Effects on productivity

from Swedish offshoring[1]

Preliminary results September 2006

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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. From the estimations, no overall effects on firm productivity were found. However, groups of firms were affected, positively or negatively by offshoring. No productivity premiums were found for firms already globally engaged or pure domestic ones.

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 data collection as from 2003, the last two years have been estimated separately.

Being an offshorer means in general 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 no overall effects from offshoring of services or intermediate goods were found. However, the earlier period studied shows that both manufacturing and services firms gain from offshoring of services. More recently, this is only true for manufacturers. The services firms offshoring goods to low-wage countries have a negative productivity premium. While already internationally engaged services firms had a slight productivity advantage up to 2002, the results for the later period are significant only for exporters offshoring goods to low-wage countries, with a negative productivity premium. Being a Swedish multinational firm only gives a positive productivity premium for 2003 and 2004 while no effects whatsoever were found for earlier years.

The different results from the two periods of time raises the question whether something in the data set distorts the estimations. Therefore, not only further test of the models need to be carried out, but also double checks of the data set, before final conclusions can be drawn.

Introduction

Background

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 (IT) 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.

Purpose of this study

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 the Irish study, 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.

The structure of this paper

This paper can be divided into three parts. Following the introduction, including a background and the description of the purpose, is a discussion of concepts as well as results from similar studies. Thereafter, the data set is illustrated, together with the recent development for some main variables. Thirdly, the different steps of the regressions will be presented along with robustness tests and results. Finally, the conclusion will cover a discussion of the results, both in comparison with other countries and related to the expectations.

Offshoring and productivity

Concepts

Initially in this paper, the terms *migration* or *relocation of production or jobs* have been used to introduce the reader to the subject. However, there is some general confusion over concepts and definitions, like Strandell and Mattila (2006) and Boulhol and Fontagné (2005) points out. Therefore, a clarification of what it is meant should be in place here. Görg et al (2005) 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 imports, 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 and intermediate goods, which are also in fact the variables most studies have chosen to use. 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 extension that offshoring of intermediate goods and services is the outcome from a decision to fragmentise the production. 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.

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.

Productivity can be defined and measured in several different ways. According to the OECD (2001) the productivity measures can generally be 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 chosen to illustrate this. This measure captures effects from capital, labour and other structural changes which otherwise cannot easily be singled out. So, if nothing else is mentioned, productivity will be used here synonymously with total factor productivity.

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 (2006) for further descriptions.

Recent findings internationally

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 OECD (2005b). The OECD found that adjustment costs appeared to be higher for trade-displaced workers than for others who were made redundant. Compared with these people, the displaced manufacturing workers also tended to be both older and less educated.

Most studies have thus discussed if international relocation exists, generally in terms of goods, and its effects on employment in high-wage countries. Fewer studies focus on the service industry and the effects on productivity. Exceptions to this rule are Görg et al and Criscuolo and Leaver, who have used microdata on firms in Ireland and the United Kingdom (UK), 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.

The Irish case

Görg et al investigate the effects on productivity from international outsourcing by using plant level data on manufacturing industries from the Irish Economy Expenditure Survey, and cover the period 1990 to 1998. International outsourcing is defined as the value of the imported intermediates at the level of the plant. The paper focuses on the first plant level effects, partly due to the data available and partly due to the nature of the econometric approach, which should be interpreted in the short run.

Since the plant engaged in international outsourcing has access to internationally traded inputs which may be available at lower costs, or at higher quality than those available domestically, the theoretical rationale for expecting an effect from international outsourcing on plant level productivity is considered fairly straightforward, through an outward shift in the production function. In the longer run, international outsourcing is believed to change the factor shares, which may have implications for productivity.

Purely domestic plants have been distinguished from domestic exporters and foreign-owned multinationals. The latter two establishments were expected to face lower costs of searching for suppliers abroad as they are already embedded in international production networks with more foreign contacts than purely domestic firms.

