-0.41	-1.87	-3.67	2.67
31-32	13.32	0.10	0.06	0.03	0.22	3.20	9.80
33	7.47	0.65	0.05	0.60	0.38	5.87	0.56
34	9.55	0.41	0.23	0.19	0.43	6.23	2.48
35	1.07	0.12	0.04	0.08	0.20	2.75	-1.99
36	2.40	0.10	0.03	0.07	-0.61	1.68	1.22
37	19.14	2.43	0.50	1.93	1.21	17.27	-1.76
40	1.57	0.48	0.11	0.37	0.04	1.12	-0.06
41	0.02	-0.11	0.04	-0.16	0.60	-0.01	-0.46
45	1.18	0.11	0.01	0.10	0.44	0.22	0.42
50-52	3.38	0.60	0.35	0.25	0.22	0.43	2.13
55	3.34	0.04	0.09	-0.06	0.58	2.06	0.66
60	2.24	0.89	0.22	0.67	-0.08	1.30	0.13
61	3.92	0.18	0.15	0.03	-0.13	1.13	2.74
62	-4.36	0.17	0.15	0.02	-1.44	0.49	-3.58
63	4.65	0.70	0.14	0.57	0.54	2.19	1.22
64	5.61	1.14	0.91	0.23	-0.48	2.93	2.01
65	2.81	2.64	1.19	1.45	-0.29	-0.10	0.56
66	-0.25	0.01	0.17	-0.16	0.36	0.44	-1.06
67	4.99	0.21	0.14	0.07	2.10	1.77	0.91
70	0.93	0.51	-0.08	0.59	-0.02	0.46	-0.02
71	3.79	2.48	0.53	1.96	0.36	1.53	-0.59
72	7.31	0.21	0.15	0.06	2.82	4.51	-0.24
73	7.23	0.72	0.08	0.64	1.35	5.02	0.14
74	3.09	0.43	0.28	0.15	1.18	1.13	0.35
80	5.89	0.68	0.27	0.40	1.64	3.42	0.15
85	6.70	1.51	0.17	1.34	3.30	3.42	-1.53
90	4.29	1.46	0.35	1.11	0.41	3.04	-0.61
91	1.77	5.77	0.60	5.17	0.44	1.28	-5.72
92	4.64	2.31	1.57	0.74	0.48	1.98	-0.12
93	2.49	-0.55	0.01	-0.56	0.13	1.67	1.24
95	17.55	0.00	0.00	0.00	4.06	0.00	13.49

