Decomposing value chains
within Swedish multinationals

In the 2000s, the employment in Swedish multinational enterprises grew rapidly in their affiliates abroad, in particular in low-income countries. What are the consequences for the demand for skills and different tasks – routine or offshorable – in their parents in Sweden?

tillväxtanalys

Foreword

Declining costs for transportation, information and communication, together with lower barriers to international trade and investment, have led to increased fragmentation of production within global value chains (GVC). Multinational enterprises (MNEs) play a leading role within GVC and they occupy an important position in the Swedish business sector.

The purpose of this report is to examine which activities and tasks within Swedish MNEs are retained in the parent companies onshore in Sweden when their affiliates abroad are expanding. This is important as growing fragmentation of production has resulted in analyses of comparative advantages in terms of industries becoming less meaningful, while the focus rather should be on tasks and business functions.

We use unique data compiled by Growth Analysis for employment in Swedish MNEs in Sweden and abroad. Employment in Sweden in the 2000s has been more or less constant, whereas Swedish MNEs have expanded abroad, in particular in low-income countries such as China.

Our main finding is that between 2001 and 2013 within Swedish MNEs non-routine tasks and activities conducted by skilled workers have been retained in the MNE parents in Sweden. When we distinguish between different destinations for foreign direct investment we observe that offshoring to low-income countries appears to be more strongly related to skill upgrading and higher non-routine intensity in the parents in Sweden (onshore) than offshoring to high-income countries.

The report is an interim report by the Swedish Agency for Swedish Growth Policy Analysis commissioned by the Ministry of Enterprise and Innovation to contribute to increased knowledge of global value chains. It is written by Kent Eliasson, Pär Hansson, and Markus Lindvert at Growth Analysis.

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Förord

Fallande kostnader för transporter, information och kommunikation kombinerat med minskade hinder för internationell handel och investeringar har lett till en ökad fragmentering av produktionen inom globala värdekedjor (GVK). Multinationella företag (MNF) spelar en ledande roll inom GVK och de har en framskjuten position inom det svenska näringslivet.

Syftet med denna rapport är att undersöka vilka aktiviteter och arbetsuppgifter inom svenska MNF som blir kvar i moderföretagen i Sverige när deras dotterföretag utomlands expanderar. Frågan är viktig eftersom det i takt med en tilltagande fragmentisering av produktionen blir allt mindre meningsfullt att studera komparativa fördelar i termer av branscher, snarare bör fokus ligga på arbetsuppgifter och affärsfunktioner.

I analysen används unika data som sammanställs på Tillväxtanalys över sysselsättningen i svenska MNF i Sverige och utomlands. Under 2000-talet har sysselsättningen i Sverige varit i stort sett konstant, medan svenska MNF har ökat antalet sysselsatta utomlands, särskilt i låginkomstländer.

Vårt huvudresultat är att mellan 2001 och 2013 har inom svenska MNF icke-rutinartade arbetsuppgifter och aktiviteter som utförs av kvalificerad arbetskraft behållits i moderföretagen i Sverige när dotterföretagen utomlands expanderar. När vi skiljer på direktinvesteringar till hög- och låginkomstländer finner vi att offshoring till låginkomstländer tycks vara starkare relaterat till ökad efterfrågan på kvalificerad arbetskraft och icke-rutinartade arbetsuppgifter i moderföretagen i Sverige än offshoring till höginkomstländer.

Rapporten utgör ett underlag från Tillväxtanalys på uppdrag från Näringsdepartementet för att öka kunskapen om de globala värdekedjornas betydelse. Den har skrivits av Kent Eliasson, Pär Hansson och Markus Lindvert

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Summary

Multinational enterprises (MNE) have been highly instrumental in the processes that have led to increased fragmentation of production within global value chains. In the 2000s, employment in Swedish MNEs grew rapidly in their affiliates abroad, whilst employment in the parents in Sweden remained more or less unchanged. Moreover, in contrast to the 1990s, when the greatest employment growth was in affiliates in high-income countries, employment in the 2000s mainly expanded in affiliates in low-income countries, for example, China and the Central and Eastern European countries.

At the same time as we note a substantial increase in the employment share in affiliates of Swedish MNEs abroad, the proportion of skilled labour, defined as the share of employees with a post-secondary education more than three years, has risen more rapidly in Swedish MNEs than in non-MNEs in Sweden. This observation is consistent with Swedish MNEs maintaining and expanding skilled activities in their parents in Sweden (onshore), while moving less-skilled activities to their affiliates abroad (offshore). Such an outcome is reasonable given that, in the 2000s, it was the offshore share in low-income countries, where the wages of less-skilled labour were significantly lower than in Sweden, which were growing.

Routine tasks are activities that can be accomplished by following a set of specific, well defined rules, whereas non-routine tasks are more complicated activities such as creative problem solving and decision making. Accordingly, non-routine tasks may be too complex to be fully communicated to production teams in another country. Routine tasks are thus more easily fragmented geographically than non-routine tasks because they can be simply translated into instructions for the offshore producers. Hence, we expect the proportion of non-routine tasks to increase in the parents at home while MNEs are expanding their activities abroad. Non-routineness is one factor that determines the offshorability of a task. Another factor is the extent to which a task needs face-to-face contact with people other than fellow workers with no loss of quality. We find that non-routine tasks are performed to a greater extent by skilled individuals, whereas offshorable tasks appear to be performed by both skilled and less-skilled workers.

In the report we examine the relationship between relative demands for skills, non-routine or non-offshorable tasks in Swedish MNE parents and the proportion of employees in affiliates abroad in 2001 to 2013. We find that within Swedish MNEs non-routine tasks and activities carried out by skilled workers have been retained in the MNE parents in Sweden. When we distinguish between different destinations for foreign direct investment, we observe that offshoring to low-income countries appears to be more strongly related to skill upgrading and higher non-routine intensity in the parents in Sweden (onshore) than offshoring to high-income countries. However, we do not find any relationship between offshore employment shares and the non-offshorability intensity onshore. The latter implies that, while many MNE jobs are offshorable, it does not mean that they are always offshored. Characteristics, such as the routineness of jobs or whether the jobs are performed by less-skilled workers, seem to be more important factors for why they are offshored than whether they are offshorable.

From the estimations of absolute demand for skilled and less-skilled labour, we note that increased employment in low-income countries appears to lower the demand for less-skilled labour in MNE manufacturing parents in Sweden (substitute). In contrast, increased employment in affiliates in high-income countries seems to increase the employment of skilled labour in MNE services parents (complement).

In sum, the main conclusion is that within global value chains, Swedish MNEs tend to have increased their specialisation in Sweden on non-routine tasks and activities conducted by skilled workers and from an assessment of the economic relevance we find that this development has not been negligible.

Sammanfattning

Multinationella företag (MNF) har varit starkt bidragande i den process som lett fram till ökad fragmentering av produktionen inom globala värdekedjor. På 2000-talet ökade sysselsättningen i dotterföretagen till svenska MNF kraftigt, medan sysselsättningen i moderföretagen i Sverige var mer eller mindre oförändrad. Dessutom, till skillnad från under 1990-talet när den största sysselsättningstillväxten skedde i dotterföretagen i höginkomstländer, ökade sysselsättningen under 2000-talet i dotterföretagen till svenska MNF huvudsakligen i låginkomstländer, exempelvis i Kina och i Central- och Östeuropa.

Samtidigt som vi uppmärksammat en ökning av andelen sysselsatta i dotterföretagen utomlands har andelen kvalificerad arbetskraft, definierad som andel sysselsatta med eftergymnasial utbildning tre år eller mer, stigit snabbare i svenska MNF än i icke-MNF i Sverige. Detta är en utveckling som är förenlig med att svenska MNF behållit och expanderat sina mer kvalificerade aktiviteter i moderföretagen i Sverige, medan de flyttat ut sina mindre kvalificerade verksamheter till dotterföretagen utomlands. Ett rimligt utfall mot bakgrund av att det under 2000-talet är andelen sysselsatta i låginkomstländer, där lönerna för mindre kvalificerad arbetskraft är avsevärt lägre, som har vuxit.