The study shows that there are potential positive effects from international outsourcing of both materials and services inputs. The equations give that foreign owned plants are more productive than domestic ones. However, no statistically significant productivity premium for the Irish exporters was found. International outsourcing of services and materials seems to have roughly the same impact on average plant level productivity. For foreign-owned plants, evidence was found for productivity-enhancing effects of international outsourcing on both materials and services. Concerning domestic plants, this was only true for outsourcing of materials, while services outsourcing was associated with reductions in TFP.

Exporters also showed significant effects on productivity for both materials and services. However, for non-exporters, statistically significant and strong negative effects of international outsourcing on productivity were found. This is interpreted as an indication that only exporters appear to benefit from international production networks and lower search costs. Most foreign owned multinationals in Ireland are exporters, but there is also a significant minority that only serves the local market. Similarly, the majority of domestic plants are also exporters.

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

The British case

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

Offshoring firms are defined as 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. 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 also pay higher salaries to their employees than non-offshorers. Among offshorers, the average offshore intensity was almost 20 per cent. The study also shows that offshoring is likely a part of a more general global engagement strategy since 60 per cent of 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 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. Multinationals were the most productive firms, followed by exporters, importers and finally by non-globally engaged firms.

As a robustness check, the Görg et al offshoring measure was also used. This operation led to a similarly positive correlation with productivity. The same results were found with value added as an approximation of offshoring instead of the import ratio. The results show that, as opposed to the hypothesis formulated by the authors, there is no robust additional effect coming from any form of the types of services or partner countries considered.

National findings

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 relocation of production or jobs to low-wage countries.[5] However, the economy is far more 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 was also stressed by Gustafson and Hagsten (2005), who suggest 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 international relocation of production.

According to Mattila and Strandell, the driving forces behind relocation of production 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 relocation of production. 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.

Ekholm concludes that international relocation of production 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.

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[5] "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.

Description of the data used

The data used 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. Some of the data have been accessed via the FIEF database, through the Mona infrastructure for research access to microdata.

The structural Business Statistics

The Structural Business Statistics (SBS) is an EU-regulated survey carried out on a yearly basis[6]. The purpose of the survey is to compile statistics on the structure, activity, competitiveness and performance of businesses. 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. In the latter case the taxation data is not used at all but instead a questionnaire including somewhat more detailed questions about income statement, balance sheet, investments, shares and participation.

One of the drawbacks with the heavy reliance on taxation data is the time delay before the taxation is completed. However, the degree of reliability increases the quality in statistics.

Trade in goods and services

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.[7]

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 a system of special reporting used by the Riksbank for travel funds and certain government authorities.[8] Furthermore, some

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[6] This description is mainly based on Hertzman et al (2006).
[7] 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.
[8] This is in accordance with recommendations made by the International Monetary Foundation (IMF).

model estimations are made covering exports and imports of services, wages and transfer payments.

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 calendar 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. Until 1994, it was possible to base the statistics entirely on data on the imports and exports of goods submitted by enterprises to customs. When Sweden became a member of the EU and part of the single market this was replaced by the EU-system (Intrastat) that collects information directly from enterprises about dispatches and arrivals of goods among member states.

Within the EU, detailed data on goods items and country are collected from enterprises with a trade sum exceeding a certain threshold value. 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 enterprises 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 submitted by the enterprises 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 and using the extrapolation method Exponential Smoothing.

The Swedish EU-membership has changed the breakdown of reporting by country. Previous reporting did refer to the country of the origin of the goods. From 1995, 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 only cover those goods that have gone through

customs in Sweden and not via a third country. However, data on exports of goods by country remain unaffected compared to previous reporting.

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 extensive quality improvements that the register underwent during 2000 imply that comparisons backwards in time need to be done with utmost care. These improvements included an adaptation of the Swedish educational terminology to the International Standard Classification of Education (ISCED). A number of new data sources were also added during this revision.

