WORKING PAPER

No 9/2018

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Kent Eliasson, Pär Hansson and Markus Lindvert

Economics

ISSN 1403-0586

http://www.oru.se/Institutioner/Handelshogskolan-vid-Orebro-universitet/Forskning/Publikationer/Working-papers/
Örebro University School of Business
701 82 Örebro
SWEDEN

Decomposing value chains within Swedish multinationals

Kent Eliasson*, Pär Hansson** and Markus Lindvert***

June 12 2018

Abstract

Multinational enterprises (MNE) have been highly instrumental in the processes leading to the increased fragmentation of production within global value chains. We examine the relationship between relative demands for skills, non-routine or non-offshorable tasks in Swedish MNE parents (onshore) and their employment shares in affiliates abroad (offshore), as well as the impact on relative demand in Swedish enterprises at home when establishing an affiliate abroad. The period of study is 2001 to 2013, a period of expansion for Swedish MNEs, particularly in low-income countries such as China. Our instrumental variable estimates suggest that there is a causal relationship of increased employment shares in affiliates abroad (offshore) on higher relative demand for skills and non-routine tasks in the parents at home (onshore) and that the impact of such offshore employment changes onshore is non-negligible. Furthermore, we estimate the relationships between absolute employment onshore (skilled and less-skilled labor) and employment in affiliates offshore (high- and low-income countries). Increased employment in affiliates in low-income countries is negatively related to the employment of less-skilled workers in manufacturing MNE parents (*substitute*), whereas increased employment in affiliates in high-income countries is positively related to the employment of both skilled and less-skilled workers in service at MNE parents (*complement*).

Keywords: multinational enterprises, relative labor demand, offshoring, skill upgrading, non-routine and offshorable tasks

JEL: F14, F16, F23, J23, J24

* Growth Analysis, Studentplan 3, SE-831 40 Östersund
and Department of Economics, Umeå University, SE-901 87 Umeå
kent.eliasson@tillvaxtanalys.se

** Growth Analysis, Box 574, SE-101 31 Stockholm
and Örebro University School of Business, SE-701 82 Örebro
par.hansson@oru.se

*** Growth Analysis, Studentplan 3, SE-831 40 Östersund
markus.lindvert@tillvaxtanalys.se

1. Introduction[1]

Declining costs for transportation, information and communication, together with lower barriers to international trade and investment, have led to the 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, or onshore in Swedish enterprises that are establishing a foreign affiliate. In other words, we aim to investigate the relationship between outward FDI and the onshore employment composition of Swedish MNEs, or of Swedish enterprises becoming 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 analyze the skill composition, but, as in Becker et al. (2013), we also study the impact of offshoring on the task content in the MNE parents.[2]

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.

[1] The authors gratefully acknowledge financial support from Swedish Research Council for Health, Working Life and Welfare. We have benefited from comments in seminars at European Trade Study Group in Florence, Nordic International Trade Seminars in Stockholm, Swedish Network for European Studies in Economics and Business in Malmö, and Örebro University.

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

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 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 the 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. The second, which has recently been put to extensive use[3] but, to our knowledge, not in this context, 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 requires face-to-face contact with people other than fellow workers with no loss of quality. Professional coders had to take such considerations into account when they were asked in Blinder and Kreuger (2013) to assess the degree of offshorability 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.[4]

[3] See, e.g., Autor and Dorn (2013), Goos et al. (2014) and Autor et al. (2015).
[4] This is a recommendation by Autor (2013).

Compared to Becker et al. (2013), instead of MNE plants, we use enterprises as the unit of analysis. We prefer enterprises because this is the level at which decisions about initiating production abroad, relocations and other structural changes within MNEs are taken. Potential problems with plants arise, for example, when MNEs relocate low-skilled 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. With enterprises, on the other hand, the proportion of skilled labor increases at home while the offshore employment share becomes higher.[5]

In contrast to previous studies, the observation period in our study is quite lengthy and up-to-date, i.e., 2001 to 2013.[6] 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, such as in China.

In our sample of enterprises, we include all Swedish-owned enterprises that have employees abroad at least one year between 2001 and 2013. This means that in addition to observations on enterprises that are MNEs, i.e., have employees abroad, we also include observations on enterprises that become MNEs or cease to be MNEs over the studied period. Accordingly, we take not only the intensive margin

[5] Another example where enterprise groups are preferable as the unit of analysis is in the case of horizontal FDI offshoring – replicating the same activities abroad as are carried out at home – which requires increased headquarter services at home. For example, when the Swedish multinational clothing-retail company H&M opens new stores in other countries, headquarters activities, e.g., management, design and marketing, must expand in the parent country (Sweden). These activities are usually more skilled and non-routine than average in the parent in Sweden, which means that the skill and non-routine intensity goes up in H&M at home. Most likely, such effects are better captured by an analysis on the enterprise level than in a plant-level analysis, since only headquarter plants at home are affected, while we expect to observe an unambiguous rise in skill and non-routine intensity on the enterprise level in the parent country due to horizontal FDI offshoring.

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

into account but also the extensive margin. In this respect, our analysis has similarities with Hijzen et al. (2011) and Hakkala et al. (2014), among others, which are studies that focus on the home effects of establishing a foreign affiliate by using matching techniques to compare the outcome in firms that become MNEs with other similar firms that continue to be non-MNEs.

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

Reasonably, technological changes (and computerization) have a positive impact on the demand for skills and non-routine tasks. Skilled labor 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 computerization in the empirical specification.

In manufacturing MNEs and service MNEs, the share of skilled labor has been growing at a similar rate. In manufacturing MNEs, however, this growth is due to a heavy decrease in the employment of less-skilled labor, whereas in service MNEs, it is a result of a substantial boost in the employment of skilled labor. To investigate these developments and reasons behind them in more detail, in addition to relative demand, we examine the relationships between offshore affiliate employment in high- and low-income countries and the absolute employment of skilled and less-skilled labor onshore separately. The results from such estimations indicate whether employment in offshore affiliates in high- and low-income

countries complements or substitutes the employment of different skills in MNE parents onshore.

One problem left largely unaddressed in previous studies estimating the relationships within MNEs between changes in their employment in affiliates overseas and changes in relative demand for skills and tasks in their parents at home is that labor demand at home and employment abroad might be jointly determined.[7] The positive relationship often found between an expansion in affiliates abroad and a higher share of skilled labor in parents at home could be a result of factors originating from abroad, such as lower costs of offshoring and increased demand overseas, as well as of domestic factors such as an increased supply of skilled labor in the home country. This means that a positive linkage between an expansion in affiliates abroad and increased relative demand for skills and tasks at home is a correlation, rather than a causal effect, and therefore becomes difficult to interpret. We attempt to identify a causal relationship by instrumenting employment in affiliates abroad. We regress employment in host country affiliates on GDP and barriers towards FDI in the host countries, which we argue are factors uncorrelated with labor demand in the parents at home. Predicted values on employment in affiliates abroad from the regressions are then used to explain labor demand in the parents at home.

Our study extends and revisits previous analyses on MNEs performed for the 1990s and the early 2000s. It is also related to other studies addressing similar questions but using different approaches, such as 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

[7] Head and Ries (2002) and Hansson (2005) present only OLS estimates for offshore employment. In an alternative but not emphasized estimation, Becker et al. (2013) use two-year lagged offshore employment as an instrument. Desai et al. (2009) and Hummels et al. (2014), however, address similar simultaneity problems more thoroughly in related problems.

(computerization) and international trade on local labor 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.

