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Globalization, Job Tasks and the Demand for Different Occupations

Fredrik Heyman[*¤] and Fredrik Sjöholm[¤*]

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Abstract: Globalization has increased during last decades with resulting structural changes of production and labor demand. This paper examines how firms' increased global engagement affect the structure of the workforce. We find that the aggregate distribution of occupations in Sweden has become more skilled between 1997 and 2013. Moreover, we find that firms with a high degree of international orientation have a relatively skilled distribution of occupations and firms with low international orientation have a relatively unskilled distribution of occupations. High- and low-skilled occupations have increased in importance whereas middle skilled occupations have declined with a resulting job polarization.

JEL: F10, F16; F23

Keywords: Occupations, Job polarization, Globalization, Multinational Enterprises, Exporter

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INTRODUCTION

International economic integration has increased substantially over the last decades, and is presumably higher than ever before. One consequence is that a large share of workers are employed in foreign owned firms, in firms that have own foreign affiliates, and in firms with export and offshoring. Globalization leads to an increased level of specialization in countries' production. Furthermore, globalization also results in increased competition, which, in turn, forces firms to engage in streamlining and improving their activities. Finally, globalization enable firms to benefit from economies of scale in production, which is particularly important for firms in relatively small countries. These effects of globalization have resulted in increased economic growth, increased incomes and an improved standard of living for large segments of the population (Frankel and Romer, 1999). However, what benefits individual countries, and the majority of people, is not necessarily beneficial for everyone. There are groups whose situation is rendered more difficult by the structural changes following increased levels of globalization.[1]

Furthermore, it appears that the nature of globalization has gradually changed. More specifically, structural change does not take place between different industries to the same extent as before, but instead within firms and between firms in the same industries (Baldwin, 2016). This change has an impact on the relative demand for different types of labor: some occupations face decreasing demand when their tasks are relocated to foreign countries, whereas others experience an increase in demand as a result of globalization. We depart from this new development and analyze labor market effects of increased globalization with a particular focus on the relative demand for different occupations. Our analysis focuses on changes within firms and industries and how these, in turn, alter the demand for different types of labor and impact on job polarization.

The labor market effects of increased globalization can be substantial. For instance, new research shows that China joining the World Trade Organization (WTO) had a significant impact on the US labor market. Many American jobs disappeared as a result of imports from China, while approximately the same number of new American jobs were added when US exports increased (Feenstra and Sasahara, 2017; Feenstra et al., 2017). But even if the net effect

[1] See, for example, Milanovic (2016) for an overview of the relationship between globalization and increased inequality. See also Saval (2017).

was marginal, the economic consequences were in many cases serious and long-lasting for the American workers losing their jobs as a result of increased imports from China (Autor et al., 2014). While the high-skill labor force managed relatively well and soon got new jobs in expanding industries, the low-skill labor force was severely affected. Decreasing incomes and increasing unemployment subsequently result in various negative effects, such as poor health, increased mortality and a decline in the number of new marriages and fertility (Autor et al., 2017; Pierce and Schott, 2016).

The increased globalization also has political implications. It is not all that surprising that citizens negatively affected by globalization have a tendency to be attracted to parties of a more protectionist or populist nature (Rodrik, 2018). In the United States, for example, districts and regions adversely affected by increased globalization have been more inclined to vote for populist candidates on the left or the right on the political scale (Autor et al., 2016a). In Europe, increased globalization has led to an increase in populism in regions affected negatively and a decrease in populism in regions affected positively (Dippel et al., 2015; Colantone and Stanig, 2017). Furthermore, it appears as if the losers of globalization to a great extent voted for the United Kingdom leaving the European Union (Colantone and Stanig, 2016).

Hence, it is clear that possible negative labor market effects may come with significant socioeconomic costs. This highlights the need for a better understanding of the mechanisms set in motion as a result of increased globalization. The effect is more complex than what is captured by for instance the educational level of the workers: the effect of globalization is not uniformly benefitting skilled workers and hurting unskilled workers. Instead, the character of the job tasks carried out by different workers seems important in determining the effect of globalization. Some job tasks can for instance be offshored to cheaper production sites in low income countries whereas other tasks need to placed close to the headquarter. The latter type of tasks include both high- and low skilled ones and empirical studies show that it is primarily middle skilled tasks that are declining. As a result, job polarization tends to increase.

In this study, we focus on certain labor market effects as a result of globalization – effects we believe have been neglected in previous literature and the public debate. Our empirical analysis covers Swedish conditions by using detailed matched data on workers and firms. We start by describing the mechanisms behind globalization and changes in labor demand, with a distinction of effects taking place between industries, between firms, and within firms. We then continue with showing how the distribution of occupations in firms have changed over time,

continue with a closer look at job polarization, and end with a discussion on the role played by globalization.

HOW DOES GLOBALIZATION AFFECT THE LABOR MARKET?

A key determinant of globalization is the liberalization of international trade and capital flows that has characterized a large part of the post-war period. Moreover, the establishment of international institutions have supported and promoted even more globalization. For example, both the WTO (formerly GATT) and the EU have played a significant role in terms of increased globalization.

Another important determinant includes technological progress and improved infrastructure. The railway and channel projects of the nineteenth century, for example, significantly lowered transport costs. Reefer ships enabled trading in goods that previously had to be consumed in close proximity to the production. The introduction of container freight and the deregulation of air traffic markets have resulted in a further decrease in transportation costs for goods and thus increased trade volumes. Likewise, the rapid development of information and communication technology (ICT) has resulted in a substantial trade in services, which was limited in scope only a few decades ago. Per definition, many services were dependent on geographical proximity between consumption and production, since transporting the service in question was either impossible or very time-consuming. Today, all it takes is an e-mail attachment for an Indian computer programmer or a Finnish auditor to be able to send their products to their Swedish or French client.

The growth in ICT services has also had a major impact on how firms organize their activities. It has become easier to communicate over long distances and managing logistical needs across national boundaries. As a result, firms have become more complex. Not least MNEs have been at the forefront of a process where different parts of the production are relocated to different facilities and frequently also to different countries. To an increasingly greater extent, different components are now produced in different geographical locations and then shipped to other factories where they are assembled into finished products and sold in the domestic market and exported to the rest of the world. This division not only applies to the production of goods, such as components and other inputs, but also the production of services, such as design, logistics

and marketing. Firms may increase their profitability by separating the production and locating each task to where it is the cheapest and the most effective.

Globalization may affect the demand for labor through various mechanisms, depending on the characteristics of the workers and where they work. These mechanisms operate between different industries, between firms in the same industry and within individual firms. For instance, increased globalization leads to some industries being able to increase their exports and thereby expand. In general, one could argue that different industries will face different outcomes depending on their ability to compete. This ability is dependent on the types of factors of production, such as capital and different types of labor, used in the production. A country is primarily able to compete in industries using factors of production that are abundant in this country. In other words, a country with a well-educated population will be competitive in industries using highly educated workers. On the other hand, this country will be less competitive in industries mainly relying on less educated workers.

Factors of production used to a relatively high extent in export-driven industries benefit from increased globalization, whereas factors of production used in import-competing industries suffer from globalization. However, finding simple and clear effects for different groups has shown to be difficult. On the contrary, it is worth noting that wages for both white- and blue-collar workers in the manufacturing sector have increased significantly in a country such as Sweden during the last 25 years, in spite of a substantially increased globalization.