The FIEF longitudinal database

The FIEF longitudinal firm level database was originally built up by researchers but is now administered by Statistics Sweden. The sample consists of Swedish manufacturing and service firms during the period 1992-2004. The data, supplied by Statistics Sweden, include all firms in Sweden with at least 20 employees. Four different databases have been matched: the financial statistics (The Structural Business Register) with information on sales and various inputs in the production, The Swedish Register of Education (Regional Labour Market Statistics, RAMS) containing detailed information on the educational level of employees. Imports and exports of goods and services are collected from the International Trade Statistics, which, as mentioned above, recently underwent extensive methodological changes. Finally, data from the National Accounts such as different price indexes have also been added. Each firm has also been assigned a four-digit industry code (according to Swedish Standard Industrial Classification 1992).

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.

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. Görg et al stress international experience as an important factor to be considered in the analysis. 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 accounted for.

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 and opportunities to be self-supportive (at least within the Commonwealth). 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. The motivation behind vertical specialisation by offshoring of production to different countries through independent suppliers could be efficiency gains from lower wages or other location advantages such as market size or growth, local demand patterns, transport costs, distance from markets (Maskus 1998). 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 completely 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.

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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.

A number of studies on the plant and firm level indicate that there are differences between multinationals and purely local firms. For the United States (US), Doms & Jensen (1998) found that workers at foreign-owned manufacturing plants generate about 50 percent more value added and receive 20 percent higher wages than employees at the average domestically-owned plant. Doms and Jensen also made a distinction between US local firms and US MNEs. They found that US MNEs were more productive than foreign MNEs and that US local firms were least productive. Aitken et al. (1996) present similar results for a number of developing countries. Modén (1998) found that foreign-owned firms in Sweden are more productive and use more capital-intensive technologies than domestic firms. For the UK, Griffith and Simpson (2001) report that the level of labour productivity as well as the rate of growth of labour productivity was higher in foreign-owned firms when compared to domestic firms in manufacturing. Griffith and Simpson also found that only firms that had always been foreign-owned showed significantly higher labour productivity. Furthermore, the difference in productivity was explained by differences in levels of investments per employee. Criscuolo and Martin (2005) show that UK MNEs are less productive than US-owned plants, but as productive as non-US foreign-owned plants.

Sweden has fostered a large number of domestic MNEs, and these firms can be easily identified as well. Swedish MNEs have been extensively documented by Andersson et al (1996). Since the OLI framework applies to foreign as well as domestic MNEs, no difference in the productivity of foreign MNEs compared to domestic ones should be expected.

Empiric development
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 an overly important trade partner 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.

When all the one-man businesses and those firms with no employees at all were excluded, slightly more than a quarter of the approximately 750 000 firms in the Structural Business Statistics remained in 2004.[9] In table 1 the development of offshoring between 1999 and 2004 is illustrated. Due to the change of method between 2002 and 2003 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 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 goods reached around 15 per cent of the same population. However, these shares does not give a particularly clear picture of the extent of offshoring, and is 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, around sixty per cent over the period of time. This does not necessarily imply a decreasing rate of offshoring, but may as well reflect changes in relative prices.

Table 1. Numbers and shares of offshorers

Year	2004	2003	2002	2001	2000	1999
Total firms, number[1]	200135	195429	194785	195265	193658	187703
Offshorers of services, number[2]	(2047)	(2372)	6626	7364	7289	7178
Offshorers of goods, number	29768	29382	29542	29883	30785	29836
Share of services offshorers, per cent	-	-	3.4	3.8	3.8	3.8
Share of goods offshorers, per cent	14.9	15.0	15.2	15.3	15.9	15.9
Value added of services offshorers/total value added, per cent	41.1	39.8	44.4	47.1	47.6	48.5
Value added of goods offshorers/total value added, per cent	66.4	63.3	64.8	66.0	68.0	67.5
Share of total employees, services offshorers, per cent	30.0	30.6	37.6	39.9	39.9	39.9
Share of total employees, goods offshorers, per cent	56.4	57.1	58.9	60.8	61.8	61.4