Table 2 **Gross Production TFP. *In percent per year***

ISIC	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	94-03	94-05
01	-3.7	-1.0	-1.4	2.4	-2.7	0.6	3.6	2.4	1.5	-0.3	-2.9	-3.8	0.1	-0.4
02	1.6	2.6	5.0	1.4	-3.5	6.9	-4.5	12.8	1.5	-6.2	3.1	-12.8	1.7	0.6
05	12.6	7.3	4.6	-0.7	1.9	-16.5	-1.1	10.1	-9.4	9.8	-12.3	-10.0	1.9	-0.3
10-12	23.8	2.6	14.8	0.7	0.3	-1.2	6.5	-10.5	4.1	-0.4	13.7	55.4	4.1	9.2
13-14	-0.1	3.1	-2.9	4.3	-0.1	1.1	-4.2	-2.5	0.3	3.0	11.4	7.2	0.2	1.7
15-16	2.0	2.3	0.7	-0.9	0.2	-0.2	-0.9	0.0	0.1	0.5	-2.2	-2.1	0.4	0.0
17	5.2	1.9	-2.8	-1.9	0.5	3.4	-0.4	-0.6	-0.5	-1.6	-1.0	-10.7	0.3	-0.7
18	-1.2	-0.3	-2.4	-2.0	5.0	-9.9	8.6	3.5	0.8	-1.7	-5.0	-16.7	0.1	-1.8
19	-4.5	1.1	1.2	0.7	0.0	-6.1	-2.9	-4.3	0.4	7.6	7.6	-3.0	-0.7	-0.2
20	1.1	0.5	3.4	-0.1	1.7	1.7	1.0	0.4	0.4	2.4	3.3	2.9	1.3	1.6
21	0.3	-6.1	-3.7	2.5	-1.1	1.8	1.7	-1.6	1.6	3.1	-7.7	-11.8	-0.2	-1.8
22	1.2	4.9	-0.4	0.6	-0.2	-0.9	-2.4	-3.6	1.9	1.4	-1.3	2.2	0.3	0.3
23	0.1	4.2	0.7	0.3	-0.9	0.6	-1.2	-0.1	1.7	-2.3	47.0	39.4	0.3	7.5
24	4.3	-6.8	-1.1	2.9	2.4	7.5	-0.6	-1.8	9.4	3.5	-0.9	-3.3	2.0	1.3
25	2.7	1.8	-1.6	3.0	0.5	0.3	1.7	-1.0	2.2	-0.3	4.2	1.1	0.9	1.2
26	1.5	1.4	-4.8	1.5	1.8	0.7	2.3	2.6	0.8	-0.8	5.3	-0.3	0.7	1.0
27	3.4	-1.7	3.1	2.5	-2.8	1.6	-0.2	-1.1	6.8	-2.0	-3.4	-10.6	1.0	-0.4
28	4.7	4.4	-4.1	-0.1	-1.8	-1.2	2.9	-3.7	-2.0	-0.3	-1.3	-0.3	-0.1	-0.2
29	4.1	2.3	-0.5	-0.4	0.9	-0.5	1.5	0.1	0.9	0.2	1.7	0.5	0.9	0.9
30	-1.7	1.9	1.3	2.5	12.7	-2.3	-1.4	5.3	-0.3	5.3	25.4	-16.5	2.3	2.7
31-32	9.3	14.3	15.3	15.2	8,8	8.7	-0.5	-17.4	10.2	5.7	39.3	8.6	9.9	9.8
33	1.9	-0.3	-1.8	1.9	5.7	-1.2	-3.4	-1.0	-3.6	0.1	9.5	-1.0	-0.2	0.6
34	9.1	-2.1	0.2	0.7	-0.4	10.3	5.7	-5.1	-0.4	1.4	8.1	2.4	1.9	2.5
35	-7.3	-0.6	-7.8	1.9	0.5	-1.4	-1.3	-1.1	-1.2	0.8	4.6	-10.8	-1.8	-2.0
36	7.2	4.5	-0.7	3.9	4.1	1.7	1.0	-1.6	0.2	0.2	-4.4	-1.4	2.0	1.2
37	-0.8	-8.7	-2.2	-2.6	1.4	-1.7	6.1	-2.2	-0.8	-1.0	13.4	-22.2	-1.2	-1.8
40	-3.8	4.6	-4.9	0.5	-4.1	-0.7	3.2	3.2	-4.5	-6.7	8.1	4.6	-1.3	-0.1
41	-1.0	2.6	-4.7	-2.0	-1.4	-0.6	0.8	0.0	0.3	2.3	-1.6	-0.4	-0.4	-0.5
45	1.6	0.6	0.3	-1.9	-0.7	-1.1	-0.7	-0.1	-0.2	-0.2	2.1	5.3	-0.2	0.4
50-52	4.2	2.5	1.8	0.5	3.0	1.7	0.7	0.4	2.2	3.2	2.3	3.1	2.0	2.1
55	-0.5	0.6	-0.1	2.5	3.5	1.2	1.7	-0.5	-1.1	-1.4	-0.6	2.6	0.6	0.7
60	3.2	2.2	-0.9	2.8	0.5	-0.6	-2.0	-3.3	-1.0	-1.4	0.6	1.5	-0.1	0.1
61	-0.4	2.7	10.2	4.4	-10.9	6.1	-3.8	1.8	6.7	-2.3	6.6	11.7	1.5	2.7
62	-6.0	2.1	1.0	-0.9	-2.9	-4.3	-0.9	-5.9	5.2	8.6	-8.0	-31.2	-0.4	-3.6
63	-0.2	2.9	-0.2	3.6	1.3	-0.6	-3.9	-0.4	-0.9	-1.9	6.3	8.6	0.0	1.2
64	1.0	5.0	0.6	2.8	2.9	2.7	5.4	-2.2	0.7	1.5	5.1	-1.2	2.0	2.0
65	-6.6	-4.9	0.4	0.9	-2.9	-4.3	6.1	-0.5	5.2	1.2	5.6	6.6	-0.5	0.6
66	-3.6	-14.4	-3.4	1.8	5.6	-0.7	0.3	-0.8	-0.1	-3.5	3.1	2.7	-1.9	-1.1
67	-8.0	-1.7	10.2	-5.0	-1.4	1.5	-0.6	-0.7	1.7	0.7	6.9	7.3	-0.3	0.9
70	-0.3	0.8	-0.7	-0.7	0.0	-0.6	0.6	1.2	1.1	-1.2	-0.2	-0.2	0.0	0.0
71	-3.5	-3.4	3.3	-1.5	1.3	6.2	1.0	-0.8	-3.2	1.5	-2.9	-5.0	0.1	-0.6
72	2.2	-0.8	-5.3	2.3	-4.6	-3.8	-2.4	-0.8	1.1	7.2	2.2	-0.1	-0.5	-0.2
73	-1.2	-4.0	-8.4	4.5	0.2	-5.1	-1.9	-7.1	-4.9	14.0	8.8	6.7	-1.4	0.1
74	0.9	-1.3	-1.8	-0.7	1.3	-0.8	-0.1	-0.6	1.0	1.1	1.8	3.6	-0.1	0.4
80	-13.0	4.7	4.8	-0.9	4.9	3.6	-6.6	-4.3	3.4	4.3	-1.9	2.9	0.1	0.2
85	-6.5	2.8	-7.1	-3.7	1.7	-4.4	1.0	1.4	-0.5	-0.3	-0.9	-1.7	-1.6	-1.5
90	0.3	2.5	-0.9	-3.3	-0.8	1.3	2.5	-0.9	1.8	-4.0	-4.3	-1.7	-0.1	-0.6
91	-9.8	-5.2	-13.5	-7.1	-15.8	-8.4	-1.0	-4.0	-6.8	-3.2	4.2	2.0	-7.5	-5.7
92	-3.1	2.1	2.6	-0.5	0.8	-3.5	-0.2	-1.2	-0.8	-2.9	2.3	2.9	-0.7	-0.1
93	7.2	3.8	-2.5	2.5	1.3	0.0	2.2	-1.1	1.9	-1.7	-0.8	2.0	1.4	1.2
95	9.0	74.7	0.4	9.9	0.8	-25.8	15.8	48.1	-29.8	33.6	18.3	7.0	13.7	13.5

Endnotes

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