Furthermore, this theoretical line of reasoning tends to predict relatively small labor market effects as a result of increased globalization, which, as mentioned above, does not seem to correspond with reality. One reason is that the theory assumes that labor can easily move between different industries. However, empirical studies have shown that there is a significant level of rigidities and difficulty involved in labor moving both geographically, and between industries and occupations (McLaren, 2017).

The difficulty in finding clear winners and losers of globalization is in many cases due to that the effect has a different impact on relatively similar factors of production. One possible explanation is that globalization may have a significant impact within industries and firms. Even firms in specific industries differ considerably in a number of respects. Some firms are large, use sophisticated technology and enjoy a high level of productivity, whereas others are small and have a lower productivity. Furthermore, some firms have a considerable international

perspective with exports, imports of inputs and perhaps facilities located abroad. Other firms are entirely focused on using domestic inputs and selling in the domestic market.

The difference between firms within industries also has an effect on the economic impact of globalization at a national level (Melitz, 2003), which is discussed below. Furthermore, this difference, or heterogeneity, results in clear labor market effects (Helpman et al., 2017). In order to understand the mechanisms behind these labor market effects, one first needs to note that efforts and investments are needed in order to operate in international markets. Firms need to invest significant resources in order to learn about foreign preferences, legislation and distribution channels. As a result, only profitable and productive firms are capable of operating globally (Helpman et al., 2004; Helpman, 2006; Greenaway and Kneller, 2007). This also means that increased globalization will have a vastly different impact on firms within the same industry. Falling transportation costs or reduced tariffs lead to two effects. On the one hand, foreign markets become more accessible to domestic firms while, on the other hand, the domestic market becomes more accessible to foreign firms.

For firms having invested in entering international markets, this change will be positive. Increased competition in the domestic market is offset by the fact that selling in the international market becomes cheaper. These firms will increase their production and increase their share of workers employed in the industry. Firms exclusively operating in the domestic market will experience increased competition from foreign imports and from subsidiaries of foreign MNEs. This increased competition in the domestic market will not be compensated by more exports. As a result, these firms either disappear from the market, or at least become less significant.

The heterogeneous firm effect will also have an impact on wages, given that these are related to firm profits. This may lead to a situation where different firms within an industry pay different wages to very similar labor force.

Increased globalization will also have effects within firms. A firm's activities consist of a variety of tasks that combined result in products being designed, produced and sold in different markets. These tasks differ considerably and include various activities such as research, design, logistics, assembly, repairs, cleaning, etc. Some tasks may be very demanding and may only be performed by experts, whereas others are easier to perform. As described above, globalization and developments in ICT have resulted in firms being able to more easily break up production chains and move different tasks to different geographical locations. In recent academic literature on global value chains, the concept of *trade in tasks* is frequently used as a

complement to defining production units in terms of produced goods or inputs (Grossman and Rossi-Hansberg, 2008; 2012). Characteristics other than knowledge intensity and formal training then become key as to whether or not a task may be carried out at a longer distance from the head office. For instance, the degree of routine tasks and the need for close communications are important determinants of what may be relocated to other countries and what needs to be located in the home country. There are tasks that may easily be codified and do not require close monitoring or interaction with the head office or other parts of the production. Many, but not all, such tasks are routine in nature and may be carried out by low-skilled labor. Computer programming is an example of the opposite; this work requires a high level of education but may easily be performed by an engineer working in, for example, India. Cleaning and repair services, on the other hand, are examples of tasks often performed by low-skilled labor, but which may hardly be relocated far away from the rest of the operations.

All in all, this means that the relationship between the knowledge intensity of job tasks and how suitable they are for relocation is complex, which in turn means that job tasks and occupations involving both a high and a low level of knowledge are affected by increased globalization (Blinder, 2006; Blinder and Krueger, 2013; Hakkala et al., 2014).

The above discussion relates to the ability of firms to, for instance, relocate certain types of job tasks and occupations to foreign countries. However, other types of internationalization aspects will also have an impact on the organization of firms and, subsequently, on the demand for different types of workers. As mentioned above, the reason is that selling to foreign markets is more challenging than selling in domestic markets. Exporting firms will have to invest in skills and recruit people in occupations that might not be needed in firms that do not export (Davidson et al., 2017). If these occupations required in exporting firms are relatively highly skilled, then increased globalization will lead to increased wage inequality. If, on the other hand, these occupations are relatively unskilled, then wage inequality is reduced.

As described above, increased globalization represent an important explanation for changes in demand for different types of labor, even though globalization clearly is not the only explanation. Technological development is frequently presented as another important factor behind changes in the labor market. Technology and globalization are, however, closely linked, thereby making it difficult to distinguish their effects. New technology increases the degree of globalization, but there is also an effect of increased globalization on the development of new technology.

Extensive research has shown that technology shifts are associated with a higher demand for skilled workers, since mastering new and more complex technology often requires a higher level of education. This phenomenon, commonly referred to as *skill-biased technological change* (SBTC), is one explanation for increased income inequality observed in many countries. In recent years, however, numerous studies have modified the perspective that education is crucial for how technology affects different groups, not least against the background that SBTC is incapable of explaining a number of important phenomena in the labor market observed in recent years. Instead, and as discussed above, the nature of the tasks performed by workers is emphasized (see Leamer and Storper, 2001; Autor, Levy and Murmane, 2003 and Levy and Murmane, 2004 for three early contributions).

Autor et al. (2003) emphasize that the specific task contents in occupations determine how new technologies affect the relative demand for different types of workers (*task-biased technological change*).[2] Different types of tasks either serve as complements or substitutes for new technology and this is precisely what will determine how different jobs are affected, rather than formal education. This, in turn, may be affected by the specific nature of tasks. Well-defined tasks that may be described in the form of clear rules, jobs of a so-called routine nature, serve as substitutes for new technologies. Tasks instead characterized by the fact that they are complex and require elements such as problem-solving (i.e., so-called non-routine jobs) instead serve as complements to new technology. The increased use of ICT may thus be expected to reduce the demand for workers with routine jobs and increase the demand for non-routine jobs, which may be seen as complementing new technology. This development is in line with the extensive international evidence on job polarization

Autor et al. (2003) also stress that the contents of various jobs will change over time and that the share of tasks in non-routine jobs will increase at the expense of more routine tasks. As a result, we will see a change in the nature of jobs as a result of technological developments. On the basis of this, Autor et al. study the US labor market during the period of 1960–2000 and find a significant reduction in occupations with routine tasks simultaneous with an increase in analytical and interactive tasks. This change is particularly clear after 1980, as computerization began to take off. However, it should be emphasized that the relationship between new

[2] Also see Acemoglu and Autor (2011) for a more developed model incorporating SBTC and the importance of specific tasks (demand for routine and non-routine jobs). Autor (2013) is a summarizing paper on how job task contents and technology affect labor markets.

technology and demand for labor is complex and that routine tasks may nevertheless be difficult to automate (Autor, 2014).[3]

We now continue with presenting empirical evidence on how globalization affects labor markets with a particular focus on relative demand for different occupations and job polarization. We also discuss our results in relation to the international evidence on relative labor demand and job polarization.