Rutinartade arbetsuppgifter är aktiviteter där ett antal specifika, väldefinierade moment utförs, medan icke-rutinartade arbetsuppgifter är mera komplicerade verksamheter, som problemlösning eller beslutsfattande. Följaktligen tenderar icke-rutinartade arbetsuppgifter att vara alltför komplexa för att friktionsfritt kunna överföras till ett produktionsteam i ett annat land. Det innebär att rutinartade arbetsuppgifter är lättare att fragmentera geografiskt genom att de helt enkelt kan översättas till instruktioner som kan användas av producenter i andra länder. Det gör att vi förväntar oss att andelen icke-rutinartade arbetsuppgifter ökar i moderföretagen när MNF expanderar sina aktiviteter utomlands. I vad mån en arbetsuppgift är flyttbar (offshorable) avgörs till viss del av hur rutinartad den är. En annan faktor som bestämmer en arbetsuppgifts flyttbarhet (offshorablility) är i vilken utsträckning den kräver kontakter ansikte mot ansikte med andra än sina arbetskamrater utan att kvaliteten på det som produceras försämras. Det visar sig att icke-rutinartade arbetsuppgifter i stor omfattning utförs av kvalificerad arbetskraft, medan flyttbara (offshorable) arbetsuppgifter tycks uträttas både av kvalificerad och mindre kvalificerad arbetskraft.

I rapporten undersöker vi sambandet mellan relativ efterfrågan på kvalificerad arbetskraft, icke-rutinartade eller icke-flyttbara (non-offshoreable) arbetsuppgifter i moderföretagen i svenska MNF och deras sysselsättningsandelar i dotterföretagen utomlands 2001 till 2013. Vi finner att icke-rutinartade arbetsuppgifter och aktiviteter som uträttas av kvalificerad arbetskraft har behållits i moderföretagen i Sverige när dotterföretagen utomlands expanderar. När vi skiljer på direktinvesteringar till hög- och låginkomstländer finner vi att offshoring till låginkomstländer tycks vara starkare relaterad till ökad efterfrågan på kvalificerad arbetskraft och icke-rutinartade arbetsuppgifter i moderföretagen i Sverige än offshoring till höginkomstländer. Däremot hittar vi inget samband mellan sysselsättningsandelar i dotterföretagen utomlands och andelen icke-flyttbara arbetsuppgifter (non-offshorable tasks) i moderföretagen i Sverige. Det senare antyder att, även om det finns många jobb i MNF som är flyttbara utomlands (offshorable), betyder det inte att dessa behöver flytta. Kännetecken, som huruvida ett jobb innehåller många rutinartade arbetsuppgifter eller om det utförs av mindre kvalificerad arbetskraft, förefaller vara viktigare faktorer för i vad mån ett jobb flyttar utomlands än i vilken utsträckning det är flyttbart (offshorable).

Från skattningarna av den absoluta efterfrågan på kvalificerad och mindre kvalificerad arbetskraft noterar vi att ökad sysselsättning i låginkomstländer tycks minska efterfrågan på mindre kvalificerad arbetskraft i moderföretagen i MNF inom tillverkningsindustrin i Sverige (substitut). Detta står i kontrast till MNF i tjänstesektorn där ökad sysselsättning i dotterföretagen i höginkomstländer ökar efterfrågan på kvalificerad arbetskraft i moderföretagen i Sverige (komplement).

Kort sagt, huvudslutsatsen av rapporten är att inom ramen för globala värdekedjor tenderar svenska MNF att i Sverige ha ökat sin specialisering på icke-rutinartade arbetsuppgifter och aktiviteter som utförs av kvalificerad arbetskraft och det rör sig om en utveckling som inte har varit ekonomisk försumbar.

1   Introduction

Declining costs for transportation, information and communication, together with lower barriers to international trade and investment, have led to increased fragmentation of production within global value chains. Multinational enterprises (MNEs) are highly instrumental in such processes. Within MNEs, some production stages of the value chains have been relocated to affiliates offshore (or outsourced to independent suppliers abroad), whereas others have been retained or even expanded in the parents at home (onshore).

The purpose of this paper is to examine which activities within Swedish MNEs are kept in the parents onshore when their affiliates abroad are expanding. In other words, we aim to investigate the relationship between outward FDI and the onshore employment composition of Swedish MNEs. Previous studies, such as Head and Ries (2002) and Hansson (2005), have focused solely on skills measured, e.g. in terms of educational attainment of the employees. We also analyse the skill composition, but, as in Becker et al. (2013), in addition we study the impact of offshoring on the task content in the MNE parents.[1]

Routine tasks are activities that can be accomplished by following a set of specific, well defined rules, whereas non-routine tasks are more complicated activities such as problem solving and decision making. Accordingly, non-routine tasks may be too complex to be fully communicated to production teams in another country. Routine tasks are thus more easily fragmented geographically than non-routine tasks because they can simply be translated into instructions for the offshore producers. Hence, we expect the share of non-routine tasks to increase in the parents at home when MNEs are expanding their activities abroad.

We use two commonly employed measures of non-routineness of jobs to investigate the relationship between increased offshore activities in the affiliates of Swedish MNEs and the share of non-routine tasks in their onshore MNE parents. The first is proposed and employed by Becker et al. (2013) and is based on survey questions concerning whether the respondent workers use a listed workplace tool or not. The second, which has recently been put to extensive use[2] but to our knowledge not in this context before, is a routine task index of different jobs consisting of three aggregates: manual, routine, and abstract tasks.

Non-routineness is one factor that determines the offshorability of a task. Another factor is the extent to which a task needs face-to-face contact with people other than fellow workers with no loss of quality. Such considerations professional coders had to take into account when they, in Blinder and Kreuger (2013), were asked to assess the degree of offshorablility in different jobs. We exploit the Blinder and Kreuger measure of offshorability to examine whether the shares of non-offshorable tasks increase in Swedish MNE parents in connection with higher offshore employment shares in their affiliates.

In other words, we take these classifications of occupations regarding non-routine and offshorability at face value. Utilizing these "off the shelf" measures of non-routineness and non-offshorability as above, instead of constructing our own measures, enables us to achieve better comparability among similar studies.[3]

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[1] A limitation of such an approach is that it only partially captures the offshore activities of MNEs because it excludes their arm's-length relations.

[2] See e.g. Autor and Dorn (2013), Goos et al. (2014) and Autor et al. (2015).

[3] This is a recommendation by Autor (2013).

Compared to Becker et al. (2013), instead of plants we use multinational enterprise groups as the unit of analysis. We prefer enterprise groups as this is the level where decisions about relocations and other structural changes within MNEs are taken. Potential problems with plants arise, for example, when MNEs relocate activities from their home country to other countries by closing down plants at home and reopening them abroad. With plants as the unit of analysis the observations disappear from the sample, whereas with enterprise groups the proportion of skilled labour increases at home whilst the offshore employment share becomes higher.

In contrast to previous studies, the observation period in our study is quite lengthy and up-to-date, i.e. 2001 to 2013.[4] This is important because we are able to investigate effects over a longer term and during a period when foreign direct investment has grown substantially in low-income countries, e.g. in China.

We employ a commonly applied cost function approach originating from Berman et al. (1994) to examine the relationship between relative demands for skills, non-routine or non-offshorable tasks in MNE parents (onshore) and their employment shares in affiliates abroad (offshore).

It might reasonably be expected that technological changes (and computerisation) would have had a positive impact on the demand for skills and non-routine tasks. Skilled labour benefits more from technological changes than other production factors. Non-routine tasks are often sufficiently complex that they cannot be completely specified in computer code and executed by machines. It is therefore necessary to include controls for technological changes and computerisation in the empirical specification.

One might expect less-skilled activities and more routine tasks to be offshored to a greater extent to low-income countries, where the wages for less-skilled labour are significantly lower than in Sweden, and in our analyses we consequently distinguish between offshoring to different destinations, e.g. high- and low-income countries.