To preview our results, we find that expansions within Swedish MNEs of their offshore employment or Swedish enterprises initiating production abroad is associated with the fact that non-routine tasks and activities conducted by skilled workers are retained or expanded in the parent in Sweden (onshore). Our instrumental variable estimates suggest that there is a causal relationship of increased employment shares in affiliates abroad (offshore) on higher relative demand for skills and non-routine tasks in the parents at home (onshore). Moreover, the impact of such offshore employment changes onshore is non-negligible.

From the estimations of the absolute employment of skilled and less-skilled labor onshore, we note that increased employment in low-income countries appears to be negatively related to the employment of less-skilled labor in manufacturing MNE parents in Sweden (*substitute*). This is consistent with one of the motives put forward in the literature for foreign direct investment FDI, namely, resource-seeking (vertical FDI). Vertical FDI may lead to a relocation of less-skilled activities from Sweden to countries where less-skilled workers are cheaper.

Another motive for FDI is market-seeking (horizontal FDI). Unlike vertical FDI, horizontal FDI has positive employment effects in the home countries; an expansion abroad requires expanded headquarters activities in the parents (coordination and development). In contrast to manufacturing, our results for services show that increased employment in affiliates in high-income countries seems to be positively

related to the employment of both skilled and less-skilled labor in service MNE parents in Sweden (*complement*).

The structure of the remainder 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 presenting results from estimations of the relationships between offshore employment in high- and low-income countries and onshore employment of skilled and less-skilled labor. Section 4 summarizes and concludes.

2. Data and description

2.1 Data sources

To construct our dataset, we connect 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 labor 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).

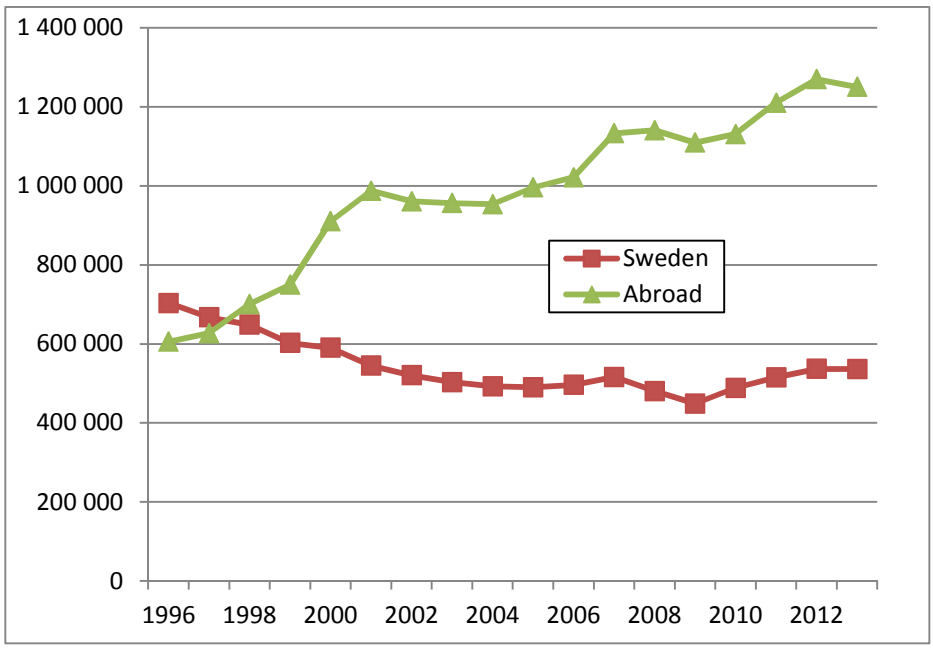
The basic variables in our study of individuals' educational attainment and occupations are derived from annual registers of the Swedish population compiled by Statistics Sweden (SCB). The education register has existed since 1985 and a

complete register on occupations has existed since 2001. Wage incomes[8] are from register-based labor 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 are 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 the development of employment in Swedish MNEs in Sweden and abroad between 1996 and 2013.

Figure 1 Employment in Swedish MNEs in Sweden and abroad

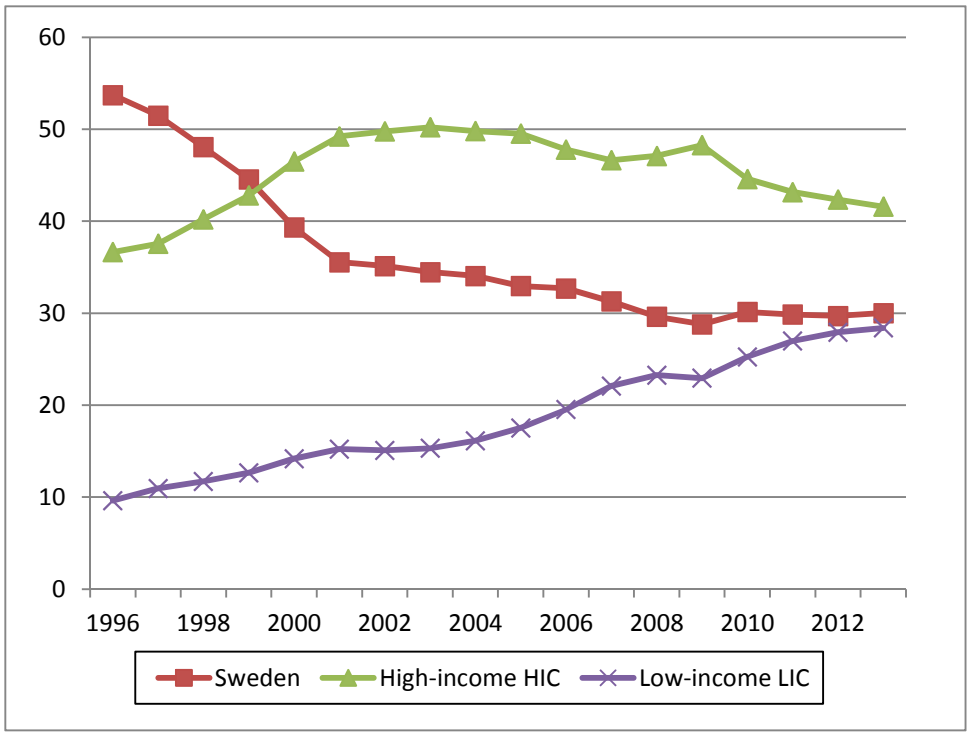


[8] More precisely, wage incomes are gross annual earnings.

Source: Growth Analysis, Swedish Groups with Affiliates Abroad

From 1996 to 2013, parent employment in Swedish MNEs decreased from 703,000 to 536,000 (−24%), 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 (+106%). Although 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 illustrated in Figure 2, where we show the development of employment shares in the parents in Sweden and in the affiliates in high-income and low-income countries.

Figure 2 Employment shares of Swedish MNEs in Sweden and in high-income and low-income countries[9]. Percent.



[9] The way we define high- and low-income countries (see the remark in the figure), low-income countries might be better termed as low- and middle-income countries.

Remark: High-income countries are the "old" OECD countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Switzerland, the United Kingdom and the United States.

Source: Growth Analysis, Swedish Groups with Affiliates Abroad

In Sweden, the proportion of total employment in Swedish MNEs has fallen from 54% in 1996 to 30% in 2013. The drop was largest in the late 1990s, however, and flattens out in the 2000s. In the late 1990s, the share abroad grows in both high- and low-income countries. In affiliates in high-income countries, the proportion at the outset increased from 37% in 1996 to its peak at 50% in 2003. The share then decreased, dropping to 42% in 2013. In low-income countries, the employment share has a distinctly rising trend, from nearly 10% in 1996 to more than 28% in 2013.