[1]All Swedish firms except one-man businesses and those with no employees are included.
[2]The 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

Not only offshorers of services, but also those offshoring intermediate goods are large or medium sized firms, that is, with more than 50 employees. This group of firms also corresponds to the

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[9] 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.

predominate part of offshoring, measured as their share of value added. 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. Quite many small manufacturing firms take part in offshoring, but their share of value added is only marginal. 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, per cent		Share of value added, per cent	
	Offshoring services	Offshoring goods	Offshoring services	Offshoring 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. 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 actors within an international corporation. In 2004 two thirds of the services offshorers belonged to a multinational enterprise and slightly less than a third of these firms were in fact 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 services firms.

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 the discrepancies are far smaller. Just like the offshorers of services, offshorers of intermediate goods have higher labour productivity and a higher production value per employee, but the levels are in general much lower. However, the capital intensity is much lower than for all firms. While the offshorers of services tend to have a higher share of employees with post-secondary education than both firms on average and offshorers of intermediate goods, this distinction could not be found for offshorers of intermediate goods. Their share of employees with higher education is slightly lower than for firms on average. The relations of the variables analysed have not changed significantly during the period of time studied, although there has been an increase in value added per employee 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 et cetera 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 offshoring intensity, initially considered a straightforward measure of imports of services or intermediate goods divided by their respective total of purchases, unfortunately appeared to be non-existing at firm level for the services firms. 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 are not 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 intensity, which showed that on average seven per cent of the services purchased by the offshorers came from abroad.

Table 3. Facts about offshorers in 2004, unweighed means

Variable	All firms	Offshorers of services	Offshorers of goods
Labour productivity (value added per employee), SEK	517.9	1095.1	587.8
Number of full time employees	11.39	327.9	42.9
Value of production per employee, SEK	1192.9	4336.3	1570.5
Value of intermediates per employee, SEK	688.5	3300.0	1001.8
Capital intensity (capital per employee), SEK	719.5	1019.8	404.6
Import intensity (imports/total purchases), per cent*	0.07	7.1	5.2
Export intensity (exports/value of production), per cent	0.00	0.18	0.01
Share of MNEs, per cent	6.12	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 certain multinational firms.
Source: Statistics Sweden

Definition and measurement of productivity and econometric issues

To estimate the importance of offshoring intensity, a production function is used augmented by measures of import intensities and a set of control variables assumed to capture their contribution to total factor productivity.[10]

Calculations of productivity

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, intermediates and capital:

$$Q_{it} = A_{it} U_{it}^{\alpha_U} S_{it}^{\alpha_S} K_{it}^{\alpha_K} IMG_{it}^{\alpha_{IMG}} IMS_{it}^{\alpha_{IMS}} \qquad \mu = \alpha_U + \alpha_S + \alpha_K - 1 \qquad (1)$$

where $Q_{it}, A_{it}, U_{it}, S_{it}, K_{it}, IMG_{it}, IMS_{it}$ 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. Dividing both sides of Equation 1 by total employment $L_{it} = U_{it} + S_{it}$ (that is, multiplying with $L^{-1} = L^{\mu - \alpha_U - \alpha_S - \alpha_K - \alpha_{IMG} - \alpha_{IMS}}$) labour productivity can be written $q_{it} = \frac{Q_{it}}{L_{it}}$ as

$$q_{it} = A_{it} u_{it}^{\alpha_U} s_{it}^{\alpha_S} k_{it}^{\alpha_K} img_{it}^{\alpha_{IMG}} ims_{it}^{\alpha_{IMS}} L_{it}^{\mu} \qquad (2)$$

where u, s, k, m, img, ims are share 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 and imports (offshoring). Thus, a rise in labour productivity is the result of the increase in the skill- and capital intensity, the intensity with which intermediate goods and services are used, and the size of the firm multiplied by the rise in the total factor productivity.