GLOBALIZATION AND THE ORGANIZATION OF FIRMS: EMPIRICAL EVIDENCE

Swedish matched employer-employee data

To examine how globalization shapes the relative demand for different occupations, we will use detailed, register-based, matched employer-employee data from Statistics Sweden (SCB). The database comprises firm, plant and individual data, which are linked with unique identification numbers and cover the period from 1996 to 2013. The firm data contain detailed information on all Swedish firms, including variables such as value added, capital stock (book value), number of employees, wages, ownership status, sales, and industry. Moreover, the Regional Labor Market Statistics (RAMS) provide plant-level information on education and demographics, which we aggregate to the firm level. RAMS include data on all Swedish plants. The data on individuals originate from Sweden's official wage statistics and contain detailed information on a representative sample of the labor force, including full-time equivalent wages, education, occupation, and gender. Occupations are based on the *Swedish Standard Classification of Occupations* (*SSYK96*) which in turn is based on the *International Standard Classification of Occupations (ISCO-88).*

Firm level data on exports and imports by products and countries originate from the Swedish Foreign Trade Statistics, collected by Statistics Sweden.[4] Based on compulsory registration at Swedish Customs, the data cover all trade transactions from outside the EU. Trade data for EU

[3] Autor (2014) discusses the relationship between digitalization and the demand for different types of tasks on the basis of the so-called Polanyi's Paradox. Polanyi's Paradox says that many simpler tasks may be surprisingly difficult to automate. Autor (2014) further argues that complementary effects between new technology and labor may be significant.

[4] These data cover the period 1997-2013.

countries are available for all firms with a yearly import or export of around 1.5 million SEK and above. Material imports are defined at the 5-digit level according to NACE Rev 1.1 and grouped into Main Industrial Groupings (MIGs) based on intended use. Based on the MIGs definition of intermediate inputs we identify offshoring using import data at the firm and product level.

Information on foreign MNEs operating in Sweden comes from the Swedish Agency for Economic and Regional Growth (Tillväxtanalys). The Agency uses definitions that are in accordance with definitions in similar data from the OECD and Eurostat. A firm is classified as a foreign-owned MNE if more than 50% of the equity is foreign-owned. Finally, Swedish MNEs are defined as firms reporting positive exports to other firms within the corporation.

All data sets are matched by unique identification codes. To make the sample of firms consistent across the time periods, we restrict our analysis to firms with at least 10 employees in the non-agricultural private sector, which are available throughout the period.

Relative demand for different occupations over time

As discussed above, there are reasons to expect that the increased internationalization has an effect on how firms organize their production. Below, we compare the relative occupational structure in firms with different degrees of international involvement in order to isolate the effect of globalization on the occupational composition.

One way of measuring the structure of the occupational composition is to create an index where we first calculate the share of the workforce working in different occupations. This index is created at the firm level. We use information on the occupation for each individual worker. Altogether, we have 100 different occupations. These are ranked according to their level of skill. For our ranking, we use the average wage in the occupation over the period 1997–2013.[5] The occupation ranked 1 has the lowest average wage and the occupation ranked 100 has the highest average wage. The highest average wages during the period (and thus ranked the highest) are found in the occupations such as CEOs, lawyers and healthcare specialists. The

[5] See Davidson et al. (2017) for results and details regarding different alternative occupational rankings. These include ranking (i) on the basis of wages in non-MNEs (in order to take higher wages in MNEs into account), (ii) on the basis of education, and (iii) on the basis of a regression approach where we take various individual characteristics into account. The results are robust and do not change depending on our choice of ranking.

lowest wages are observed for cleaners, and kitchen and restaurant workers. We construct our measure by weighting the ranking of an occupation by the occupation's share of the total labor force and then sum over all occupations. The firm-specific index vary between 1 and 100, and a higher index indicates that employment is allocated towards higher-paid occupations.[6]

We have calculated this index for the period 1997–2013, as shown in Figure 1. The index was stable during the period 1997–2007. After 2007, however, the index has continuously increased: it was about 0.54 in 2007, while it had increased to about 0.59 by 2013. This means that the occupational composition has become more skilled: an increasing share of the workforce is working in relatively skilled occupations and a decreasing share in relatively less skilled occupations

--Figure 1 about here--

A supplementary picture is presented in Figure 2, showing the development in employment shares for the period 1997–2013 for 21 specific occupational categories. In order to be comparable with the work by Goos et al. (2009; 2014) on job polarization we have applied the same grouping of occupations. The largest increase is seen for both occupations at the top and at the bottom of the wage distribution. For low-wage occupations, we see an increase in employment shares for occupations in the service, care and security sectors and for different types of services only requiring a low level of education. High-wage occupations increasing in employment shares include various specialist and managerial occupations. We also see a reduction in relative shares for a number of occupations, several of which are located in the middle of the wage distribution. These include occupations in machine and assembly work in addition to metal workers and repairs workers. All in all, the changes in Figure 2 support the presence of job polarization, i.e. the simultaneous growth of high-skill, high-wage jobs and low-skill, low-wage jobs at the expense of middle-skill jobs.

[6] See Davidson et al. (2017) for details regarding this index.

--Figure 2 about here--

The tendency of increased job polarization has been presented in a large number of studies for different countries (see e.g. Goos et al. (2014) for an overview). An early study is Goos and Manning (2007). They look the relationship between wages of individual occupations and the extent to which they may be characterized as being routine intensive. They find that occupations characterized more by routine are found in the middle of the wage distribution, while occupations not characterized by routine are found in both the upper and lower end of the wage distribution. This indicates potentially improved employment opportunities for highly skilled occupations with relatively high wages as well as for low-skill low-wage occupations in combination with a less favorable development for occupations in-between, primarily various white-collar occupations involving routine tasks.

Goos et al. (2009) study job polarization and the relationship between wages and employment using data for a large number of European countries between 1993 and 2006. Their study shows clear evidence of job polarization across the included countries. Aggregated for all countries, they find decreased employment shares in nine occupations in the middle of the wage distribution, while the employment shares increase in the groups with the highest and lowest wages. Most individual countries also exhibit signs of job polarization. When they then study the relationship between job polarization and task contents, they find that relative employment change is positively correlated with occupations that are non-routine and cognitive in nature and negatively correlated with occupations more characterized by routine. This result is consistent with the hypothesis of *task-biased technological change*.

A number of studies have subsequently confirmed improved employment opportunities for occupations with relatively high and relatively low wages, in combination with a weaker development for occupations in-between, primarily various white-collar occupations (see, for example, Autor et al., 2006; Acemoglu and Autor, 2011; Asplund et al., 2011; Autor and Dorn, 2009, 2013; Spitz-Oener, 2006; Michaels et al., 2014; Adermon and Gustavsson, 2015 and Gustavsson, 2017).

The job polarization literature focus on employment changes in different occupations, with no consideration given to how firms shape the labor demand process: the influence of firms in the

observed job polarization patterns is more or less absent in the empirical literature. One exception is Heyman (2016) who uses detailed matched firm-worker data for Sweden spanning the period 1996-2013 to investigate the role played by firms in the recent trend toward a more polarized labor market. The study presents results that show novel evidence on within-firm job polarization.

Two additional papers study job polarization at the firm level. Kerr et al. (2016) find evidence of job polarization within Finnish firms and that this polarization is also influenced by the entry and exit of firms. They also find that increased trade and offshoring plays a role in terms of job polarization. Harrigan et al. (2016), who study French firms, also find that job polarization occurs both within and between firms and that both new technology and globalization serve as drivers in this development.