Table 1 Employment in affiliates in various low-income groups

Country group	1996	2001	2013	Δ2013-1996
Central and Eastern European Countries *CEEC*	34,549 (2.6)	96,047 (6.3)	168,607 (9.4)	134,058
China *CHN*	7,315 (0.6)	16,837 (1.1)	85,873 (4.8)	78,558
India *IND*	9,553 (0.7)	18,385 **(**1.2)	37,303 (2.1)	27,750
Other Low-Income Countries *OLIC*	74,599 (5.7)	102,042 (6.7)	215,418 (12.1)	140,819
Total employment Low-Income	126,016 (9.6)	233,311 (15.2)	507,201 (28.4)	381,202

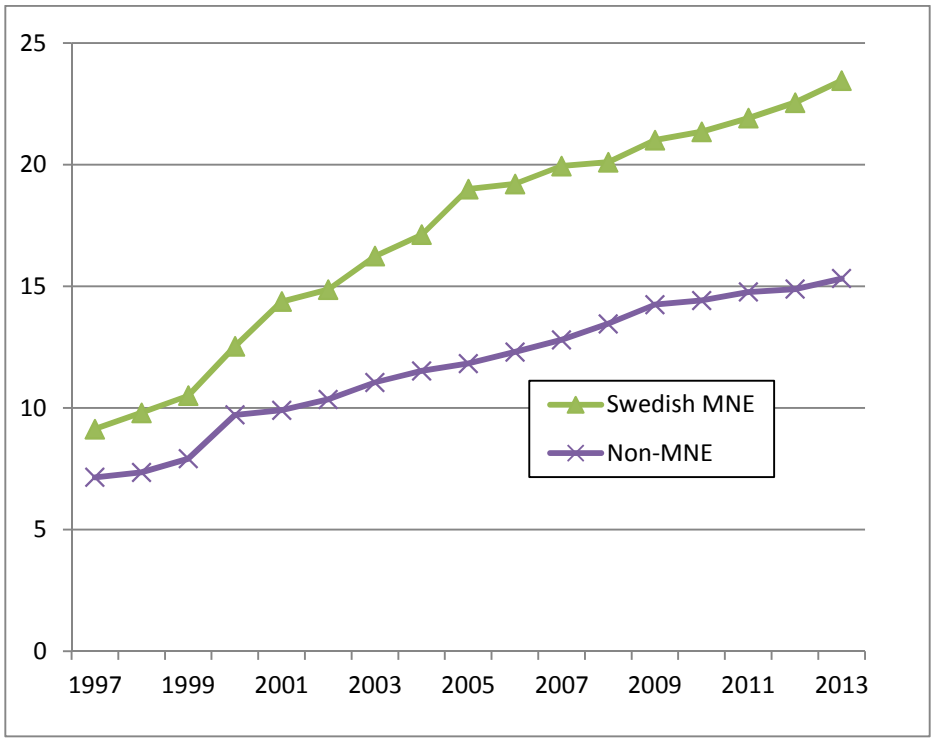
Remark: Within parentheses employment shares of total employment in Swedish MNEs in percent.

As we notice from Figure 2, during the study period from 2001 to 2013, employment in Swedish MNEs has shifted from high-income countries, including the parent country Sweden, towards growing countries with lower incomes. Table 1 gives a more detailed view of employment in various groups of low-income

countries. The table shows that in percentage terms the largest employment growth between 2001 and 2013 was in China (+410%); China started from a low level.

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 may therefore be of interest to compare the development of the share of skilled labor in the parents of Swedish MNEs with the development in non-MNEs in Sweden. This is shown in Figure 3. We define skilled labor as employees with three years or more of post-secondary education.

Figure 3 Share of skilled labor in Swedish MNEs and in non-MNEs. Percent.



Source: Statistics Sweden, Register-based Labor Market Statistics (RAMS)

We find that in both Swedish MNEs and non-MNEs, skill intensity grew substantially between 1997 and 2013. The reason behind these trends is most likely a substantial increase in the supply of skilled labor in Sweden during this period.

What is of greater interest, however, 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 14.3 percentage points, whereas the rise in non-MNEs is 8.2 percentage points. One possible explanation is 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 retained and expanded at home, we expect to see a greater increase in skill intensity in Swedish MNEs than in non-MNEs in Sweden. Additionally, notice from Figure 3 that the skill intensity is considerably higher in MNEs than in non-MNEs; in 2013, the share of skilled labor in MNEs is 23.5% compared to 15.3% in non-MNEs.

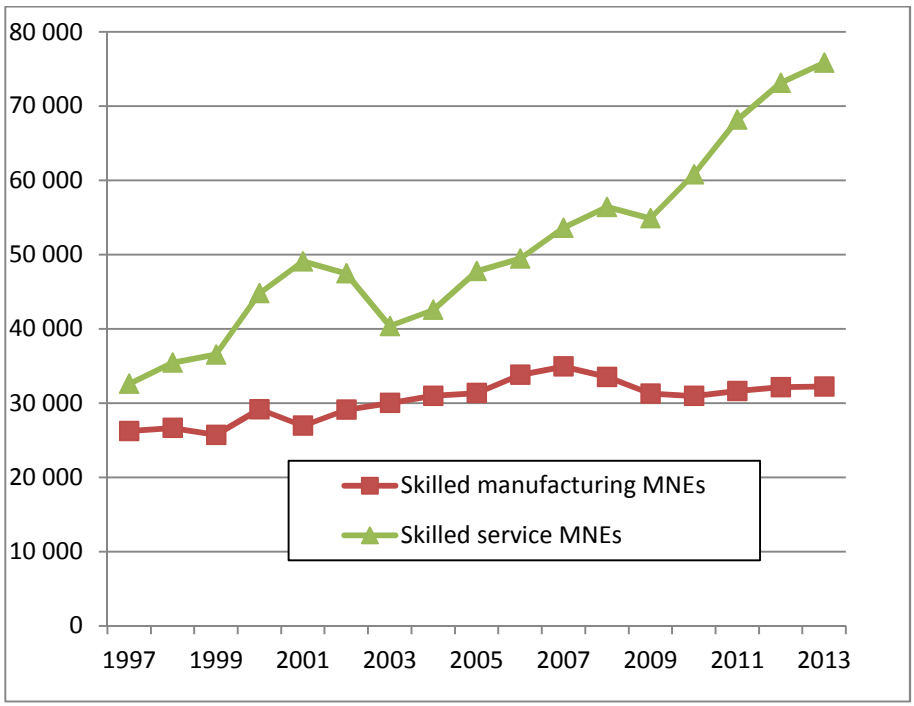
We found differences above in how the share of skilled labor developed in MNEs and non-MNEs. Can we also observe such differences between manufacturing MNEs and service MNEs? If we compare the share of skilled labor in the parents of manufacturing MNEs and the parents of service MNEs, we can see that the change in skill intensity is similar. In manufacturing MNEs the share of skilled labor rose 12.3 percentage points between 1997 and 2013 and in service MNEs, it increased 14.1 percentage points. In 2013, the skill intensity in service MNEs is higher than in manufacturing MNEs, 25.0% in service MNEs and 21.0% in manufacturing MNEs.