TFP (A_{it}), or efficiency, 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. Efficiency, of the i:th firm can also increase by outsourcing of production of intermediate goods or services, domestic or international. These efficiency gains may arise at the firm level due to economies of scale that come from outsourcing to an independent foreign firm serving many firms. Alternatively efficiency gains can follow with fragmentation of production to take advantage of technology or specialist services, lower factor cost and higher quality. Offshoring may results in a more specialized production in the home market.

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[10] 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 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.

Productivity can be written as a function of the different components of the knowledge capital stock:

$$A_{it} = F(\kappa_{it}^{LE}, \kappa_{it}^{SP}, \kappa_{it}^{EXP}, \kappa_{it}^{MNE}, \kappa_{it}^{OFFS}) \qquad (3)$$

On the sources of knowledge coming from learning (κ_{it}^{LE}), spillovers in general, domestic and international (κ_{it}^{SP}), 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 $s_{it} + u_{it} = 1$ (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:

$$\ln q_{it} = A_{it} + \beta_1 \ln s_{it} + \beta_2 \ln k_{it} + \beta_3 \ln img_{it} + \beta_4 \ln ims_{it} + \beta_7 \ln L_{it} + \lambda_j + \lambda_t + \lambda_r + \varepsilon_{it} \qquad (4)$$

Firm size, L_{it} is measured as employment of the i:th firm.[11] By substituting multinational firm and offshoring of services and intermediate goods for A_{it} in equation 2 and assuming an autoregressive (AR1) the following specification is estimated:

$$\ln q_{it} = \beta_0 + \beta_1 \ln q_{it-1} + \underbrace{(\beta_2 MNE_{it} + \beta_3 \ln offG_{it} + \beta_4 \ln offS_{it} + \beta_5 \ln \exp_{it})}_{A_{it}}$$
$$+ \beta_6 \ln s_{it} + \beta_7 \ln k_{it} + \beta_8 \ln img_{it} + \beta_9 \ln ims_{it} + \beta_{10} \ln L_{it} + \lambda_j + \lambda_t + \varepsilon_{it}, \quad |\beta_1 < 1| \qquad (5)$$

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. Age of the firm as well as age squared are also used as control variables. Equation 5 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. Equation 5 may be extended using interaction variables between MNEs and offshoring as previously outlined.

The offshoring model

Due to the break in the time series of import of services, the data have to be treated as two different sets with two separate models, one for the period of 2000 to 2002 and one for the years of 2003 and 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

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11 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).

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 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 productive. Moreover, the input variables capital and labour may also be endogenous. The existence of such two-way causality may lead to erroneous conclusions about the offshoring effects of 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 GMM estimator uses time-differenced variables in order to remove permanent unobserved heterogeneity, Arellano & 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 (2000) 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.

The GMM model may be specified as:

$$\Delta \ln q_{it} = \beta_0 + \beta_1 \ln q_{it-1} + \underbrace{\left(\beta_2 MNE_{it} + \Delta\beta_3 \ln offG_{it} + \Delta\beta_4 \ln offS_{it} + \Delta\beta_5 \ln \exp_{it} \right)}_{A_{it}}$$
$$+ \Delta\beta_6 \ln s_{it} + \Delta\beta_7 \ln k_{it} + \Delta\beta_8 \ln img_{it} + \Delta\beta_9 \ln ims_{it} + \Delta\beta_{10} \ln L_{it} + \lambda_t + \Delta\varepsilon_{it}$$

Extensions

Up to this point, two homogenous groups of firms have been considered, namely multinational firms and domestic local firms. It is, however, possible that offshoring effects on productivity may be different depending on the characteristics of the firm. That is why some extensions are considered here, based on the earlier described expectations. Previous international experience is a factor that needs to be considered. This 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.

Results

Firstly, the results for 2003 and 2004 will be presented. Thereafter follows the period 2000 to 2002. Due to delays in data delivery, data on offshoring of intermediate goods is not yet available for the earlier period of time. This will be added in later versions of this paper.