Changes in employment can be decomposed into a within-industry and a between-industry component. In their analysis on 16 European countries, Goos et al. (2014) find that both components are qualitatively important in terms of explaining the overall pattern, hence job polarization is driven by both employment dynamics within industries as well as between industries. To analyze if the same pattern can be seen for Sweden we present similar results based on our Swedish matched-employer-employee data.[7] In addition to studying industry components, we extend the analysis in Goos et al. (2014) by looking at employment dynamics at the firm level and the importance of within-firm and between-firm components of overall job polarization. Results using industry decomposition are presented in Figure 3a) whereas Figure 3b) show corresponding results at the firm level. Looking at the industry components, we see that both industry components are typically positive for high-wage and low-wage occupations and that they are mostly negative for the group of middling-wage occupations.

Occupations are also divided into three wage groups as in Goos et al. (2009; 2014). For these three groups, we notice a 6.7 percentage point increase in the employment share for the high-wage group, a decrease in the middle-wage group equal to 17.8 percentage points and an increase in the low-wage group equal to 11.1 percentage points during the period 1996-2013. For these broad groups, we find that both industry components are positive for the high-wage and low-wage groups, and for the middle-wage group, they are both negative. These results are

[7] The results and discussion in this section are based on results in Heyman (2016).

in accordance with results in Goos et al. (2014) and indicate that overall job polarization originate from both within- and between-industry reallocation.

Interestingly, and in addition to the analysis in Goos et al. (2014), very similar patterns can also be traced at the firm level (Figure 3b). One difference is related to changes in employment shares for low-wage jobs. For this wage group, the within and between components are generally stronger at the firm level than at the industry level, suggesting that reallocation at the firm level, both within and between firms, is important for the overall rising demand for low-wage jobs. This is less clear in the industry decomposition, where several within and between components are negative, despite a strong overall growth in low-wage jobs.

--Figures 3a and 3b about here--

After showing descriptive evidence on overall job polarization in Sweden, we now present regression results at the firm-level. We estimate within-firm regressions models where share of workers in the three wage groups are regressed on year dummies. All regressions also include time-varying firm characteristics and firm fixed-effects. Details can be found in Heyman (2016).

Results are presented in Figure 4. The figure plots the estimated coefficients for the year dummies for the three different wage groups.[8] The figure shows a clear and increasing trend in the share of employees in the high-wage group, while at the same time, the share of middle-wage group workers decreases within firms over time. Quantitatively, results indicate an increase in the high-wage group of about 5 percentage points over the period 1996-2013. The share of middle-wage employees decreases by roughly the same amount. These two developments are consistent with within-firm job polarization. However, we find no support for an increasing share of low-wage jobs within firms over the period. We note, however, a few years with positive and statistically significant estimated coefficients that are in accordance with a positive development for this wage group. We also see that the estimated coefficients are consistently positive during the period for the low-wage group. Overall, the evidence in

[8] The exact estimates are available upon request.

Figure 4 points to a divergence in employment dynamics across occupations at different parts of the wage distribution.

--Figure 4 about here--

How are different occupational categories affected by globalization?

We continue our analysis by looking in more detail at the extent to which changes in globalization is related to changes in the relative demand for different occupations. This is done in Table 1. The classification into low- and high-skilled occupations is based on the average wage over the period 1997–2013, as shown in column 1. Managerial employees have the highest average wage and the group other low-educated workers has the lowest. The difference in wages between these two groups is approximately 130 percent. Column 2 shows the shares of total employment for the occupational categories and column 3 shows the corresponding wage cost shares.

-- Table 1 about here--

Columns 4–7 show the corresponding shares in the manufacturing industry and the service sector, respectively. The largest differences are found in the less-skilled occupations: machine operators represent a large group within the manufacturing sector but a very small group in the service sector, whereas service and sales workers represent a large group in the service sector but are non-existent in the manufacturing sector.

In order to compare the occupation shares for firms with different international engagement we divide our firms into three types and estimate regressions at the firm level. Our firm types are MNEs, which are the most globally integrated firms; non-MNEs that do not export (i.e., Local firms), which are the least globally integrated; and non-MNE exporters, which represent an intermediate degree of global integration. The dependent variable is the occupational share for the occupational categories in the table. The regressions control for time and industry variation

as well as for a variety of firm characteristics, such as size, capital intensity, firm age and labor productivity (see Davidson et al., 2017 for details).

The results for MNEs and exporters are shown in columns 8–11 and are based on both employment shares and wage shares. α_k^M is an estimate of the share of an occupational category working in MNEs in comparison with the share employed in local firms after we have taken the above mentioned firm-specific factors into account. A positive coefficient means that MNEs have a relatively large share of the occupational category in question compared to similar local firms. A negative coefficient means that they have a relatively small share in relation to local firms. In the same way, α_k^X captures the share of an occupational category in exporting firms compared to the share in local firms.

For instance, looking at managers, and on the basis of employment shares, we see that the estimated coefficient for α_k^M is equal to 0.04. This means that in comparison with local firms, the share of managers is 4 percentage points higher for MNEs. The corresponding estimate for exporters, α_k^X, is approximately 0.03, indicating that the share of managerial employees is on average 3 percentage points higher for exporters compared to local firms.

As we can see in Table 1, MNEs and exporters have a larger share of employees within highly skilled occupations compared to local firms. The difference between local and globalized firms is particularly significant with regard to Legal and financial specialists, where MNEs have an employment share close to 4 percentage points larger than local firms. Furthermore, we see that the coefficient for α_k^M is larger than the coefficient for α_k^X in all high-skill occupational categories. This means that the shares are larger in MNEs than in exporting firms. In other words, with regard to high-skill occupations, we have the largest shares in MNEs followed by exporting firms and then by local firms.

The results for less-skilled occupations are basically a mirror image of the above results. MNEs and exporting firms tend to have relatively small employment and wage shares. The exceptions are Machine operators and Information assistants, where local firms have relatively large shares. The difference between local firms and globalized firms is particularly significant for Construction workers and for Service and sales workers. Furthermore, the coefficient for MNEs tends to be smaller than the coefficient for exporting firms. This indicates that for less-skilled

occupational categories, MNEs tend to have the smallest employment shares, local firms the largest shares and exporting firms somewhere in-between.

A more general picture of the occupational distribution in different firm types

Instead of analyzing differences in specific occupations, we also analyze how the overall occupational distribution differs between different firm types. This is done in Figure 5. Along the horizontal line, we have ranked our 100 occupations from the least skilled to the most skilled. Just like before, the ranking is based on the average wage for the occupations throughout the period. The vertical axis is the cumulative employment share of the labor force accounted for by the skill category that is indicated on the horizontal axis. If all occupations would represent the exact same share of the workforce, we would have a 45-degree straight line. The curves for the three firm types differ, indicating differences in the shares of different occupations for different firms. The curve for local firms is found above the curve for exporters and somewhat more above the curve for MNEs. This is a result of the relatively large share of low-skilled occupations in local firms. For instance, we see that the 50 percent lowest-skilled occupations account for almost 70 percent of employees in the least globalized firms (local) and about 50 percent in the most globalized firms (MNEs). Exporters have a share located somewhere in-between local and multinational firms. The results in Figure 5 illustrate that firms level of globalization is positively correlated with the share of highly skilled occupations.