If in Figure 4 we instead look at the trends in the employment of skilled and less-skilled labor, however, we observe a different pattern in manufacturing than in services. Although the employment of skilled labor in manufacturing MNEs grew significantly between 1997 and 2013 (+23%), the increase in service MNEs is more substantial (+133%). Regarding less skilled labor, we find that a sharp decline in the employment in manufacturing MNEs (−59%) and a much smaller decrease in service MNEs (−20%). In other words, in manufacturing MNEs, the rising skill

share is due to a heavy decrease of less skilled labor, whereas in service MNEs, the higher skill intensity is largely the result of a considerable increase in the employment of skilled labor.[10]

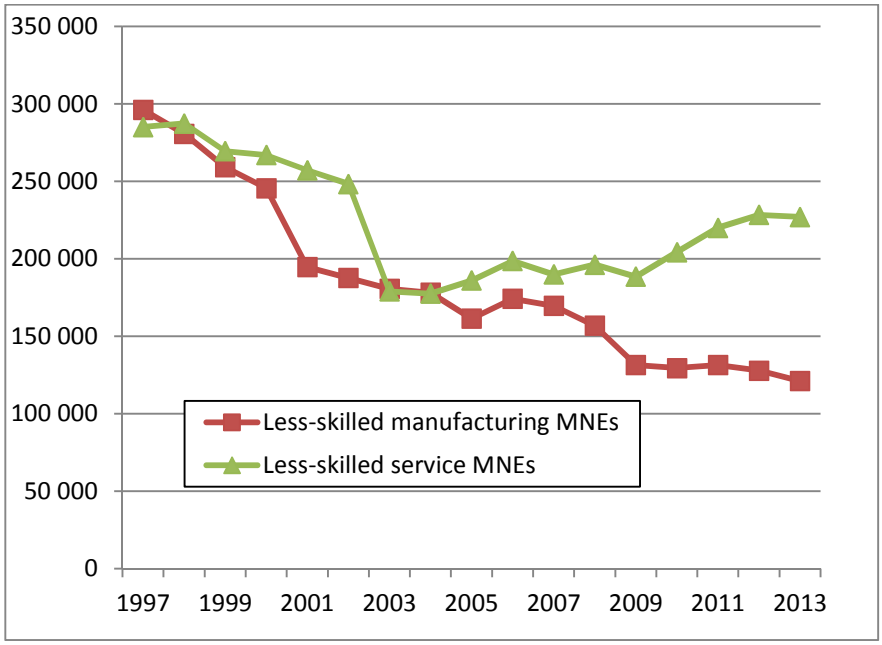
Figure 4 Trends in the employment of skilled and less-skilled workers in the parents of manufacturing MNEs and the parents of service MNEs

(a) Skilled workers



[10] Notice in Figure 4 that owing to population changes, e.g., Swedish MNEs becoming foreign-owned and therefore disappearing from the population, the changes between years in absolute employment can be quite dramatic.

(b) Less-skilled workers

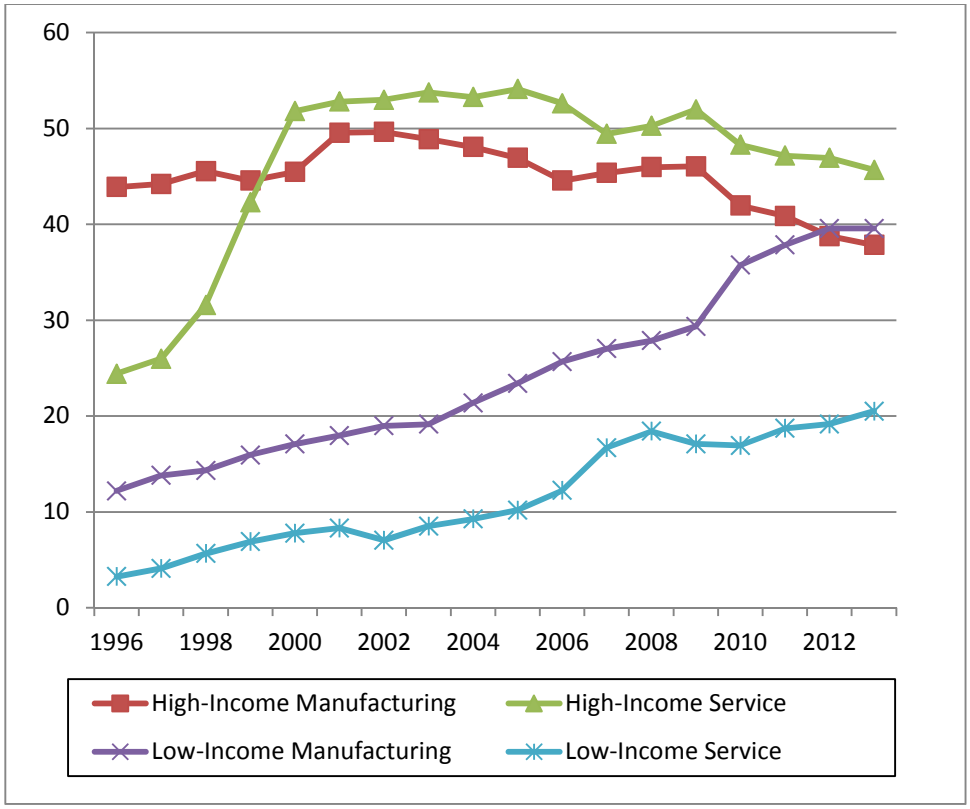


Source: Statistics Sweden, Register-based Labor Market Statistics (RAMS)

If we then examine the overseas affiliates of manufacturing and service MNEs, do they have different patterns of localization? First, in Figure 5, note that the offshore employment share is larger in manufacturing MNEs than in service MNEs, 77% in manufacturing MNEs and 66% in service MNEs in 2013. Second, at least from year 2000, the offshore employment share in high-income countries is higher in service MNEs than in manufacturing MNEs, while the reverse applies to low-income countries. Third, over time, the offshore employment share in high-income countries in manufacturing MNEs as well as in service MNEs has declined from approximately 50% to approximately 40%. Fourth, the offshore employment shares in low-income countries, both in manufacturing and service MNEs, have trended heavily upwards, from 12% in 1996 to 40% in 2013 in manufacturing MNEs and from 3 percent to 21% for service MNEs for the same period. Fifth, in recent years, the offshore employment share in low-income and high-income countries in

manufacturing MNEs has been approximately the same (40%); in services, the share is considerably higher in high-income countries.

Figure 5 Offshore employment shares in high-income and low-income countries in manufacturing MNEs and service MNEs. Percent.



Source: Growth Analysis, Swedish Groups with Affiliates Abroad

In sum, we discern 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 labor 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 employment share in low-income countries that has been growing, and lately in

manufacturing, the offshore employment share has grown to be approximately the same in high- and low-income countries.

However, to obtain more direct and reliable evidence regarding the impact of changes in offshore employment on the onshore skill (and task) composition within Swedish MNEs requires econometric analyses. Before presenting the results of such analyses, 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 characterize various occupations. First, we present two different measures of the element of non-routineness in an occupation, and second, an index of the degree of non-offshorability of an occupation. Non-routineness and offshorability are factors that can be expected to impact whether a task will be relocated abroad or not.

The first measure of the 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.[11] Each of the 81 tools identified is assumed to indicate whether non-routine tasks are performed by a worker.[12] Non-routine tasks are non-repetitive and require large amounts of problem solving ability. Because 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

[11] The survey is the German Qualification and Career Survey 1998/99 (BIBB-IAB).
[12] The 81 workplace tools range from hand tools to machinery and diagnostic devices to computers and means of transport. For a complete list of the workplace tools included in the survey along with whether they indicate that non-routine tasks are performed, see Becker et al. (2013) Table A1.

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, the variable *NRTI1* is transformed to assume values between 0 and 100. Table 2 shows *NRTI1* for different occupations *k*. $NRTI1_k$ can be interpreted as the percentage of non-routine tasks in occupation *k*.[13]

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), normalized to have zero mean and unit standard deviation and mapped onto the two-digit ISCO88 by Goos et al. (2014).[14] The RTI index consists of three task aggregates: manual, routine, and abstract tasks, which are combined to create the summary measure *RTI* by occupations *k*.[15] 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 2 presents $NRTI2$ for various occupations *k*.