In addition to relative demand, we estimate absolute demand for skilled and less skilled labour separately. The results from such estimations can tell us whether employment in offshore affiliates in high- and low-income countries are complements or substitutes to the employment of different skills in MNE parents onshore.

Our study extends and revisits previous analyses on MNEs performed for the 1990s and the early 2000s. It is also related to Autor, Dorn and Hanson (2015). In contrast to our study, their unit of analysis is regions (commuting zones) in the US. The aim of their analysis is to examine the simultaneous impact of technology (computerisation) and international trade on local labour markets, e.g. on skills and occupations. One important finding is that, as imports from China accelerate in the 2000s, employment declines in routine task-intensive occupations and among workers without a college education, particularly in regions heavily exposed to increasing competition from China in manufacturing products.

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[4] In Becker et al (2013) the observation period is solely the period 1998 to 2001 and studies using more recent data are sparse. Other prominent studies of the effects on labour markets of offshoring, e.g. Harrison and McMillan (2011) and Ebenstein et al. (2014), end at around the year 2000.

To preview our results, we have found that in the light of a significant expansion of employment in affiliates abroad, within Swedish MNEs, non-routine tasks and activities conducted by skilled workers have been retained in parent MNEs in Sweden. If we distinguish between different destinations for FDI, we observe that offshoring to low-income countries has had a larger economic impact on skill upgrading and non-routine intensities in the parents in Sweden (onshore) than offshoring to high-income countries, which is economically negligible.

From the estimations of absolute demand for skilled and less-skilled labour, we note that increased employment in low-income countries appears to reduce the demand for less-skilled labour in the MNE parents in Sweden (substitute). In contrast, increased employment in affiliates in high-income countries seems to increase employment of skilled labour in the parents (complement).

The structure of the paper is as follows. In section 2.1 we discuss the Swedish micro data we employ. Section 2.2 describes Swedish MNE employment at home and abroad. Section 2.3 presents the measures of non-routine and non-offshorable tasks in different occupations. Section 3 contains the econometric analysis, with section 3.1 setting out the econometric specification, section 3.2 presenting results from estimations of relative demand for skills and tasks, and section 3.3 from estimations of absolute demand for skilled and less-skilled labour. Section 4 summarises and concludes.

2 Data and description

2.1 Data sources

To construct our dataset we link data from a range of microdata sources. The unique identification numbers of the firms enable us to link information on financial accounts, R&D expenditure, and register-based labour statistics (in our case, the education levels of employees and their occupations). The unit of analysis is Swedish controlled enterprise groups with affiliates abroad, i.e. Swedish MNEs. Firms within enterprise groups are identified by means of Koncernregistret (the Business Group Register).

Basic variables in our study of individuals' educational attainment and occupations are derived from annual registers of the Swedish population compiled by Statistics Sweden (SCB). The education register has existed since 1985 and a complete register on occupations since 2001. Wage incomes are from register-based labour market statistics (RAMS) and variables derived from balance sheets and income statements, such as value added and capital, are from the Structural Business Statistics (SBS). Both RAMS and SBS are also register data collected by SCB. Employment in Swedish MNEs in their Swedish parents and in their affiliates abroad at country level derives from statistics compiled by the Swedish Agency for Growth Policy Analysis.

2.2 Swedish MNE employment at home and abroad

To illustrate how employment within Swedish multinationals has been distributed between their parents and their affiliates abroad, in figure 1 we present development of employment in Swedish MNEs in Sweden and abroad between 1996 and 2013.

From 1996 until 2013, the parent employment in Swedish MNEs has decreased from 703,000 to 536,000 (−24 percent), while over the period studied, 2001 to 2013, parent MNE employment is almost unchanged. In stark contrast, employment in the affiliates of Swedish MNEs abroad has increased from 605,000 in 1996 to 1.25 million in 2013 (+107 percent). Even though employment in Swedish MNEs in Sweden is no longer declining, the relative importance of Sweden as a location for Swedish MNEs has decreased. This is also set out in figure 2 below.

To give an indication of the countries in which employment in affiliates of Swedish MNEs has grown fastest, in figure 2 we show development of the proportion of employment shares in Swedish MNEs in different country groups: Sweden, high-income countries, Central and Eastern European countries, China, India, and other low-income countries.

Figure 1 Employment in Swedish MNEs in Sweden and abroad
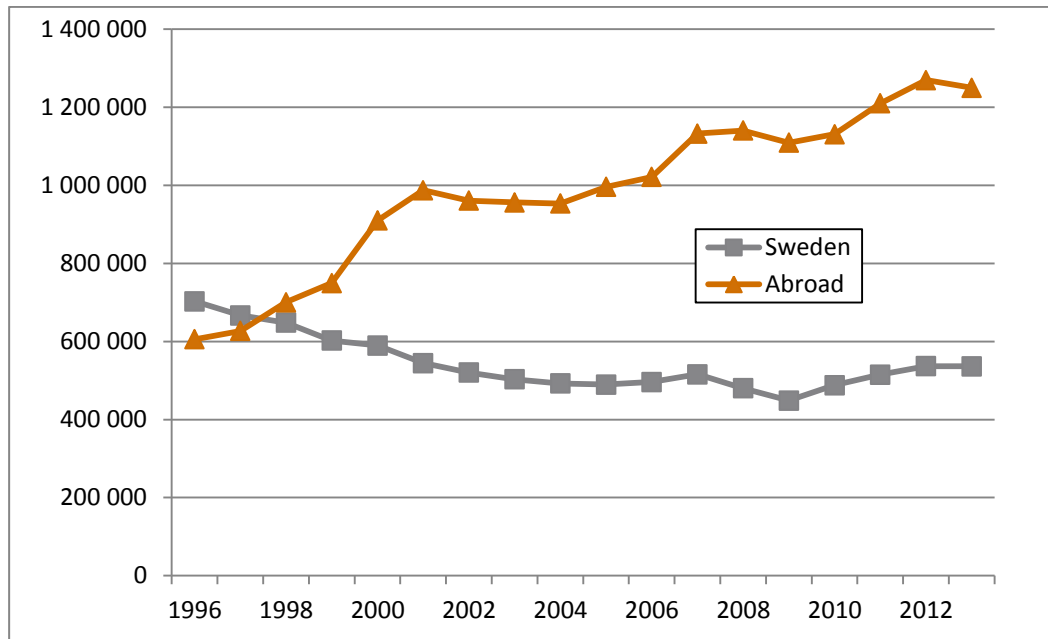
Source: Growth Analysis, Swedish Groups with Affiliates Abroad

Figure 2 Employment shares of Swedish MNEs in Sweden and in various country groups. Percent
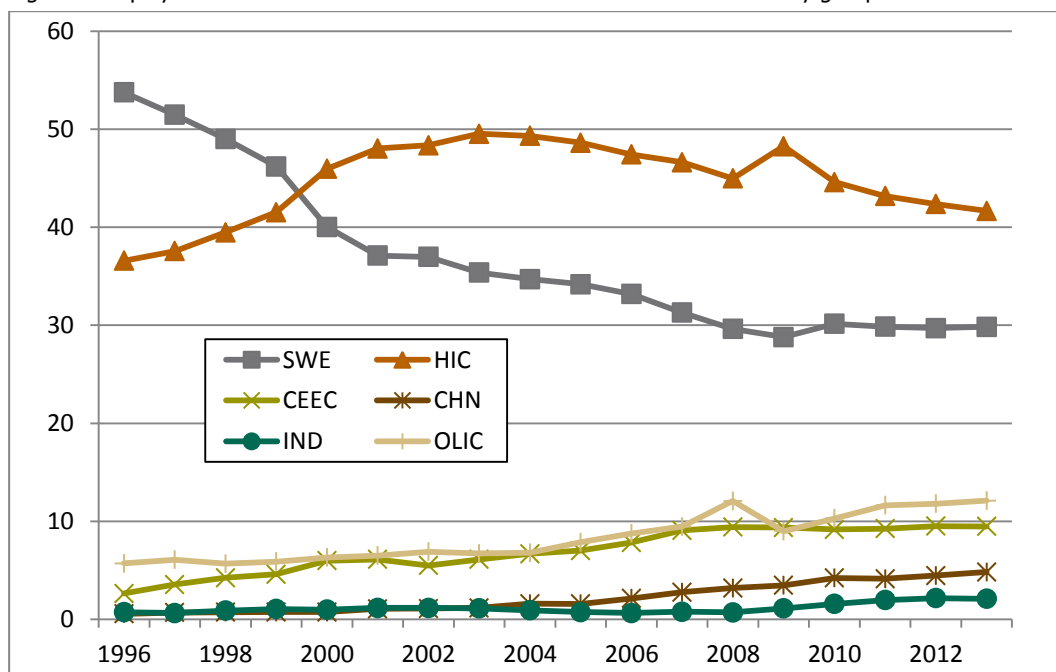
Remark: SWE: Sweden, HIC: High-Income Countries, CEE: Central and East-European Countries, CHN: China, IND: India, and OLIC: Other Low-Income Countries. We define as high-income countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, Norway, New Zealand, Portugal, Spain, Switzerland, the UK and the US.