The years 2003 and 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 populations of firms. This procedure gave significant estimates of skill intensity, capital intensity, import of intermediates, size of firm, ownership of firms (partly) and industry. Thus this procedure is considered to validate the chosen model. However, when estimating the effects of offshoring on productivity the significance sometimes disappeared. This could be the result of a certain degree of co-variation with the offshoring variables. The results also differed somewhat from each other when the two offshoring variables were used one at a time instead of together in the same equation. When adding the offshoring variables, the significant estimate of skill intensity disappeared for manufacturing firms. Despite this, a pooled sample has been used, in order not to lose those services firms that do not appear in the import of services sample both years.

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 4 and 5. Significant estimates are received for firm size (employment), skill intensity, capital intensity, intermediates per employee, type of ownership and international experience. Both manufacturers and services firms gain in labour productivity from an increase in capital intensity and intermediates per employee, while only services firms gains in productivity from increased skill intensity. Contrary to the manufacturers, the services firms have a negative productivity premium from increases in employment, and gain less in productivity from an increase in intermediates per employee. Being a multinational firm is important in terms of productivity only for the services firms.

It has been difficult to establish that offshoring of services actually affects productivity, since most attempts have lead to no significant estimates. The results here show that only manufacturing firms receive significant estimates for offshoring of services. This could of course coincide with the expectations described earlier, implying that offshoring of services does not always affect firm productivity, either because the decision to offshore is based on other factors than a wish to increase the short term profit, like widening the market, or that the possible gains have already been received through a long tradition of international activities. Most of the services offshorers are also members of multinational firms, which itself may reduce the possibility to improve productivity from offshoring. It is also possible that the model without lagged variables and its short time period misses out on some productivity effects in the longer run.

When agricultural and financial firms were excluded from the original set of firms described, something that only affects the number of firms and value added slightly, significant estimates for offshoring of intermediate goods by services firms appeared. This results in a loss of productivity for services firms from offshoring to low-wage countries, and possibly a slight gain in productivity for those offshoring to high-wage countries. This later effect is not marked in the table, but comes very close to a significant estimate at the 10 per cent level. 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.

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Table 4. Effects on firm productivity performance from offshoring of intermediate goods and services in 2003 and 2004, OLS estimations

Variables	All firms	Manufacturing firms	Services firms
Log of employment	-0.02	0.033	-0.034
	(0.006)***	(0.012)***	(0.007)***
Log of capital intensity	0.106	0.093	0.108
	(0.006)***	(0.012)***	(0.006)***
Log of skill intensity	0.045	0.005	0.051
	(0.005)***	(0.011)	(0.006)***
Log of intermediates per employee	0.18	0.232	0.17
	(0.008)***	(0.02)***	(0.009)***
Swedish MNEs	0.057	0.009	0.084
	(0.023)**	(0.04)	(0.029)***
Foreign MNEs	0.036	0.013	0.042
	(0.022)	(0.041)	(0.027)
Exporter	0.053	-0.05	0.066
	(0.034)	(0.101)	(0.037)*
Log of import intensity of services	0.001	0.005	0
	(0.001)	(0.003)**	(0.001)
Log of import intensity of goods from low wage countries	-0.002	0	-0.003
	(0.001)**	(0.001)	(0.001)***
Log of import intensity of goods from high wage countries	0	0	0.001
	(0.001)	(0.002)	(0.001)
Age	0.021	0.007	0.024
	(0.006)***	(0.011)	(0.007)***
Age squared	-0.001	0	-0.001
	(0)***	(0.001)	(0)***
Year 2004	0.073	0.078	0.069
	(0.016)***	(0.027)***	(0.02)***
R^2	0.315	0.35	0.313
Degrees of freedom	4639	1268	3358

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.

The resulting R^2-value from the regression is quite low, but this can partly be explained by the short time series studied.

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.