[13] Data on $NRTI1_k$ is from Hakkala Nilsson et al. (2014).
[14] 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.
[15] Formally, the *RTI* index in occupation *k* is calculated as:

$$RTI_k = ln\left(T^R_{k,1980}\right) - ln\left(T^M_{k,1980}\right) - ln\left(T^A_{k,1980}\right)$$

where T^R_k, T^M_k, and T^A_k are, respectively, the routine, manual, and abstract inputs in each occupation *k* in 1980.

Table 2 The share of non-routine and non-offshorable tasks and skill intensity in different occupations. Percent.

ISCO 88	Occupation	Non-routine 1 *NRTI1*	Non-routine 2 *NRTI2*	Non-off-shorable *NOFFI*	Skill-intensity *SKILL*	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)
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)

Table 2 Continued

ISCO 88	Occupation	Non-routine 1 *NRTI1*	Non-routine 2 *NRTI2*	Non-off-shorable *NOFFI*	Skill intensity *SKILL*	Employ-ment
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	Laborers in mining, construction, manufacturing and transport	2.5	32.6	74.5	3.9	48,676 (1.1)

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 Labor Market Statistics (RAMS).

We use the offshorability 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 normalized 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-offshorability index of occupation *k*, $NOFFI_k = 1 - OFFI_k$. Table 2 shows *NOFFI* for different occupations *k* and indicates the share of non-offshorable tasks in occupations.

From Table 2, 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 occupations 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 3 is fairly low (0.38) and is

significant only at the 10% level. If we take a closer look at Table 2, 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%.

Table 3 Correlations of occupational non-routine intensity, non-offshorable intensity and skill intensity

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

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 relationship 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. However, as pointed out by Nilsson Hakkala et al. (2014), although 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. In regard to offshorable tasks, it seems that such tasks are performed by both skilled and less-skilled workers.

Given these correlations between task measures and skill, it would be of interest to investigate 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 share of job task *i* in occupation *s* (see Table 2), 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 share of task *i* in MNE parent *j* and a larger compensation for task *i*.

Our corresponding measure of relative demand for skills is the wage bill share of workers with three or more years of post-secondary education. This measure captures both an increased share of skilled employment in MNE parent *j* and higher compensation for skills.

To analyze the link between the relative demand for work type *i* (skill, 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:[16]

$$WS_{jnt}^{i} = \sum_{k} \gamma_k OES_{jkt} + \beta_K ln\left(\frac{K}{Y}\right)_{jt} + \beta_Y lnY_{jt} + \beta_W ln\left(\frac{w^i}{w^{-i}}\right)_{nt} + \\ + \beta_R \left(\frac{RD}{Y}\right)_{nt} + \beta_I \left(\frac{ICT}{Y}\right)_{nt} + \alpha_j + \alpha_t + \varepsilon_{jnt}^{i} \qquad (2)$$

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

Other basic variables originating from the cost function assumptions behind this approach are the parent-level capital-output ratio $ln(K/Y)_{jt}$ – which indicates whether capital deepening affects relative demand for skills and tasks − and the parent-level real value added $ln\, Y_{jt}$. The relative wage regressor $ln\left(w^i/w^{-i}\right)_{nt}$

[16] Slaughter (2000), Head and Ries (2002), Hansson (2005) and Becker et al. (2013).

accounts for changes in the wage bill share due to substitution away from a more expensive factor. In our estimations, however, we follow the practice of many other similar studies and omit the relative wage regressor.

It has been argued and shown that technological change, computerization, and automation have a positive impact on the demand for skills and the share of non-routine tasks.[17] Routine tasks are thought to be easier to offshore, but such tasks can also be automated or replaced by computers to a larger extent. To control for the impact of technology on the relative demand for skills and non-routine tasks, we add to our econometric specification variables such as R&D expenditures and ICT capital as a share of value added in industry *n* of the MNE parent, $(RD/Y)_{nt}$ and $(ICT/Y)_{nt}$. Finally, in equation (2), α_j is a MNE-specific fixed effect, α_t a year effect, and ε_{ijt} is an error term.

3.2 Estimations of relative demand in Swedish MNE parents

We estimate equation (2) for each of the work types: skilled, non-routine, and non-offshorable, and present the results in Tables 4, 6 and 7. Our estimations are based on Swedish enterprise groups with employees abroad in at least one year during the studied period from 2001 to 2013, which means that OES in many cases may be zero.[18] Table 4 includes estimates for manufacturing and services together and we start with showing ordinary OLS estimates. We will argue, however, that the wage-bill shares in the parents of MNEs and their offshore employment shares might be simultaneously determined. Accordingly, we also present IV estimates. Finally, if the impact of offshoring is more pronounced in larger MNEs, weighted estimates

[17] Machin and Van Reenen (1998), Autor, Levy and Murnane (2003) and Autor and Dorn (2013).
[18] If we restrict our sample to observations where Swedish enterprise groups have employees abroad in every period during the period from 2001 to 2013, $OES > 0$, the number of observations in our analysis on skill upgrading in Table 4 falls from 25,800 to 14,454.

would be considerably different.[19] Therefore, in Table 4, we also show weighted IV estimates. Table 6 provides separate results for manufacturing MNEs and services MNEs, and Table 7 contains the outcome when we allow for different impacts of offshoring in high- and low-income countries.

For our key variable in Table 4, the offshore employment share OES, the OLS estimate is positive and significant only for non-routine 1 tasks, whereas the estimates are insignificant for skills, non-routine 2 and non-offshorable tasks.

As we pointed out in the introduction, an issue that has been somewhat neglected in previous studies is the potential simultaneity problems that might exist in the determination of the onshore wage-bill shares of Swedish MNEs WS^i and their offshore employment shares OES. Lower costs to locate jobs in foreign countries due to reduced barriers to establish activities offshore and lower communication and information costs, as well as increased demand abroad owing to high growth, particularly in some large low- and middle-income countries over the studied period, have led to larger OES in these countries. Such underlying factors leading to higher OES might, in turn, have affected the relative demand for skills, non-routine and non-offshorable tasks WS^i onshore. This is the effect we are interested in and want to estimate.

On the other hand, the causality may as well run the other way: a heavily increased supply of skilled labor in Sweden during the period of study, as a result of a significantly higher number of graduates from universities and university colleges,[20] could have made it more profitable for Swedish MNEs to keep non-routine tasks and activities intensive in the use of skilled labor in the parent

[19] Previous studies, e.g. Slaughter (2000) and Hansson (2005), have preference for weighted estimates.
[20] The number of university degrees as a share of population aged 20-24 year increased rapidly in the late 1990s from approximately 6% to over 10% in the 2000s (Eliasson et al 2012 Figure 3).

companies in Sweden, while at the same time increasing the incentives to relocate routine tasks and less-skilled intensive activities to affiliates abroad.

A third reason why the wage-bill share of skilled labor and non-routine tasks onshore increase simultaneously with the offshore employment share might be that successful enterprises tend to boost their presence abroad at the same time as they increase their relative demand for skills and non-routine tasks at home.

To address the simultaneity issue, we create an instrument for $\mathrm{OES}_{\mathrm{jt}}$. First, we regress growth and reduced barriers on FDI in different countries *c* (together with the MNE *j* variables in equation (2) and dummies for MNEs and time) on the offshore employment share $\mathrm{OES}_{\mathrm{jct}}$. From the estimates shown in Table A1 in the Appendix, we get predicted values $\widehat{\mathrm{OES}_{\mathrm{jct}}}$. The instrument we use in our IV estimations $\widehat{\mathrm{OES}}_{\mathrm{jt}}$ is obtained by summing $\widehat{\mathrm{OES}_{\mathrm{jct}}}$ over the countries *c*. Thus, our intention is to try to disentangle effects of OES on wage-bill shares in the MNE parents that originate from factors in the host countries, such as high growth and reduced barriers to FDI.[21]

[21] The Appendix gives more details on the generation of our instrumental variables.