--Figure 5 about here--

Yet another way of analyzing the difference in occupational composition is to use our previously defined index in regressions with different firm types and different control variables as explanatory variables. In Table 2, we only show the estimated coefficients for our firm types. The estimated coefficients show the difference in the skill index for different globalized firms as compared to local firms. For instance, a positive coefficient means that the firm in question has a distribution of occupations that is more skewed towards highly skilled occupations as compared to local firms.

In column 1, we compare MNEs and exporters with local firms. The results show that MNEs have the most skilled occupational composition in comparison with the other firm types, MNEs have more employees in high-wage occupations and fewer employees in low-wage occupations. Non-MNE exporters have the second most skilled occupational composition.

We previously discussed offshoring as an additional dimension of international integration. In column 2 we examine whether offshoring has an impact on the occupational mix. Offshoring is measured by imported inputs as a share of total sales. As shown in column 2, inclusion of offshoring has little impact on our main results. The coefficient for offshoring is statistically insignificant, suggesting that our main result is not driven by the possibility that MNEs or exporters are more able to offshore lower skilled tasks than local firms.

In the last column, we look at occupational differences on the basis of multinational ownership and show differences between different types of MNEs. The results indicate that there is no difference between Swedish and foreign-owned MNEs; both firm types have a relatively skilled occupational composition.

-- Table 2 about here--

Does globalization contribute to job polarization?

Figures 2-4 showed job polarization to have increased in Sweden. In Table 3, we examine the main determinants to the increased job polarization. Focus is on the results on within-firm polarization presented above. The results and discussion in this section is based on Heyman (2016). We here depart from the impact of routine-based technological change, and the offshorability and automation of jobs on job polarization. The influence of routine-based technological change, and offshoring has been analyzed in previous studies. For instance, Goos et al. (2014) use data on European countries to analyze the relative importance of technology and globalization in relation to job polarization. Their main result is that technology represents a much more important explanation for job polarization compared to offshoring.

-- Table 3 about here--

As discussed above on the separate impact of globalization and new technology on labor market outcomes, the same applies here. It is of course difficult to exactly disentangle the influence from each explanation given that they interact. Many of the same arguments on how new technology and routineness of jobs influence different occupations can also be applied on the impact of international trade and offshoring.

Panel a) in Table 3 show results on routineness, panel b) on offshoring and panel c) on automation. To investigate how the degree of routineness of jobs influence within-firm job polarization we divide firms into two groups according to the intensity of routineness for the firm's workforce in their initial year. Routineness is defined in terms of the routine task-intensity (RTI) index used in e.g. Autor (2013), Autor and Dorn (2013), and Goos et al. (2014). RTI is available at the 2-digit level for the Swedish job classification, SSYK96. A higher value indicates that the occupation is characterized by more routine tasks. We then estimate separate regressions on each wage group and on each group according to the intensity of routineness. The hypothesis is that firms with a high initial share of routine employees have greater opportunities to reallocate its workforce towards a composition of employees with more non-routine jobs, as compared to firms that initially have a low share of routine (i.e. an initial high share of non-routine workers). Columns (1), (3) and (5) show estimations on the group of firms with high initial average routineness. The corresponding regressions on low routineness firms are presented in columns (2), (4) and (6).[9]

Looking across the different estimated coefficients we see that the pattern presented in Figure 2 above - showing evidence on within-firm job polarization - originates from firms with high initial routineness among the workforce. These are firms that have greater opportunities to switch to a composition of employees with less routine job tasks, as compared to firms with a low initial share of routine workers. For instance, comparing columns (1) and (2) we notice that the increase in employment for the high-wage group originates from firms that initially can be characterized as high-routine. The same is also the case for demand of low-wage jobs in high-routine firms (compare columns (5) and (6)). For these firms we notice a clear increase in employment for low-wage occupations. These results, in combination with decreasing demand

[9] See Heyman et al. (2016) for details.

for middle-wage workers in firms with high initial average routineness (column (5)), are consistent with routine-biased technological change as an explanation for job polarization. If we instead study firms with low initial average routineness, then no job polarization can be seen.

Overall, the results in panel a) in Table 2 indicate that the initial composition of the work-force in terms of the degree of routineness and it´s change over time is systematically related to the observed pattern of within-firm job polarization. The shift away in demand for jobs that are more routine-intensive does seems to bring about a change in firm´s occupational distribution.

Panel b) shows similar results on the impact of offshorability. The measure of offshorability of jobs is identical to the measure used in e.g. Goos et al. (2014) and originates from Blinder and Krueger (2013). This measure is also available at the 2-digit level. Using the same approach as for routineness, we now take into account firm's occupational structure in terms of the offshorability of occupations to see how this is associated with the relative demand for the three different wage groups. Looking across columns in panel b), differences in offshorability among the firm´s workforce seems not to be systematically related to job polarization. No differences according to job polarization can be traced in terms of differences in the risk of offshoring. The only exception is for low-wage workers, but overall, firm differences in the composition of the work-force in terms offshorability is not systematically related to within-firm job polarization.

Finally, a similar pattern can be seen when we look at automation risks for occupations. Results are presented in panel c). The measure of automation of jobs is the same as in Frey and Osborne (2013). They have estimated the extent to which new technology can replace labor for individual occupations in the US labor market for the year 2010. Their main result is that approximately 47 percent of total employment in the US is at risk of being automated within one to two decades. To adapt these to the Swedish labor market, the probabilities have been translated to the Swedish classification of occupations (see Heyman et al. (2016) for details).

Similar to what is found for offshorability of jobs, no systematic pattern in terms of job polarization can be observed for automation risks. Given the closeness between an occupation's routineness and it´s risk of being automated, we have also analyzed combinations of routineness and automation risks. For these combinations, we find that the initial composition of the workforce in terms of the degree of routineness is more important than the corresponding classification of firms in terms of automation risks. The same pattern also emerges when we study combinations of firm´s workforce in terms of routineness and offshorability. These

unreported results again suggest that routine-biased technological change is an important explanation for job polarization.

Is the relationship between globalization and changes in relative labor demand causal?

The above results and discussion show that there is a relationship between the level of international activities and the demand for high-skill occupations. An important question is whether this relationship is a causal relationship. It could be the case that, for instance, a firm's technological development will lead to both an increased demand for a highly skilled workforce and that the firm becomes more competitive, thereby increasing its international activities.

To estimate the causal effect of increased export shares on the firm-level skill mix, Davidson et al. (2017) use an instrumental variables (IV) method and construct instruments for export shares to control for time-varying unobserved factors that are correlated with export shares and the labor mix. More specifically, they use changes in global supply and demand for goods produced by Swedish firms in order to capture this type of exogenous shock.[10] The reasoning behind this approach is that when global demand (import) increases, there is a positive export shock for Swedish firms producing these goods. Likewise, an increased global supply of inputs constitutes a positive import shock for Swedish firms using these imported inputs.

The results in Davidson et al. (2017) show that there is a causal relationship between international trade and the share of high-skill workers. However, the mechanism behind this effect looks different for exports compared to the import of inputs. When Swedish firms experiencing an exogenous positive increase in demand (a positive export shock) increase their exports, the share of employees working in high-skill occupations also increases. One may break down this effect for different employee categories. Such a breakdown shows that the increase applies to both white- and blue-collar workers. In other words, increased exports lead to more and more white-collar workers working in relatively skilled white-collar occupations and fewer in less skilled occupations, and the same applies to blue-collar workers The results

[10] This method is used more and more in international economics and was first developed by Hummels et al. (2014).

in Davidson et al. (2017) also find that exports lead to a higher share of white-collar workers and a lower share of blue-collar workers.