Source: Growth Analysis, Swedish Groups with Affiliates Abroad

In Sweden, the proportion of total employment in Swedish MNEs has fallen from 54 percent in 1996 to 29 percent in 2013. However, the drop was largest in the late 1990s and flattens out in the 2000s. In the late 1990s, the share abroad grows in both high- and low-income countries. In affiliates in other high-income countries, the proportion at the outset increased from 37 percent in 1996 to almost 50 percent in 2003, and it peaked there. The share has then decreased and by 2013 it is 42 percent. In all the other low-income country groups there has been a rising trend, for instance, in the Central and Eastern Europe Countries (+6.8 percentage points) and in China (+4.3 percentage points). We note that during the course of our period of study, 2001 to 2013, there has been a clear shift in Swedish MNE employment from high-income countries, including the parent country Sweden, towards growing countries with lower incomes. The employment share in low-income countries almost doubled between 2001 and 2013 (15 percent in 2001 and 28 percent in 2013).

One of the main purposes of this study is to examine the relationship between changes in offshore employment in affiliates abroad and the skill composition in the parent companies at home. It might therefore be of interest to compare the development of the share of skilled labour in the parents of Swedish MNEs with the development in non-MNEs in Sweden. This is shown in figure 3. We define skilled labour as employees with three years or more of post-secondary education.

Figure 3 Share of skilled labour in Swedish MNEs and in non-MNEs. Percent
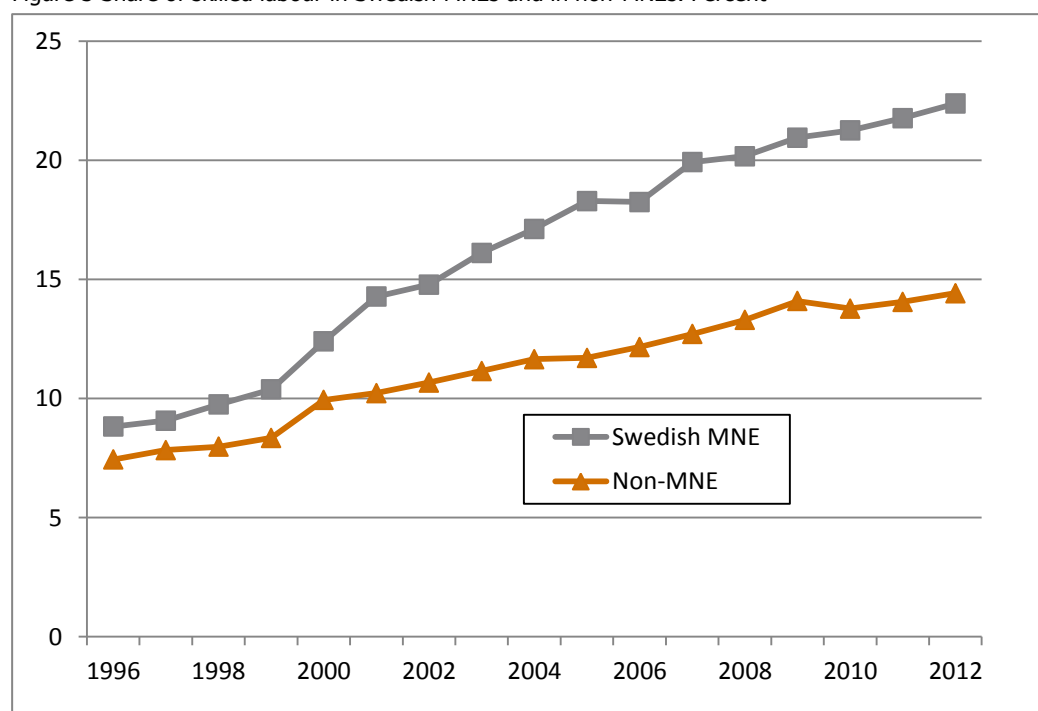
Source: Statistics Sweden, Register-based Labour Market Statistics (RAMS)

We find that in both Swedish MNEs and non-MNEs skill intensity grew substantially between 1996 and 2013. The reason behind these trends is most likely a substantial increase in the supply of skilled labour in Sweden during this period. However, what is of greater interest is that we observe a greater increase in the skill intensity in Swedish MNEs than in non-MNEs; the skill intensity in Swedish MNEs grew by 13.6 percentage points, whereas the rise in non-MNEs is 7.0 percentage points. One explanation might be that, unlike non-

MNEs, MNEs have opportunities to move activities between plants located in different countries. If less-skilled activities tend to be relocated from Sweden by MNEs, while skilled activities are kept and expanded, we expect to see a greater increase in skill intensity in Swedish MNEs than in non-MNEs in Sweden.

In sum, we note from the figures in section 2.2 that, at the same time as we see a substantial increase in the employment share in affiliates of Swedish MNEs abroad, the proportion of skilled labour has risen more rapidly in Swedish MNEs than in non-MNEs in Sweden. This observation is consistent with Swedish MNEs retaining and expanding skilled activities onshore, while moving less-skilled activities offshore. Remarkably, we also find that in the 2000s it is the offshore share in low-income countries that has been growing. However, obtaining more direct and reliable evidence regarding the impact of changes in offshore employment on the onshore skill composition within Swedish MNEs requires an econometric analysis. Before presenting the results of such an analysis, we discuss different task measures that can be employed as complementary measures to skill.

2.3   Construction of task measures

In the econometric analysis in section 3 we make use of three different task intensity measures that have recently been used in the literature to characterise various occupations. Firstly, we present two different measures of the element of non-routineness in an occupation, and secondly, an index of the degree of non-offshorability of an occupation. Non-routineness and offshorability are factors that can be expected to impact on whether a task will be relocated abroad or not.

The first measure of non-routine intensity of an occupation is proposed by Becker et al. (2013) and is based on survey questions regarding whether the respondent workers use a listed workplace tool or not.[5] Each of the 81 tools identified is assumed to indicate whether non-routine tasks are performed by a worker or not.[6] Non-routine tasks are non-repetitive and require large amounts of problem solving ability. Since the respondents of the survey also state their occupation, the average number of non-routine tasks in an occupation k, T_k, and the maximum number of non-routine tasks in any occupation, $Max\ T$, can be calculated. A measure of the non-routine intensity of an occupation k, $NRTI1_k$ is then generated by dividing T_k by $Max\ T$, which gives a continuous task intensity measure ranging between 0 and 1, where 1 denotes maximum intensity. To enable linkage between our Swedish data at individual level and $NRTI1_k$ the more detailed German two-digit occupation in Becker et al. (2013) is translated into the more limited two-digit international standard classification ISCO88. Moreover, we transform the variable *NRTI1* to assume values between 0 and 100. Table 1 shows *NRTI1* for different occupations k. $NRTI1_k$ can be interpreted as the percentage of non-routine tasks in occupation k.