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

	Skill upgrading			Non-routine 1			Non-routine 2			Non-offshorable		
	OLS UW	IV UW	IV W	OLS UW	IV UW	IV W	OLS UW	IV UW	IV W	OLS UW	IV UW	IV W
OES	0.013	4.246	2.848	0.839	1.228	2.063	0.690	2.121	1.816	0.157	0.854	0.266
	(0.02)	(4.13)	(3.35)	(2.46)	(2.03)	(3.45)	(1.63)	(2.80)	(2.75)	(0.46)	(1.44)	(0.31)
$ln(K/Y)$	−0.597	−0.608	−0.172	−0.334	−0.335	−0.229	−0.639	−0.643	−0.931	−0.246	−0.248	−0.474
	(−3.36)	(−3.42)	(−0.37)	(−3.39)	(−3.40)	(−0.66)	(−5.93)	(−5.97)	(−3.82)	(−2.47)	(−2.49)	(−1.88)
$ln\,Y$	−1.769	−1.821	−4.175	−0.603	−0.606	−1.551	−1.647	−1.662	−1.639	−0.769	−0.777	−0.005
	(−5.85)	(−6.05)	(−2.23)	(−3.52)	(−3.53)	(−2.74)	(−9.26)	(−9.46)	(−3.64)	(−4.32)	(−4.38)	(−0.01)
RD/Y	−0.734	−0.693	−2.574	−0.162	−0.159	−0.476	−0.876	−0.863	−0.655	−0.526	−0.519	1.126
	(−1.13)	(−1.07)	(−0.97)	(−0.40)	(−0.40)	(−0.48)	(−2.73)	(−2.67)	(−1.10)	(−1.22)	(−1.20)	(2.01)
ICT/Y	−7.000	−7.075	−22.04	−0.664	−0.648	6.544	−5.517	−5.525	2.445	−7.550	−7.559	−2.527
	(−1.44)	(−1.47)	(−1.54)	(−0.20)	(−0.19)	(1.68)	(−1.73)	(−1.74)	(0.72)	(−2.73)	(−2.72)	(−0.70)
R^2 (within)	0.045	0.047	0.224	0.011	0.011	0.101	0.025	0.026	0.127	0.008	0.009	0.019
R^2 (between)	0.041	0.042	0.021	0.038	0.038	0.015	0.092	0.092	0.104	0.034	0.034	0.010
R^2 (overall)	0.034	0.035	0.013	0.037	0.037	0.012	0.068	0.068	0.077	0.025	0.025	0.007
Observations	25,800	25,800	25,800	25,642	25,642	25,642	25,642	25,642	25,642	25,642	25,642	25,642
Groups	3,488	3,488	3,488	3,479	3,479	3,479	3,479	3,479	3,479	3,479	3,479	3,479

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

In contrast to the OLS estimate, the IV estimate of OES on the relative demand for skills and non-routine tasks 2 in the MNE parents are also positive and significant. Hence, we conclude from Table 4 that increased employment shares in the affiliates of Swedish MNEs abroad appear to have a positive impact on the relative demand for skills and non-routine tasks in the MNE parents in Sweden. For non-offshorable tasks, the IV estimate of OES is still insignificant; an expansion in affiliates abroad does not mean a larger concentration of non-offshorable tasks to the parents at home. Our interpretation of the results for offshorable tasks is that although many jobs potentially are offshorable within MNEs, this does not mean that they actually become offshored, and thus far, this does not seem to have been the case in Swedish MNEs.

In an assessment of the economic relevance of offshoring on skill upgrading and task intensities in Swedish MNE parents in general, i.e., the aggregate impact, larger MNEs might arguably play a greater role. As an alternative in such assessments, in Table 4, we also provide weighted IV estimates.[22] We weigh the regressions by the wage bill shares of the MNE parents.[23]

To assess the economic relevance of offshoring on skill upgrading and task intensities in Swedish MNE parents, in Table 5, we calculate the explanatory power of offshore employment for wage bill shares of skilled labor and non-routine tasks.[24] We multiply the offshoring unweighted or weighted coefficient estimates in Table 4 (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

[22] Solon et al. (2013) contains an interesting discussion on when and how to weight data used in estimations. 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."
[23] Cf. Head and Ries (2002) and Hansson (2005).
[24] We focus on skill upgrading and non-routine intensity because in Table 4, the estimates of *OES* on the non-offshorable intensity always are insignificant.

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).[25]

From this assessment of the economic relevance of offshoring on the workforce composition onshore we find that offshoring "explains" between 3 and 11% of the overall skill upgrading or increased non-routine intensity in Swedish MNE parents. Notice that the estimated coefficients and the change in OES differ little regardless of whether they are weighted or unweighted. Therefore, in the rest of the paper, we present only unweighted estimates.

Table 5 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					
IV UW	4.246	0.104	0.442	7.9	5.6%
IV W	2.848	0.084	0.239	7.9	3.0%
Non-routine 1					
IV UW	1.228	0.104	0.128	1.6	8.0%
IV W	2.063	0.084	0.173	1.6	11.0%
Non-routine 2					
IV UW	2.121	0.104	0.221	2.5	8.8%
IV W	1.816	0.084	0.153	2.5	6.1%

If we return to Table 4 and the control variables, we find that decreased value added in the Swedish parts of the MNEs seems to be correlated with skill upgrading, and higher intensities of non-routine and non-offshorable tasks. One interpretation might be that less production in Sweden involves a concentration of the remaining parts of the MNE parents to more skilled activities and more non-routine and non-offshorable tasks.

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

Additionally, there appears be to a negative relationship between capital deepening and skill upgrading and the wage-bill shares of non-routine and non-offshorable tasks. This implies that our results provide no support for either capital-skill complementarity or for complementarity between capital and non-routine tasks.

Somewhat surprisingly in the light of the results from previous studies (older as well as more recent) regarding the effects of technological change and computerization on skills and non-routine task intensities,[26] we obtain no significant positive coefficients on R&D and ICT intensities.

Offshoring may have a different impact on the onshore composition of skills and tasks in manufacturing or services MNEs or whether offshoring takes place in low- or high-income countries. Table 6 shows separate estimates on manufacturing MNEs and services MNEs, whereas Table 7 presents results where we allow for different impacts of offshoring in high- and low-income countries.

The picture in the tables is not clear-cut. In Table 6, the IV estimates are positive and significant for OES in manufacturing and services for skill upgrading; in manufacturing for non-routine task 1 intensity; in services for non-routine task 2 intensity; and in services, although only on the 10% level, for non-offshorable task intensity. In Table 7, the IV estimates are positive and significant on onshore skill upgrading of offshoring to high-income countries and on onshore non-routine 1 task intensity of offshoring to low-income countries.

[26] Machin and Van Reenen (1998), Hansson (2005), Autor and Dorn (2013) and Goos et al. (2014).

Table 6 Offshore employment and onshore skill upgrading, non-routine and offshorable task intensities. Manufacturing and services.