CONCLUDING REMARKS

Globalization has increased substantially over the last few decades. As a results, production patterns are also changing and with them, the demand for different types of workers. We have in this paper looked at some of these changes on the labor market. Firstly, we have shown that the overall distribution of occupations in Sweden has become more skilled intensive over time. There are more people working in relatively skilled occupations today than what there were in the 1990's. The increasingly skilled distribution is not, however, caused by a decline in the lowest skilled occupations. On the contrary both the lowest- and highest-skilled occupations have increased their employment shares. The share of medium skilled occupations has declined which altogether has led to an increased job-polarization.

We continue by examining the role of globalization in changing the distribution of occupations. We find that globalized firms have a more skilled distribution of occupations than less globalized firms. More precisely, multinational firms have a more skilled distribution than firms that only sell their products on the local market. Exporting firms have a distribution which is less skilled than in multinational firms but more skilled than in local firms.

More rigorous econometric results confirm a positive relationship between globalization and the skill level of firms' occupations. They do also confirm a positive effect from globalization on job polarization.

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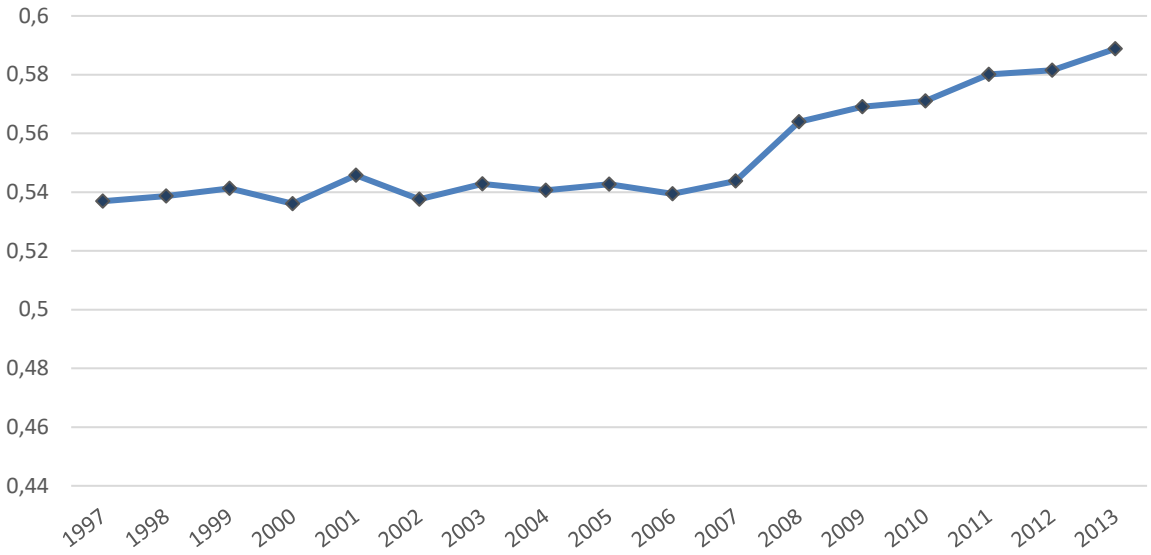
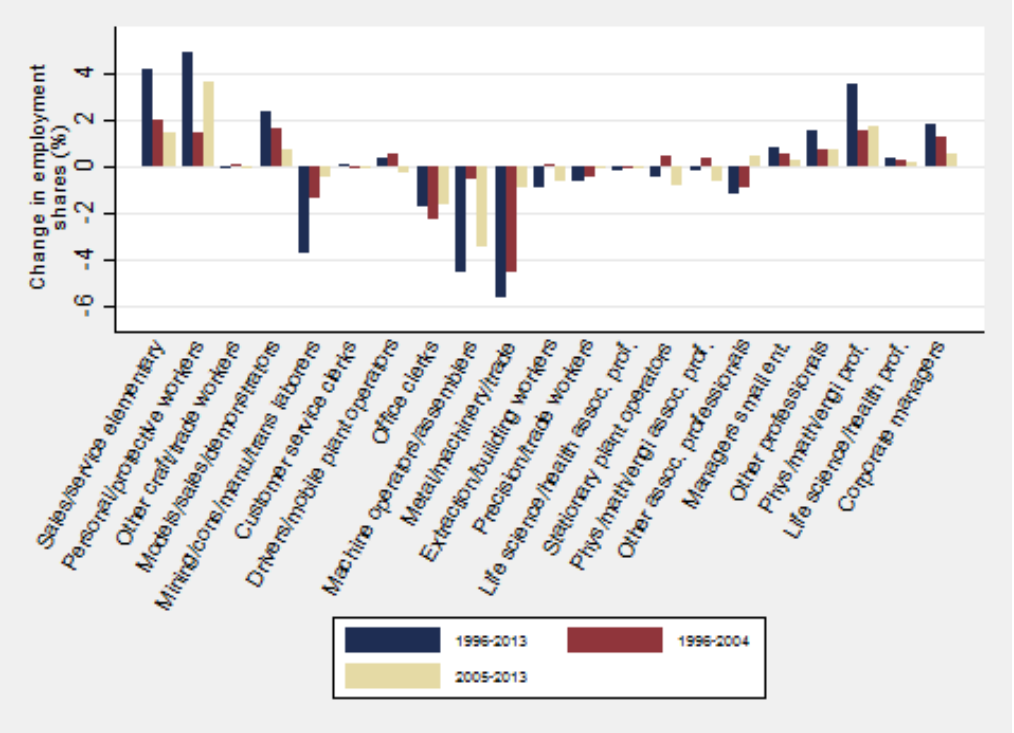
TABLES AND FIGURES

Figure 1. Development of the occupational composition in Sweden 1997–2013 (index).



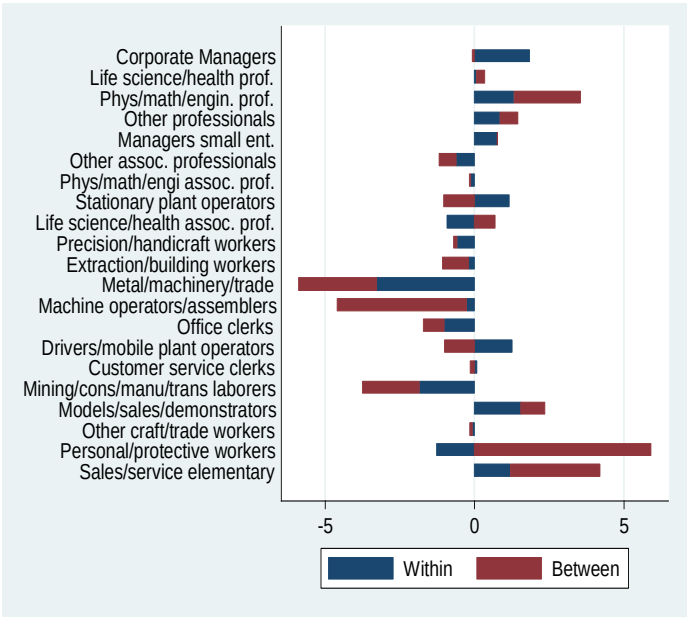
Notes: The index is estimated as a weighted average of the occupational composition in Sweden. A high value represents a relatively skilled occupational composition. The figure shows annual averages. See Davidson et al. (2017) for details.