The second measure of non-routine intensity of an occupation is based on the Routine Task Intensity (*RTI*) index used for the US by, for example, Autor and Dorn (2013), normalised to have zero mean and unit standard deviation and mapped onto the two-digit ISCO88 by Goos et al. (2014).[7] The RTI index consists of three task aggregates: manual, routine, and

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[5] The survey is the German Qualification and Career Survey 1998/99 (BIBB-IAB).
[6] The 81 workplace tools range from hand tools to machinery and diagnostic devices to computers and means of transport. For a complete list, the workplace tools are included in the survey along with whether they indicate that non-routine tasks are performed or not, see Becker et al. (2013) Table A1.
[7] A caveat is that the mapping from the US occupational code to the international ISCO88 code means that we are left with a crude occupational classification of only 21 occupations.

abstract tasks, which are combined to create the summary measure *RTI* by occupations k.[8] The measure rises with the importance of routine tasks in each occupation and declines with the importance of manual and abstract tasks. To map the *RTI* values in Goos et al. (2014) onto a variable *RTI2* that assumes values between 0 and 100, we use the cumulative normal distribution with mean 0 and standard deviation 1. From $RTI2_k$ we obtain the non-routine task intensity of occupation k, $NRTI2_k = 1 - RTI2_k$. Table 1 presents $NRTI2$ for various occupations k.

Table 1 The share of non-routine and non-offshorable tasks and skill intensity in different occupations. Percent.

ISCO 88	Occupation	Non-routine 1	Non-routine 2	Non-offshor-able	Skill-intensity	Employ-ment
11	Legislators and senior officials	54.4	..	..	62.5	4,833 (0.1)
12	Corporate managers	78.4	77.3	62.6	40.8	188,239 (4.3)
13	Managers of small enterprises	46.6	93.6	73.6	21.0	79,041 (1.8)
21	Physical, mathematical and engineering science professionals	100.0	79.4	14.7	57.2	206,146 (4.7)
22	Life science and health professionals	90.4	84.1	77.6	50.5	94,484 (2.2)
23	Teaching professionals	61.2	..	..	80.4	214,851 (4.9)
24	Other professionals	63.0	76.7	41.7	61.0	311,621 (7.1)
31	Physical and engineering science associate professionals	79.7	65.5	54.8	23.7	209,176 (4.8)
32	Life science and health associate professionals	56.3	62.9	77.3	65.8	132,554 (3.0)
33	Teaching associate professionals	36.1	..	..	43.9	99,713 (2.3)
34	Other associate professionals	52.7	67.0	46.0	24.9	411,100 (9.4)
41	Office clerks	52.1	1.3	34.5	11.3	262,620 (6.0)
42	Customer services clerks	27.1	7.9	59.9	11.0	71,096 (1.6)
51	Personal and protective services workers	32.0	72.6	82.6	6.4	677,186 (15.5)
52	Models, sales persons and demonstrators	8.1	48.0	81.3	6.5	225,312 (5.2)
61,62	Market-oriented skilled agricultural and fishery workers	10.8	..	..	7.3	91,448 (2.1)
71	Extraction and building trades workers	21.4	57.5	82.4	2.0	260,910 (6.0)

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[8] Formally, the *RTI* index in occupation k is calculated as:

$$RTI_k = ln(T_{k,1980}^R) - ln(T_{k,1980}^M) - ln(T_{k,1980}^A)$$

where T_k^R, T_k^M, and T_k^A are, respectively, the routine, manual, and abstract inputs in each occupation k in 1980.

ISCO 88	Occupation	Non-routine 1	Non-routine 2	Non-offshor-able	Skill-intensity	Employ-ment
72	Metal, machinery and related trades workers	41.6	32.3	67.4	1.7	129,472 (3.0)
73	Precision, handicraft, printing and related trades workers	39.8	5.6	4.8	8.4	11,724 (0.3)
74	Other craft and related trades workers	17.7	10.7	12.5	4.9	18,388 (0.4)
81	Stationary-plant and related operators	43.6	37.4	5.6	2.9	52,850 (1.2)
82	Machine operators and assemblers	18.8	31.2	0.9	2.9	183,917 (4.2)
83	Drivers and mobile-plant operators	6.3	93.3	84.1	3.4	167,284 (3.8)
91	Sales and services elementary occupations	0.0	48.8	79.1	5.9	210,283 (4.8)
92	Agricultural, fishery and related laborers	0.9	..	..	7.0	3,831 (0.1)
93	Labourers in mining, construction, manufacturing and transport	2.5	32.6	74.5	3.9	48,676 (1.1)

Remark: Percentage of total employment within parentheses.

Source: Non-routine 1 Nilsson Hakkala et al. (2014) Table 1, Non-routine 2 Goos et al. (2014) Table 1, Non-offshorable Goos et al. (2014) Table 1, Skill intensity and employment Statistics Sweden, Register-based Labour Market Statistics (RAMS)

We use the offshorablity measure *OFF* in Blinder and Kreuger (2013). *OFF* is based on professional coders' assessment of the ease with which an occupation could potentially be offshored. This measurement is normalised to have zero mean and unit standard deviation and is converted to the two-digit ISCO88. As we did with *RTI* above, we map these values onto a variable *OFFI* that assumes values between 0 and 100 by using the cumulative normal distribution. We obtain our non-offshoreability index of occupation k, $NOFFI_k = 1 - OFFI_k$. Table 1 shows *NOFFI* for different occupations k and indicates the share of non-offshorable tasks in occupations.

From table 1 we observe that according to *NRTI1* the non-routine intensity is greatest among "21 Physical, mathematical and engineering science professionals", while according to *NRTI2* it is greatest among "13 Managers of small enterprises". The least non-routine intensive are "91 Sales and services elementary occupations" (*NRTI1*) or "41 Office clerks" (*NRTI2)*. Given that *NRTI1* and *NRTI2* are supposed to measure more or less the same thing (the non-routine intensity of an occupation), the correlation coefficient in table 2 is fairly low (0.38), and is only significant at the 10 percent level. If we take a closer look at table 1, the low correlation is not surprising; the non-routine intensity among "83 Drivers and mobile plant operators" is quite high according to *NRTI2*, whereas according to *NRTI1* it is very low. We observe the same pattern for "91 Sales and service elementary occupations". Furthermore, we notice that employment in ISCO 83 and ISCO 91 is not negligible; in each of the occupations the employment share is larger than 4 percent.

Table 2 Correlations of occupational non-routine intensity, non-offshorable intensity and skill intensity

	NRTI1	NRTI2	NOFFI	SKILL
NRTI1	1			
NRTI2	0.38*	1		
NOFFI	−0.20	0.47**	1	
SKILL	0.77***	0.51**	0.03	1

Remark: ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

The most offshorable occupations are "82 Machine operators and assemblers", i.e. *NOFFI* is lowest, and the least offshorable are "83 Drivers and mobile plant operators". It is unclear whether non-offshorable tasks are non-routine, since the correlation coefficient between *NOFFI* and *NRTI1* is positive (0.47) and significant, whereas the correlation coefficient between *NOFFI* and *NRTI2* is negative (−0.20) and insignificant.

An interesting question is the extent to which non-routine and non-offshorable tasks are carried out by skilled workers. Table 3 shows that the correlation between non-routine intensity (both *NRTI1* and *NRTI2*) and skill intensity is positive and significant, i.e. those working on non-routine tasks are often individuals with a high level of education. In contrast, there is no relation between those who work on non-offshorable tasks and their skill level; the correlation between *NOFFI* and *SKILL* is insignificant. The latter differ slightly from the findings in Blinder and Kreuger (2013), where educated workers appear to hold somewhat more offshorable jobs.

We conclude that non-routine tasks are performed to a great extent by skilled individuals. Yet, as pointed out by Nilsson Hakkala et al. (2014), even though the non-routine task measures and the measure of skill clearly overlap, the mapping is far from one-to-one. On the other hand, the correlation between the two different non-routine measures is surprisingly much lower than the correlation between non-routineness and skill. When it comes to offshorable tasks, it seems that such tasks are performed by both skilled and less-skilled workers.