Offshore employment share	Skill upgrading				Non-routine 1				Non-routine 2			
	Manufacturing		Services		Manufacturing		Services		Manufacturing		Services	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
OES	−0.060	4.299	0.353	4.510	1.705	2.010	0.501	−0.459	1.651	0.825	0.347	2.809
	(−0.10)	(5.41)	(0.51)	(2.36)	(3.23)	(3.42)	(1.23)	(−0.47)	(2.14)	(0.86)	(0.67)	(2.44)
R^2 (within)	0.081	0.089	0.032	0.033	0.044	0.042	0.007	0.007	0.046	0.043	0.013	0.014
R^2 (between)	0.018	0.031	0.032	0.032	0.043	0.045	0.105	0.102	0.090	0.086	0.043	0.041
R^2 (overall)	0.006	0.016	0.029	0.028	0.022	0.023	0.109	0.107	0.036	0.033	0.032	0.031
Observations	7,613	7,613	18,187	18,187	7,601	7,601	18,041	18,041	7,601	7,601	18,041	18,041
Groups	1,148	1,148	2,675	2,675	1,146	1,146	2,661	2,661	1,146	1,146	2,661	2,661

Offshore employment share	Non-offshorable			
	Manufacturing		Services	
	OLS	IV	OLS	IV
OES	1.328	0.073	0.092	1.348
	(2.05)	(0.09)	(0.24)	(1.66)
R^2 (within)	0.017	0.017	0.003	0.003
R^2 (between)	0.074	0.074	0.036	0.032
R^2 (overall)	0.058	0.060	0.027	0.026
Observations	7,601	7,601	18,041	18,041
Groups	1,146	1,146	2,661	2,661

Remark: The specifications in the table include 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.

Table 7 Offshore employment and onshore skill upgrading, non-routine and offshorable task intensities. High and low-income countries.

Offshore employment share	Skill upgrading		Non-routine 1		Non-routine 2		Non-offshorable	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
OES	0.367	8.071	0.302	−1.599	0.025	3.099	0.172	2.959
High income	(0.43)	(3.02)	(0.73)	(−1.01)	(0.05)	(1.30)	(0.30)	(1.73)
OES	−0.248	−0.245	1.572	4.544	1.599	0.974	0.147	−1.615
Low income	(−0.38)	(−0.08)	(2.86)	(2.61)	(2.27)	(0.29)	(0.36)	(−0.77)
R^2 (within)	0.045	0.047	0.012	0.011	0.026	0.026	0.008	0.009
R^2 (between)	0.041	0.044	0.034	0.020	0.090	0.093	0.034	0.035
R^2 (overall)	0.033	0.038	0.034	0.021	0.066	0.070	0.025	0.028
Observations	25,800	25,800	25,642	25,642	25,642	25,642	25,642	25,642
Groups	3,488	3,488	3,479	3,479	3,479	3,479	3,479	3,479

Remark: See Table 6.

3.3 Relationship between offshore and onshore employment

In the previous section, the estimations of relative demand for skills indicates that increased offshore employment shares OES leads to larger wage-bill shares of skilled labor WS^{skill} − skill upgrading − in the MNE parents at home. Figure 4 suggests that the driving forces behind skill upgrading differ between manufacturing and services. In manufacturing, the higher share of skilled labor onshore is a result of decreased employment of less skilled workers, whereas in services, the skill upgrading appears to be due to the increased employment of skilled labor.

We examine the relationship between changes in offshore employment in high- and low-income countries and onshore employment of skilled and less-skilled labor in absolute terms in manufacturing and services by replacing the dependent variable in equation (2), the wage-bill-share of skilled labor WS_{jnt}^{skill} with 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}. Equation (3) shows the new specification:

$$L_{jnt}^{i} = \sum_{k} \gamma_k OE_{jkt} + \beta_K ln\left(\frac{K}{Y}\right)_{jt} + \beta_Y lnY_{jt} + \beta_R \left(\frac{RD}{Y}\right)_{nt} + \beta_I \left(\frac{ICT}{Y}\right)_{nt} + \\ + \alpha_j + \alpha_t + \varepsilon_{jnt}^{i} \qquad (3)$$

Essentially, the explanatory variables are the same in equation (3) as in equation (2) except for OE_{jkt}; that is, employment in affiliates of MNE *j* in country group *k* (high- or low-income countries) at time *t*. We estimate equation (3) for total parent employment, as well as for parent employment of skilled and less-skilled.

Successful MNEs will most likely increase their employment both in the parents at home and in their affiliates abroad simultaneously due to, e.g., the launching of new, highly demanded products on the world market. To take such problems with

the simultaneous determination of OE_{jkt} and L^{i}_{jnt} into account and try to isolate effects of OE_{jkt} on L^{i}_{jnt}, we use a similar approach as we did for the relative demand in Section 3.2. We regress growth and changes in barriers to FDI in different countries *c* (together with the MNE *j* variables in equation (3), MNE and time dummies) on offshore employment in *c*, OE_{jct} (see Table A1). From the estimates we generate predicted values $\widehat{OE}_{jct}$, which we then aggregate over countries to get predicted values of employment in high- and low-income countries, $\widehat{OE}_{jkt}$. Table 8 presents OLS and IV estimates at the outset for manufacturing and services together and then for manufacturing and services separately.

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

	Total		Skilled		Less-skilled	
	OLS	IV	OLS	IV	OLS	IV
			All sectors			
Offshore employment high-income OE_{high}	0.080	1.132	0.018	0.237	0.062	0.894
	(1.73)	(2.30)	(1.68)	(2.54)	(1.51)	(2.14)
Offshore employment low-income OE_{low}	−0.006	−0.058	0.009	0.007	−0.016	−0.058
	(−0.19)	(−1.14)	(1.22)	(0.70)	(−0.50)	(−1.18)
Capital-output $ln(K/Y)$	15.87	8.091	2.546	0.884	13.33	7.207
	(3.77)	(1.27)	(2.48)	(0.60)	(3.77)	(1.38)
Value added $ln(Y)$	93.71	38.03	13.64	1.980	80.08	36.05
	(6.42)	(1.90)	(5.70)	(0.46)	(6.12)	(2.18)
RD/Y	21.36	73.70	2.596	13.13	18.76	60.58
	(0.87)	(2.49)	(0.45)	(2.49)	(0.97)	(2.39)
ICT/Y	631.4	1024	156.08	237.8	475.32	786.0
	(1.30)	(2.08)	(1.83)	(2.67)	(1.16)	(1.90)
R^2 (within)	0.031	0.044	0.064	0.079	0.027	0.037
R^2 (between)	0.248	0.181	0.160	0.120	0.241	0.172
R^2 (overall)	0.228	0.172	0.152	0.116	0.220	0.162
Observations	25,801	25,801	25,801	25,801	25,801	25,801
Groups	3,489	3,489	3,489	3,489	3,489	3,489

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

Table 8 Continued

	Total		Skilled		Less-skilled	
	OLS	IV	OLS	IV	OLS	IV
			Manufacturing			
Offshore employment high-income OE_{high}	0.061	0.480	0.007	−0.050	0.054	0.531
	(1.15)	(0.54)	(0.49)	(−0.23)	(1.24)	(0.79)
Offshore employment low-income OE_{low}	−0.089	−0.253	0.015	0.056	−0.104	−0.309
	(−2.97)	(−3.10)	(0.72)	(1.23)	(−5.59)	(−5.96)
R^2 (within)	0.180	0.153	0.060	0.090	0.264	0.265
R^2 (between)	0.158	0.401	0.441	0.008	0.084	0.348
R^2 (overall)	0.173	0.457	0.454	0.018	0.088	0.414
Observations	7,613	7,613	7,613	7,613	7,613	7,613
Groups	1,148	1,148	1,148	1,148	1,148	1,148
			Services			
Offshore employment high-income OE_{high}	0.111	1.584	0.033	0.330	0.078	1.254
	(1.64)	(3.07)	(2.86)	(3.87)	(1.32)	(2.73)
Offshore employment low-income OE_{low}	0.032	−0.010	0.008	−0.000	0.024	−0.010
	(0.87)	(−1.13)	(1.66)	(−0.01)	(0.74)	(−1.25)
R^2 (within)	0.032	0.054	0.092	0.120	0.024	0.042
R^2 (between)	0.159	0.095	0.078	0.056	0.161	0.092
R^2 (overall)	0.141	0.092	0.067	0.051	0.144	0.090
Observations	18,188	18,188	18,188	18,188	18,188	18,188
Groups	2,676	2,676	2,676	2,676	2,676	2,676

Remark: The specifications in the table include 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.