Figure 2. Changes in employment shares for different occupational categories 1996–2013



Source: Heyman (2016).
Notes: The occupational distribution is identical to the one used in Goos et al. (2014). The least skilled occupation on the basis of wages is found on the left and the most skilled is found on the right.

Figure 3. Changes in employment shares 1996-2013.



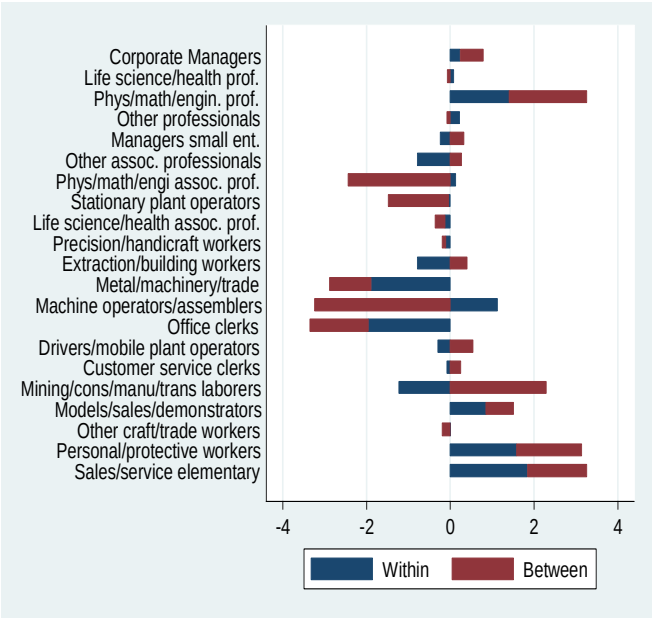


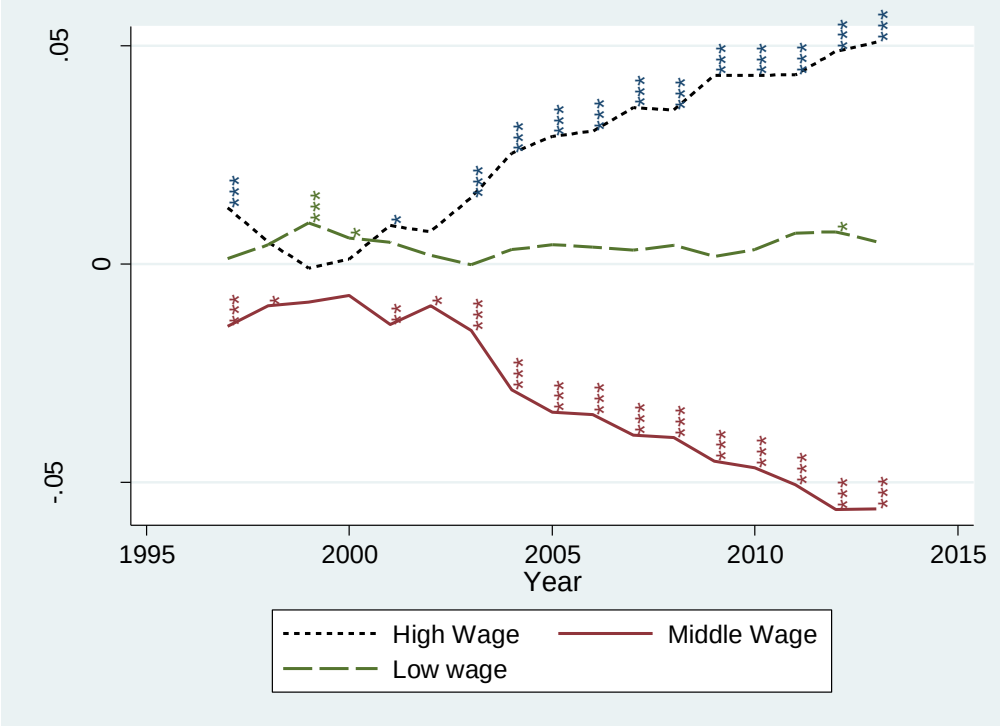
Fig. 3a. Within and between industries.

Fig. 3b. Within and between firms.

Source: Heyman (2016).

Notes: The figures show decompositions of changes in employment shares for 1996-2013. Occupations are based on ISCO-88 and are ordered by their mean wage in the first year (1996). Each bar represents percentage point changes in employment shares between 1996 and 2013. Fig. 1b) illustrates the within- and between-industry components of the overall pattern for 1996-2013 presented in Fig. 1a). For occupations with one positive and one negative component, the sum adds up to the overall change seen in Fig. 1a). Fig. 1c) illustrates the within- and between-firm components. These are based on using the earliest and latest years of data for each firm for firms that do not exist for the whole period of study, 1996 through 2013.

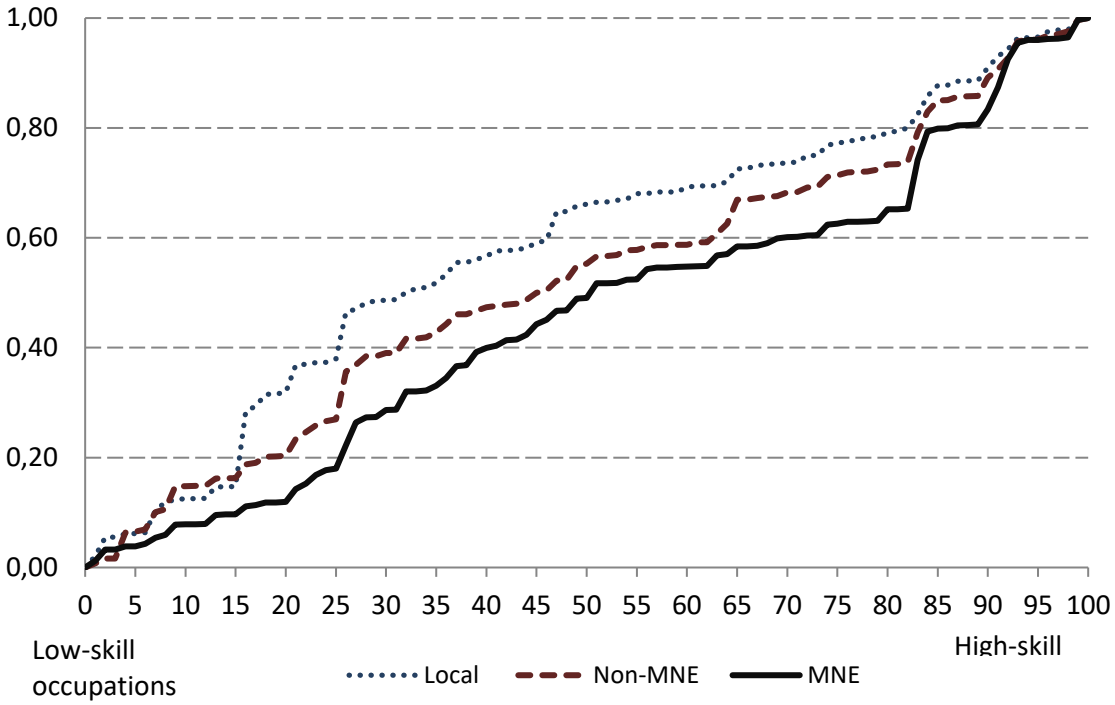
Figure 4. Within-firm job polarization in Sweden 1996-2013.