Given these connections between task measures and skill, it would be of interest to see whether it is routine tasks or activities conducted by less-skilled workers that are offshored when Swedish multinationals expand their employment abroad, or rather, if it is offshorable tasks that are relocated overseas. In the econometric analysis in the following section we examine the relationship between relative demand for skills and tasks in the parents of Swedish multinationals and changes in employment in their affiliates abroad.

3 Econometric analysis

3.1 Econometric specification

As a measure of relative demand for task i in MNE parent j at time t we use the wage bill share

$$WS_{jt}^i = \frac{\sum_s \delta_s^i W_{sjt}}{W_{jt}} \qquad (1)$$

where W_{sjt} is the sum of wages of workers in occupation s in MNE parent j at time t, δ_s^i the proportion of job task i in occupation s (see table 1), and W_{jt} is the total wage bill in MNE parent j at time t. The wage bill share in equation (1) picks up both a higher proportion of task i in MNE parent j and a greater remuneration of task i.

Our corresponding measure of relative demand for skills is the wage bill share of workers with three years of post-secondary education. This measure captures both an increased proportion of skilled employment in MNE parent j and a greater remuneration for skills.

To analyse the link between the relative demand for work type i (skilled, non-routine or non-offshorable tasks) at the parent of MNE j in Sweden and the offshore employment at foreign location k, we employ an approach that has become standard in such analyses.[9]

$$WS_{jnt}^i = \sum_k \gamma_k OES_{jkt} + \beta_K ln\left(\frac{K}{Y}\right)_{jt} + \beta_Y lnY_{jt} + \beta_W ln\left(\frac{w^i}{w^{-i}}\right)_{nt} +$$

$$+\beta_R \left(\frac{RD}{Y}\right)_{nt} + \beta_I \left(\frac{ICT}{Y}\right)_{nt} + \alpha_j + \alpha_t + \varepsilon_{jnt}^i \qquad (2)$$

WS_{jnt}^i is the wage bill share of work type i at parent j in industry n at time t. The variable of greatest interest is the offshore employment share OES_{jkt}, i.e. the ratio of employment in foreign affiliates of MNE j in location k to total employment in MNE j at time t. This is a measure of MNE j's offshore activities in location k at time t.

It has been argued, as well as demonstrated empirically, that technological change, computerisation, and automation have a positive impact on the demand for skills and the proportion of non-routine tasks.[10] Skilled-biased technological change shifts the production technology in favour of skilled labour over less-skilled labour by raising the productivity of skilled labour more than that of less-skilled, and therefore increasing the relative demand for skills. Routine tasks are thought to be easier to offshore, but such tasks can also to a greater extent be automated or replaced by computers. To control for the impact of technology on the relative demand for skills and non-routine tasks, in our econometric specification we add the variables R&D expenditures and ICT capital as a proportion of value added in industry n of the MNE parent $(RD/Y)_{nt}$ and $(ICT/Y)_{nt}$. $(RD/Y)_{nt}$ is in current prices and $(ICT/Y)_{nt}$ in 2010 prices.

K is capital, i.e., the book value of buildings, machinery and equipment, Y is value added, and both variables are in 2010 prices. Finally, in equation (2), α_j is an MNE-specific effect, α_t is a year effect, and ε_{ijt} is an error term.

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[9] Slaughter (2000), Head and Ries (2002), Hansson (2005) and Becker et al. (2013).
[10] Machin and Van Reenen (1998), Autor, Levy and Murnane (2003) and Autor and Dorn (2013).

3.2 Estimations: relative labour demand

We estimate equation (2) for each of the types of work: skilled, non-routine, and non-offshorable, and present the results in table 1 to table 5. Table 3 includes the estimates for all sectors and table 4 shows separate results for manufacturing and services. Table 5 contains the outcome when we allow for different impacts of offshoring to various country groups.

Table 3 Offshore employment and onshore skill upgrading, non-routine and non-offshorable task intensities. All sectors.

	Skill upgrading	Non-routine 1	Non-routine 2	Non-offshorable
Offshore employment share OES	1.823	1.478	0.451	−0.082
	(2.83)	(3.53)	(1.09)	(−0.21)
Capital-output K/Y	−0.547	−0.366	−0.365	−0.158
	(−2.74)	(−2.90)	(−2.43)	(−1.36)
Value added Y	−1.464	−0.822	−1.137	−0.567
	(−3.79)	(−3.26)	(−4.45)	(−2.57)
RD/Y	0.454	0.487	−0.364	0.192
	(0.63)	(1.20)	(−1.34)	(0.50)
ICT/Y	−9.048	−4.649	−7.501	−1.980
	(−1.61)	(−1.00)	(−1.82)	(−0.62)
R^2 (within)	0.081	0.022	0.024	0.001
R^2 (between)	0.041	0.031	0.079	0.013
R^2 (overall)	0.034	0.030	0.051	0.013
Observations	14,880	14,865	14,865	14,865
Groups	3,438	3,432	3,432	3,432

Remark: Using an LM test the null hypothesis of homoscedasticity is rejected for all models. The reported t-values in parentheses are hence based on robust standard errors, clustered at the MNE group level.

For our key variable, the offshore employment share OES, in table 3 we find that an increase in OES means that there is generally an increase in the intensities of skilled and non-routine 1 *NRTI1* in the MNE parents in Sweden. In table 4, we can see that the result for skills is driven by the service industries, whereas for *NRTI1* there is a positive correlation both in manufacturing and in services. Regarding the intensities of non-routine 2 *NRTI2* and non-offshorability *NOFFI* in the MNE parents, they are unrelated to changes in OES.

In other words, increased employment shares offshore seems to be positively related to skill upgrading onshore, which is consistent with a development where higher proportions of jobs are performed by skilled workers in the MNE parents in Sweden, at the same time as less-skilled activities are relocated to their affiliates abroad. On the other hand, we do not find any relationship between offshore employment shares and non-offshorability intensity onshore. Our interpretation here is that, even though many jobs are potentially offshorable within MNEs, it does not mean that they actually become offshored, and in Swedish MNEs this has not thus far been the case. Finally, we conclude that how non-routine intensity in the MNE parents is related to changes in offshore employment is ambiguous and appears to depend on how we measure the non-routine content of jobs.

Table 4 Offshore employment and onshore skill upgrading, non-routine and offshorable task intensities. Manufacturing and services.

	Skill upgrading	Non-routine 1	Non-routine 2	Non-offshorable
Manufacturing				
Offshore employment	0.426	1.726	0.776	0.789
share OES	(0.57)	(3.08)	(1.58)	(1.02)
Capital-output	−0.443	−0.510	−0.422	−0.489
K/Y	(−1.46)	(−2.34)	(−2.11)	(−1.78)
Value added	−1.278	−1.654	−1.106	−1.137
Y	(−2.41)	(−4.57)	(−3.44)	(−2.68)
RD/Y	0.498	0.658	0.035	1.566
	(1.14)	(1.60)	(0.12)	(2.67)
ICT/Y	−0.175	−4.090	0.3234	3.081
	(−0.04)	(−1.00)	(0.11)	(0.68)
R^2 (within)	0.160	0.077	0.060	0.020
R^2 (between)	0.033	0.070	0.062	0.044
R^2 (overall)	0.018	0.033	0.029	0.044
Observations	4,993	4,993	4,993	4,993
Groups	1,072	1,072	1,072	1,072

	Skill upgrading	Non-routine 1	Non-routine 2	Non-offshorable
Services				
Offshore employment	2.334	1.338	0.009	−0.399
share OES	(2.81)	(2.48)	(0.02)	(−0.95)
Capital-output	−0.449	−0.297	−0.171	0.037
K/Y	(−1.93)	(−2.08)	(−1.01)	(0.31)
Value added	−1.022	−0.409	−0.764	−0.115
Y	(−2.15)	(−1.31)	(−2.32)	(−0.48)
RD/Y	14.198	10,897	4.160	−6.785
	(2.84)	(3.22)	(1.56)	(−2.43)
ICT/Y	−15.137	−1.176	−12.054	0.843
	(−1.47)	(−0.16)	(−1.49)	(0.20)
R^2 (within)	0.063	0.015	0.012	0.007
R^2 (between)	0.041	0.082	0.028	0.041
R^2 (overall)	0.043	0.103	0.018	0.053
Observations	9,887	9,872	9,872	9,872
Groups	2,531	2,525	2,525	2,525

Remark: The reported t-values in parentheses are based on robust standard errors, clustered at the MNE group level.