It is sometimes believed that smaller firms in a study like this one are more likely to create chaos in the result 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 chosen group of firms with more than one employee, but also step by step up to firms with 50 employees. This led to one significant offshoring variable at one stage, and another at the next. A feasible explanation could be that the design of the import of services sample, where all large firms are included and only a sample of

the smaller ones run the risk of distorting the results. If the smaller firms were to be cut-off, the remaining firms would be those already active on the international arena and often parts of international networks. So, leaving out all smaller firms does not seem to be 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. Both the already internationally experienced and Swedish multinationals lost in productivity from offshoring of goods to low-wage countries, while Swedish MNEs gained slightly from offshoring of services.

Table 5. Effects on firm productivity performance from offshoring of intermediate goods and services in 2003 and 2004 by previous international experience, OLS estimations

Variables	Exporters	Foreign MNEs	Swedish MNEs
Log of employment	-0.019	-0.033	-0.028
	(0.007)***	(0.011)***	(0.014)**
Log of capital per employee	0.107	0.091	0.117
	(0.006)***	(0.01)***	(0.013)***
Log of skill intensity	0.045	0.054	0.054
	(0.005)***	(0.01)***	(0.016)***
Log of intermediates per employee	0.182	0.163	0.235
	(0.009)***	(0.015)***	(0.02)***
Swedish MNEs	0.046	n.a.	n.a
	(0.024)*	n.a	n.a
Foreign MNEs	0.031	n.a	n.a
	(0.024)	n.a	n.a
Exporter	n.a	0.035	-0.096
	n.a	(0.07)	(0.1)
Log of import intensity of services	0.001	0	0.006
	(0.001)	(0.002)	(0.003)*
Log of import intensity of goods from low wage countries	-0.002	0	-0.004
	(0.001)**	(0.001)	(0.002)**
Log of import intensity of goods from high wage countries	0	0	-0.001
	(0.001)	(0.002)	(0.002)
Age	0.019	0.033	-0.004
	(0.006)***	(0.01)***	(0.013)
Age squared	-0.001	-0.002	0
	(0)***	(0.001)***	(0.001)
Year 2004	0.069	0.085	0.093
	(0.017)***	(0.027)***	(0.035)***
R^2	0.303	0.323	0.332
Degrees of freedom	4319	1592	1192

*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 exporter partly affected productivity, the non-exporters totally lacked significant productivity effects. 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 services. This contradicts the results from the UK study totally, where they found the highest productivity premiums for less internationally experienced and pure domestic firms.

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, air transporters and computer consultancies increased their productivity by offshoring of services. Even manufacturers of pulp, paper and basic metals as well as land transporters achieved a positive productivity premium, but from offshoring of intermediate goods to low-wage countries. Some industries also gained in productivity from offshoring of intermediate goods to high-wage countries, like travel agencies, research and development and manufacturers of radio, TV and telecommunication equipment. Somewhat surprising, there were also industries losing productivity from offshoring of intermediate goods to high-wage countries. Examples of these are computer consultancies.

The years 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 conclusions drawn about the services offshoring firms in tables 1 and 2 are still valid. Firms offshoring services have on average higher labour productivity, measured as value added and deflated by the industry producer price index per employee, than non-offshoring firms. At the same time, services offshorers firms are also more skill intensive, measured by the proportion of employees with post-secondary education, as well as more physical capital intensive (defined as the stock of capital, measured by book value machinery and buildings, per employee). Services offshoring firms are larger, in terms of number of employees, outlays on materials and wages.

Table 6A 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 and manufacturers and services firms separately. Note that in all regressions, industry, time and region dummy variables are included, as specified in Equation 4. Clearly higher skill and capital intensity as well as intermediates purchased increases labour productivity.[12] 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

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[12] 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.

for exporting services. Exporting firms are more productive in the manufacturing sector than in the service sector.

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 purely local non-MNE domestic firms, so being international is more important than nationality.[13] 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, other things being equal, firms offshoring services have a productivity advantage over domestic firms in general.