Source: Heyman (2016).

Notes: Job polarization in Sweden 1996-2013. Estimated coefficients on occupation group-year dummies. The figure plots estimated year coefficients on δ_t obtained from equation (1) in Heyman et al. (2016). Stars denote the level at which the estimated coefficients are significantly different from zero. To allow for within-firm correlation over time, standard errors are adjusted for clustering at the firm level. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.

Figure 5. Composition of occupations based on skill levels in different firm types, 1997–2013.



Notes: "Local" are non-exporters that are not MNEs, "Non-MNE" are exporters that are not MNEs and "MNE" are multinational enterprises. See Davidson et al. (2017) for details.

Table 1. Differences between firm types in employment shares (percent) for different occupational categories, 1997–2013.

				Manufacturing		Service		Employment share		Wage share	
	Mean wage	Employment share	Wage share	Employment share	Wage share	Employment share	Wage share	α_k^M	α_k^X	α_k^M	α_k^X
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Higher-skilled occupations											
Managers	38 988	6,41%	10,75%	6,48%	11,23%	6,37%	10,44%	0,041***	0,030***	0,071***	0.047***
Research professional	32 651	7,72%	10,84%	8,00%	11,10%	7,54%	10,68%	0,044***	0,029***	0,044***	0.029***
Business professional	28 009	9,83%	11,85%	8,54%	10,15%	10,64%	12,95%	0,086***	0,049***	0,083***	0.049***
Technicians	25 691	10,20%	11,27%	11,94%	12,93%	9,10%	10,19%	0,043***	0,029***	0,037***	0.026***
Other professional	24 533	3,37%	3,55%	1,78%	2,00%	4,37%	4,58%	-0,010***	-0,013***	-0,012***	-0.014***
Lower-skilled occupations											
Craft	20 778	11,18%	9,99%	12,06%	10,21%	10,62%	9,85%	-0,094***	-0,049***	-0,091***	-0.049***
Machine operators	20 177	14,62%	12,69%	35,01%	29,81%	1,75%	1,48%	0,028***	0,031***	0,020***	0.027***
Transportation operators	19 265	4,03%	3,34%	1,62%	1,37%	5,55%	4,63%	-0,057***	-0,047***	-0,057***	-0.047***
Information-processing clerks	19 222	6,75%	5,59%	4,59%	3,78%	8,12%	6,77%	0,036***	0,030***	0,024***	0.022***
Sales and service workers	18 802	12,11%	9,80%	0,62%	0,55%	19,37%	15,85%	-0,079***	-0,066***	-0,079***	-0.066***
Other clerks	18 340	5,13%	4,04%	1,67%	1,41%	7,31%	5,77%	-0,003	-0,004**	-0,007***	-0.006***
Laborers	16 880	8,65%	6,28%	7,67%	5,46%	9,26%	6,82%	-0,034***	-0,019***	-0,035***	-0.020***

Source: Heyman and Sjöholm (2018).
Notes: This table lists twelve broad occupation groups based on their functions in production. Column 1 shows the average wages for 1997-2013. Columns 2 and 3 show the employment and wage cost shares. Columns 4–7 show corresponding shares in the manufacturing industry and the service sector. Columns 8–11 report estimates from firm-level regressions, where α_k^M indicates the difference in employment shares (or wage shares) between multinational (MNEs) and local firms, and α_k^X indicates the difference in employment shares (or wage shares) between exporting non-MNEs and local firms. Standard errors are clustered by firm. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.

Table 2. Differences in occupational structures between different firm types. Firm-level regressions 1997-2013.

	(1)	(2)	(3)
MNE	0.137***	0.116 ***	
	(0.004)	(0.004)	
non-MNE exporter	0.092 ***	0.074 ***	
	(0.004)	(0.003)	
Offshoring		0.050 ***	
		(0.003)	
Foreign MNE			0.084 ***
			(0.004)
Swedish MNE			0.083 ***
			(0.005)

Source: Heyman and Sjöholm (2018). See also Davidson et el. (2017) for details.
Notes: This table shows estimated coefficients from regressions with an index of the skill level in the firms' workforce as dependent variable. The regressions are at the firm level and cover the period 1997–2013. The estimated coefficients show the skill level in the occupational composition compared to the composition in local firms. A positive estimated coefficient indicates that a firm type has a more skilled occupational composition compared to local firms. All regressions control for firm size, capital intensity, value added per employee and firm age. They also control for industry-specific and year-specific factors. The regressions are based on 69,109 observations. To allow for within-firm correlation over time, standard errors are adjusted for clustering at the firm level. ***, **, * show significance at the 1%, 5%, and 10% level, respectively

Table 3.Routineness, automation, offshoring and job polarization at the firm level. Firm-level regressions 1996-2013.

	(1) High wage group	(2) High wage group	(3) Middle wage group	(4) Middle wage group	(5) Low wage group	(6) Low wage group
	Low:	High:	Low:	High:	Low:	High:
Panel a: Routineness						
D_1999-2003	-0.012***	0.006	0.014***	-0.011***	-0.002	0.006*
	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)	(0.003)
D_2004-2008	-0.010*	0.042***	0.023***	-0.056***	-0.013**	0.014***
	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)	(0.004)
D_2009-2013	-0.007	0.064***	0.020***	-0.078***	-0.013**	0.014***
	(0.007)	(0.006)	(0.007)	(0.006)	(0.006)	(0.004)
Panel b: Offshoring						
D_1999-2003	0.008**	-0.008*	-0.008*	0.004	0.000	0.005**
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.002)
D_2004-2008	0.020***	0.023***	-0.013**	-0.034***	-0.007	0.011***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.003)
D_2009-2013	0.033***	0.036***	-0.024***	-0.049***	-0.009	0.012***
	(0.006)	(0.006)	(0.007)	(0.006)	(0.007)	(0.003)
Panel c: Automation						
D_1999-2003	0.003	-0.004	-0.006	0.002	0.004	0.002
	(0.005)	(0.004)	(0.005)	(0.005)	(0.003)	(0.003)
D_2004-2008	0.021***	0.023***	-0.025***	-0.026***	0.004	0.003
	(0.006)	(0.005)	(0.006)	(0.006)	(0.003)	(0.005)
D_2009-2013	0.031***	0.039***	-0.035***	-0.043***	0.004	0.003
	(0.007)	(0.006)	(0.006)	(0.007)	(0.004)	(0.006)
Firm controls	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES

Source: Heyman (2016).

Notes: The dependent variable is the share of high-, medium- and low-wage employees at the firm level. Low and high in columns 1-6 refer to initial values of routineness, automation and offshoring. For each wage group, firms are divided into two groups, high and low, based on initial values of routineness, automation and offshoring. Firm controls include the log of value added per employee and the log of the capital-labor ratio. Firm and year fixed effects are included in all estimations. To allow for within-firm correlation over time, standard errors are adjusted for clustering at the firm level. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.