Decreased value added in the Swedish parts of the MNEs is related to skill upgrading, and higher intensities of non-routine and non-offshorable tasks. One interpretation might be that reductions of operations in Sweden involve a concentration of the remaining parts of the MNE parents on more skilled activities and more non-routine and non-offshorable tasks.

If anything, there appears be to a negative correlation between capital deepening and skill upgrading, and wage bill shares of non-routine and non-offshorable tasks. This implies that our results provide no support, neither for capital-skill complementarity, nor for complementarity between capital and non-routine tasks.

Somewhat surprisingly when compared to previous studies of the effects of technological change and computerisation on skill and non-routine task intensities, we obtain almost no significant positive coefficients on R&D and ICT intensities (exceptions are in table 4 for skill upgrading and NRTI1 in services).

In table 5, we present estimates examining offshoring OES to various country groups. Initially, we note that there are positive and significant (in some cases, however, only at 10 percent level) relationships between offshore employment shares and onshore wage bill for shares of skilled and non-routine tasks (both 1 and 2). The coefficients for employment shares in low-income countries are, as expected, larger; less-skilled activities and routine tasks tend to a greater degree to be relocated to low-income countries. However, note that the coefficients for high- and low-income countries are not significantly different from each other.

Table 5 Offshore employment and onshore skill upgrading, non-routine and offshorable task intensities. All sectors. Offshore employment shares in different country groups.

Offshore employment share	Skill upgrading		Non-routine 1		Non-routine 2		Non-offshorable	
High income	1.712	1.691	0.786	0.863	−0.039	0.038	−0.450	−0.428
	(2.64)	(2.44)	(1.79)	(1.93)	(−0.09)	(0.09)	(−1.10)	(−1.04)
Low-income	2.046		2.871		1.438		0.660	
	(1.79)		(3.82)		(1.79)		(0.88)	
Central and		2.309		2.089		0.272		0.616
Eastern Europe		(1.24)		(2.37)		(0.30)		(0.60)
China		1.708		3.533		2.748		0.367
		(0.99)		(2.15)		(2.30)		(0.18)
India		2.713		0.432		4.392		−1.246
		(0.69)		(0.21)		(1.74)		(−0.51)
Other		1.779		3.819		2.413		0.920
low-income		(0.67)		(3.00)		(1.69)		(0.87)
R^2 (within)	0.081	0.081	0.023	0.024	0.025	0.026	0.008	0.008
R^2 (between)	0.041	0.041	0.025	0.028	0.076	0.079	0.011	0.012
R^2 (overall)	0.033	0.033	0.023	0.026	0.047	0.051	0.011	0.011
Observations	14,880	14,880	14,865	14,865	14,865	14,865	14,865	14,865
Groups	3,438	3,438	3,432	3,432	3,432	3,432	3,432	3,432

Remark: The specifications in the table include the same variables as in tables 3 and 4, i.e. capital-output, value added, R&D and ICT intensities. The reported t-values in parentheses are based on robust standard errors, clustered at the MNE group level.

In an assessment of the economic relevance of offshoring on skill upgrading and task intensities[11] in Swedish MNE parents in general, i.e. the aggregate impact, it could be argued that larger MNEs play a greater role. As an alternative in such assessments to the estimates in table 5, in table 6 we provide weighted estimates[12]. We weigh the regressions by the wage bill shares of the MNE parents.[13] In contrast to the unweighted estimates on the variable of primary interest, namely the offshore employment share in low income countries, the coefficients in the weighted regressions are substantially larger and all are clearly significant.

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[11] We focus on skill upgrading and non-routine intensity, because in table 5, the relations between offshoring and non-offshorable intensity always are insignificant.

[12] Solon et al. (2013) contains an interesting discussion on when and how to weight data used in estimation. They conclude that: "In situations in which you might be inclined to weight, it is often useful to report both weighted and unweighted estimates, and discuss what the contrast implies for the interpretation of the results."

[13] See the remark in table 6.

Table 6 Offshore employment and onshore skill upgrading, non-routine and offshorable task intensities. All sectors. Results based on unweighted vs. weighted estimations.

	Skill upgrading		Non-routine 1		Non-routine 2	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
High income	1.712	3.253	0.786	1.120	−0.039	0.721
OES	(2.64)	(1.40)	(1.79)	(0.79)	(−0.09)	(0.75)
Low-income	2.046	8.163	2.871	6.229	1.438	3.389
OES	(1.79)	(2.61)	(3.82)	(3.23)	(1.79)	(2.06)
Capital-output	-0.547	-0.333	-0.362	-0.771	-0.362	-0.716
K/Y	(-2.74)	(-0.88)	(-2.86)	(-2.36)	(-2.41)	(-2.78)
Value added	-1.463	-0.534	-0.816	-0.881	-1.133	-0.531
Y	(-3.79)	(-0.80)	(-3.24)	(-2.23)	(-4.44)	(-0.80)
RD/Y	0.453	0.911	0.477	0.115	-0.371	0.082
	(0.63)	(0.74)	(1.17)	(0.16)	(-1.36)	(0.12)
ICT/Y	-9.064	-23.63	-4.753	10.57	-7.575	4.420
	(-1.61)	(-1.66)	(-1.03)	(2.25)	(-1.84)	(1.19)
R^2 (within)	0.081	0.394	0.023	0.122	0.025	0.142
R^2 (between)	0.041	0.052	0.025	0.040	0.076	0.098
R^2 (overall)	0.033	0.035	0.023	0.037	0.047	0.069
Observations	14,880	14,146	14,865	14,865	14,865	14,865
Groups	3,438	3,176	3,432	3,432	3,432	3,432

Remark: In the weighted regressions the weight for a particular enterprise group is defined as the total wage bill for the enterprise group in question over the sum of total wage bills for all enterprise groups. The weights are specific for each skill or task measure. The reported t-values in parentheses are based on robust standard errors, clustered at the MNE group level.

In table 7, to calculate the explanatory power of offshore employment for wage bill shares of skilled labour and non-routine tasks, we multiply the offshoring unweighted or weighted coefficient estimates in table 6 (column 1) by the observed unweighted or weighted changes in offshoring OES between 2001 and 2013 (column 2), which gives us in-sample predictions of the changes in wage bill shares (column 3). By relating that to the observed onshore change in the wage bill shares (column 4), we obtain an estimate of the contribution of offshoring to the onshore change in wage-bill shares (column 5).[14]

From this assessment of the economic relevance of offshoring to the workforce composition onshore, in table 7 we find that offshoring to low-income countries contributes positively to the wage bill share of skilled labour and non-routine tasks, whereas offshoring to high-income countries almost always contributes negatively.

If we, in the evaluations of the impact, use the coefficients from the unweighted regressions and the unweighted changes in OES, the contribution from offshoring to low-

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[14] Cf. Becker et al. (2013) Table 10.

income countries is, with the exception on non-routine intensity 1, of relatively minor importance, for skill upgrading only 1 percent and 2 percent for non-routine intensity 2.

If we instead use the coefficients from the weighted regressions and the weighted changes in OES, we obtain a much larger impact, for skill upgrading 12 percent and 7 percent for non-routine intensity 2. For non-routine intensity 1, it is as much as 21 percent. The reason is both larger coefficient estimates in the weighted regressions and greater changes in weighted OES than in unweighted, due to that the changes in OES for larger parent MNEs are greater. However, the contribution from offshoring to high income countries using coefficients from weighted regressions and weighted changes in OES is still relatively small and negative.