Table 6A. Effects on firm productivity performance from offshoring of services in 2000 to 2002, OLS estimations

	All firms offshoring services	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)***
Log of intermediates per employee	0.022	0.054	0.018
	(0.002)***	(0.011)***	(0.002)***
Domestic Swedish MNEs	0.104	0.064	0.14
	0.012	(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.

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

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[13] 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.

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) only catches the possible short-term productivity effects due to an ownership change. See Karpaty (2006) for fixed effects estimations using a two-step approach.

Table 6B. Effects on firm productivity performance from offshoring of services in 2000 to 2002, within firm estimations

	All firms offshoring services	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)
Log of intermediates per employee	0.016	0.109	0.010
	(0.004)***	(0.020)***	(0.004)**
Domestic 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 positive demonstration effects were found. However, the possible endogeneity of the input and offshoring variables is likely to lead to biased results of the time-differenced OLS regression. Moreover, the positive results for the service sector in the OLS regressions should 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 (but estimating the period 2000-2002), the regressions can include up to four

lags. The lagged levels of the input factors used are: capital, skilled labour, intermediates, 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 6C. Effects on firm productivity performance from offshoring of services in 2000 to 2002, GMM SYS estimations

	All firms offshoring services	Manufacturing 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)***
Log of intermediates per employee	0.009	0.017	0.015
	(0.009)	(0.023)	(0.011)
Domestic 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.

Up to this point the issue of offshoring has been dealt with among a homogenous group of firms. However, it is possible that potential effects on productivity from offshoring differ due to the global engagement of the firm. Nevertheless, the results presented in Table 7 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 pure local firms.

Table 7. Effects on firm productivity performance from offshoring of services in 2000 to 2002 by previous international experience, OLS estimations

	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.

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. It would appear from the results that offshoring of services only affected productivity in Swedish services firms during the years from 2000 to 2002. This effect was positive while using a static approach. Moreover, firms that are already globally engaged did not benefit more from offshoring than pure local firms. When taking into account firm specific effects in the fixed effects model and possible endogeneity in the dynamic system GMM model these effects disappeared.

The static approach to the years of 2003 and 2004 gave significant positive results for the offshoring of services by manufacturing firms. In contrast, the services firms, showed significant results from offshoring of intermediate goods to low-wage countries. However, these effects were negative. Clearly significant productivity effects from offshoring of services were found for a small number of industries. International experience only partly affected productivity, and negatively. However, being a Swedish MNE led to a positive productivity premium for offshoring of services.

The main difference in results between the two periods of time studied is the significant effects from offshoring of services by services firms from 2000 to 2002 as contrary to the non-significant estimates for the same variable in 2003 and 2004. Otherwise the estimates are surprisingly similar, despite the fact the two data sets are not identical. Whether this reflects the

actual situation or more likely is a result of using different data sets still needs to be further investigated. However, it is important to note that the more recent data are considered to be of much higher quality.

Somewhat surprisingly, the results are partly at odds with those from the Irish and the British studies, despite the fact that the general descriptions of offshorers coincide to a large extent. The regressions only gave positive productivity premiums from offshoring of services to certain (Swedish) multinationals, like in Ireland, while already internationally experienced firms were only affected by offshoring of intermediate goods to low-wage countries, negatively. There were no significant effects on productivity for non-exporters or pure domestic firms, like in the United Kingdom.

Assuming that the models used are correctly specified, the results indicate that no overall effects from offshoring on either intermediate goods or services can be found, but rather occurs in certain sub-groups. The results also emphasise the high degree of difficulty in working on large microdata sets (with time series breaks). Alternative measures still need to be tested as well as further regressions on certain sub-groups, together with more checks of the data set available before final conclusions about the effects from offshoring on productivity can be drawn.

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Appendix 1 Description of variables

Table 1: Description of variables

Variable name	Description
Img	The ratio between input of intermediate goods and employment
Ims	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