First notice that in our specifications in Table 8, we control for onshore output changes, and not surprisingly, increased value added in the MNE parents is in most cases positively correlated with larger onshore employment. If we then look at the variable of main interest, employment changes abroad, we find that given output changes onshore, no relationship between employment changes in affiliates in low-income countries abroad and employment changes in the parent companies at home. There is a positive correlation, however, within Swedish MNEs between employment changes in affiliates in high-income countries and onshore employment changes (both for skilled and less-skilled labor). This relationship is

particularly valid for the IV estimates, which indicates that increased employment in affiliates in high-income countries have a positive impact on the employment in the MNE parents onshore.

Generally, a higher capital-output ratio in the parents is positively related to employment changes onshore. Additionally, the proportion of ICT capital or R&D expenditure to value added at home in the industry of the MNE parent co-varies positively with onshore employment, for both skilled and less-skilled labor. Employment is growing in Swedish MNE parents in R&D intensive industries that invest heavily in ICT.

More interesting results emerge when we estimate the model in equation (3) separately for manufacturing and services. The IV results in Table 8 imply that within manufacturing MNEs, increases in offshore employment in low-income countries have a negative effect on the onshore employment of less-skilled labor. This suggests that employment in affiliates in low-income countries is a *substitute* for less-skilled employees onshore. Accordingly, one explanation for the falling employment of less-skilled labor we observe in Figure 4 is that within Swedish MNEs, low-skilled activities are relocated from the parents in Sweden to affiliates in low-income countries abroad. In other words, resource-seeking FDI seems to be important in manufacturing.

Moreover, within service MNEs in particular, the IV estimates indicate that increases in employment in affiliates in high-income countries affect the onshore employment (both for skilled and less-skilled labor) positively. This suggests that employment in affiliates in high-income countries is a *complement* to onshore employment.[27] This might reflect that market-seeking motives for FDI are more

[27] Hijzen et al. (2011) also find that outward FDI in the service sector is associated with positive employment effects.

prevalent in the service sector because in many service industries, producers and consumers must be located in the same place.[28] To the extent that we find skill upgrading in MNE parents of offshoring in service industries,[29] that could be explained by skilled employment increasing more than less-skilled employment. An expansion abroad requires, e.g., more headquarter service at home, which is generally more skill-intensive.

4. Concluding remarks

In the 2000s, employment in Swedish MNEs grew rapidly in their affiliates abroad, while 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 countries in Central and Eastern Europe.

We estimated the relative demand for skills and tasks in Swedish MNEs between 2001 and 2013 and found that offshoring to affiliates abroad increased the relative demand for skills and non-routine tasks in the MNE parents. This indicates that offshoring entails activities being performed by low-skilled labor and routine tasks in the MNE parents being relocated abroad. An assessment of the economic importance suggests that this influence of offshoring has 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, they are not necessarily always offshored. Characteristics such as the routineness of a job or whether it involves a job

[28] Francois and Hoekman (2010) have termed that the "proximity burden".
[29] The IV-estimate on OES positive and significant in Table 6.

performed by a less-skilled worker seem to be more important factors for whether a job is offshored rather than the simple offshorability of the job.

The estimations of the relationship between employment offshore and onshore within Swedish MNEs suggest that increased employment in affiliates in low-income countries affect the employment of less-skilled workers in manufacturing MNE parents negatively; employment in affiliates in low-income countries seems to be a substitute for less-skilled labor in the parents of manufacturing MNEs. Furthermore, the estimations indicate that increased employment in affiliates in high-income countries positively impacts employment in service MNE parents; employment in affiliates in high-income countries appears to be a complement to employment in MNE parents in the service sector. Thus, our results suggest that offshoring within manufacturing Swedish MNEs destroys less-skilled jobs in their parents in Sweden, whereas offshoring within service Swedish MNEs creates jobs in their parents in Sweden.

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Appendix Effects of growth and FDI restrictions on offshore employment: First-stage IV-regressions

To handle the problems with simultaneity in estimating the effects of an expansion of MNEs' employment in affiliates abroad on their labor demand in the parents at home, we must find instruments that are correlated with the MNEs' decision to increase their employment in affiliates abroad but are not correlated with their labor demand in the parents at home.

We assume that at time *t*, a country *c*'s economic size GDP_{ct} and the restrictions towards FDI in the country $FDIR_{ct}$ are related to an MNE *j*'s offshore employment in country *c*, while reasonably, they are unrelated to the labor demand in the parent of MNE *j* at home GDP_{ct} is gross domestic product in US dollar constant 2010 prices from the World Development Indicators of the World Bank, and $FDIR_{ct}$ is the OECD regulatory restrictiveness index.[30]

To determine the impact of growth and changes in FDI restrictions abroad on offshore employment, we estimate the following model for Swedish MNEs over the period from 2001 to 2013. In the regression, we include observations of an enterprise *j* that had employees abroad for at least one year during the studied period, and for countries *c* that an enterprise ever has had employment in an affiliate abroad during the studied period.

$$OES_{jct} \; or \; OE_{jct} = \beta_1 ln\, GDP_{ct} + \beta_2 FDIR_{ct} + X_{jt} + \beta_j + \beta_t + \varepsilon_{jct} \quad \text{(A.1)}$$

[30] The index covers 22 sectors and for each sector, the scoring is based on the following elements: (i) the level of foreign equity ownership permitted, (ii) the screening and approval procedures applied to inward foreign direct investment, (iii) restrictions on key foreign personnel, and (iv) other restrictions on land ownership, corporate organization (e.g., branching). Restrictions assume values between 0 (open) and 1 (closed). The overall restrictiveness index is a weighted average of individual sectoral scores. For a detailed discussion of the index, see Kalinova et al. (2010).

X_{jt} are parent MNE$_j$ variables included in the labor demand specifications in equations (2) and (3). β_j and β_t are MNE and time dummies, respectively. We expect that higher growth in country *c* means that it becomes more profitable to establish or expand activities in country *c* ($\beta_1 > 0$). Reduced barriers towards FDI in country *c* lead to higher offshore employment in *c* ($\beta_2 < 0$). The results from the estimations are shown in Table A1.

Table A1 Relationship between offshore employment, GDP growth, and changes in FDI restrictiveness. First-stage IV regressions.

	Offshore employment share OES_{jct}	Offshore employment OE_{jct}
Gross Domestic Product $lnGDP_{ct}$	0.004	120.5
	(3.98)	(2.39)
FDI Restrictiveness $FDIR_{ct}$	−0.027	−481.6
	(−3.31)	(−1.97)
Capital-output $ln(K/Y)_{jt}$	0.002	4.414
	(2.18)	(2.03)
Value added $ln\ Y_{jt}$	0.006	23.17
	(4.17)	(3.33)
$(RD/Y)_{jt}$	−0.003	−17.28
	(−0.98)	(−1.66)
$(ICT/Y)_{jt}$	0.005	−107.8
	(0.22)	(−1.29)
R^2 (within)	0.024	0.012
R^2 (between)	0.010	0.001
R^2 (overall)	0.000	0.009
Observations	86,305	86,305
Groups	3,487	3,487
F-statistics for instruments	11.38	3.15

Remark: The specifications include MNE dummies and year dummies. The reported *t*-values in parentheses are based on robust standard errors, clustered at the MNE group level.

In Table A1, we can see that both for the offshore employment share *OES* and for the offshore employment *OE*, the estimates on $ln\ GDP$ and *FDIR* have the expected

signs and are significant. In other words, higher growth and reduced barriers towards FDI in a country increase the offshore employment of Swedish MNEs in that country.