We think that in an assessment of the economic relevance of offshoring on skill upgrading and non-routine intensities in Swedish MNE parents it is reasonable to account for the greater role that larger MNEs play. Therefore, in the evaluation of the economic impact we prefer to use coefficients estimated in the weighted regressions and the weighted changes in OES. Accordingly, we conclude that the influence of offshoring within Swedish MNEs to low income countries in the 2000s has been non-negligible and significant on skill upgrading and non-routine intensity in Swedish MNE parents.

Table 7 Assessment of the economic relevance of offshoring on onshore workforce composition

	Coefficient estimate	Change in OES	Predicted ΔWS^i	Observed ΔWS^i	Contribution to ΔWS^i
Skill upgrading					
Unweighted					
High-income	1.712	-0.052	-0.089	9.5	-0.9%
Low-income	2.046	0.048	0.098	9.5	1.0%
Weighted					
High-income	3.253	-0.070	-0.226	9.5	-2.4%
Low-income	8.163	0.140	1.144	9.5	12.1%
Non-routine 1					
Unweighted					
High-income	0.786	-0.052	-0.041	1.0	-4.1%
Low-income	2.871	0.048	0.138	1.0	13.8%
Weighted					
High-income	1.120	-0.070	-0.078	4.1	-1.9%
Low-income	6.229	0.140	0.873	4.1	21.1%
Non-routine 2					
Unweighted					
High-income	-0.039	-0.052	0.002	3.6	0.1%
Low-income	1.438	0.048	0.069	3.6	1.9%
Weighted					
High-income	0.721	-0.070	-0.050	7.0	-0.7%
Low-income	3.389	0.140	0.475	7.0	6.8%

3.3   Estimations: absolute labour demand

To examine the relationship between changes in offshore employment in high- and low-income countries and onshore employment of skilled and less-skilled labour in absolute terms, we replace the dependent variable in equation (1), the wage bill share of skilled labour WS_{jnt}^{skill} with L_{jnt}^i, the employment of work type i (skilled or less-skilled) in the Swedish MNE parent j in industry n at time t.

$$L_{jnt}^i = \sum_k \gamma_k OE_{jkt} + \beta_R \left(\frac{RD}{Y}\right)_{nt} + \beta_I \left(\frac{ICT}{Y}\right)_{nt} +$$
$$+ \alpha_j + \alpha_t + \varepsilon_{jnt}^i \qquad (2)$$

where OE_{jkt} is employment in affiliates of MNE j in country group k (high- or low-income countries) at time t. We estimate equation (2) for total parent employment as well. Table 8 presents the results of the estimations, at first, for all sectors and then for manufacturing and services separately.

Table 8 Offshore and onshore employment: total, skilled and less-skilled employment

	Total employment	Skilled employment	Less-skilled employment
All sectors			
Offshore employment	0.058	0.017	0.040
high-income OE_{high}	(1.27)	(1.53)	(0.99)
Offshore employment	−0.016	0.009	−0.024
low-income OE_{low}	(−0.44)	(1.09)	(−0.74)
Capital-output	32.69	5.376	27.32
K/Y	(3.25)	(2.54)	(3.18)
Value added	199.8	27.51	172.30
Y	(5.02)	(4.84)	(4.77)
RD/Y	25.50	5.192	20.312
	(0.41)	(0.35)	(0.42)
ICT/Y	1334	299.9	1034
	(1.36)	(1.72)	(1.26)
R^2 (within)	0.040	0.088	0.036
R^2 (between)	0.279	0.175	0.263
R^2 (overall)	0.309	0.174	0.300
Observations	14,880	14,880	14,880
Groups	3,438	3,438	3,438

	Total employment	Skilled employment	Less-skilled employment
Manufacturing			
Offshore employment high-income OE_{high}	0.060 (1.10)	0.010 (0.64)	0.050 (1.14)
Offshore employment low-income OE_{low}	−0.092 (−3.07)	0.017 (0.72)	−0.109 (−6.24)
R^2 (within)	0.214	0.087	0.314
R^2 (between)	0.187	0.395	0.128
R^2 (overall)	0.230	0.444	0.138
Observations	4,993	4,993	4,993
Groups	1,072	1,072	1,072
Services			
Offshore employment high-income OE_{high}	0.057 (1.02)	0.028 (2.51)	0.030 (0.61)
Offshore employment low-income OE_{low}	0.017 (0.52)	0.006 (1.42)	0.011 (0.37)
R^2 (within)	0.038	0.123	0.031
R^2 (between)	0.274	0.132	0.246
R^2 (overall)	0.266	0.111	0.256
Observations	9,887	9,887	9,887
Groups	2,531	2,531	2,531

Remark: The reported t-values in parentheses are based on robust standard errors, clustered at the MNE group level.

In the first place, we find no relationship, neither for skilled, nor for less-skilled workers, between employment in affiliates abroad and employment in the parent companies at home. Not surprisingly, increased value added and a higher capital-output ratio in the parents is positively correlated with larger onshore employment. The proportion of ICT capital of value added at home in the industry of the MNE parent co-varies positively with onshore employment of skilled labour (significant at 10 percent level).

More interesting results emerge when we estimate the model in equation (2) separately for manufacturing and services. In manufacturing, employment in parents is negatively related to offshore employment in low-income countries, particularly for employment of less-skilled labour. This suggests that employment in affiliates in low-income countries is a substitute particularly for less-skilled employees onshore.

Moreover, in services, skilled employment in parents is positively correlated with employment in affiliates in high-income countries, which indicates that employment in affiliates in high-income countries is a complement to onshore skilled employment in parents. Such complementarities might be a driving force behind the onshore skill upgrading we find in table 4 in services in connection with increased offshore employment shares in high-income countries.

In sum, our results indicate that increased employment in affiliates in low-income countries reduces parent employment of less-skilled labour in manufacturing MNEs, whereas increased employment in affiliates in high-income countries boosts parent employment of skilled labour in MNEs in the service sector.

4 Concluding remarks

In the 2000s, employment in Swedish MNEs grew rapidly in their affiliates abroad, whilst employment in the parents in Sweden remained more or less unchanged. Moreover, in contrast with the 1990s, when the largest employment growth occurred in affiliates in high-income countries, employment in the 2000s mainly expanded in affiliates in low-income countries, e.g. China and the Central and Eastern European countries.

We estimate the relative demand for skills and tasks in Swedish MNEs between 2001 and 2013 and found that offshoring to affiliates abroad increased the demand for skills and non-routine tasks in the MNE parents, in particular in connection with offshoring to low-income countries. This indicates that offshoring entails activities being performed by low-skilled labour and routine tasks in the MNE parents being relocated abroad. An assessment of the economic importance suggests that such influences of offshoring have been non-negligible.

On the other hand, we do not find that offshorable tasks are offshored to a greater extent when employment increases in affiliates overseas. This implies that, while many MNE jobs are offshorable, it does not mean that they are always offshored. Characteristics such as the routineness of jobs or whether it involves jobs performed by less-skilled workers seem to be more important factors for why they are offshored than the offshorability of jobs.

The estimations of absolute demand for skilled and less-skilled labour show that increased employment in affiliates in low-income countries is negatively related to the employment of less-skilled workers in manufacturing MNE parents; employment in affiliates in low-income countries appears to be a substitute for less-skilled labour in the parents of manu-facturing MNEs. Furthermore, we find that employment of skilled labour in MNE parents in services is positively related to employment in affiliates in high-income countries; employment in affiliates in high-income countries seems to be a complement to skilled labour in MNE parents in the service sector.

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Tillväxtanalys ansvarar för tillväxtpolitiska utvärderingar och analyser och därigenom medverkar vi till:

- stärkt svensk konkurrenskraft och skapande av förutsättningar för fler jobb i fler och växande företag
- utvecklingskraft i alla delar av landet med stärkt lokal och regional konkurrenskraft, hållbar tillväxt och hållbar regional utveckling

Utgångspunkten är att forma en politik där tillväxt och hållbar utveckling går hand i hand. Huvuduppdraget preciseras i instruktionen och i regleringsbrevet. Där framgår bland annat att myndigheten ska:

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