Lancaster University Management School

Economics Working Paper Series

2017/031

Offshoring and the Age-Skill Composition of Labour Demand

Sotiris Blanas

The Department of Economics
Lancaster University Management School
Lancaster LA1 4YX
UK

Offshoring and the Age-Skill Composition of Labour Demand*

Sotiris Blanas†

December 2017

Abstract

This paper is the first to study the impact of offshoring on the age-skill composition of labour demand. In doing so, it provides novel empirical evidence firmly supporting the argument that the age profile of a worker is at least as crucial a criterion as the skill to be taken into account by firms while they make optimal labour utilisation adjustments through offshoring. The analysis is conducted on a sample of manufacturing and service industries in 12 developed countries for the period 1995–2005. Its main findings are that material and service offshoring to high-income countries decrease the relative demands for older more skilled workers, while they increase the relative demands for the youngest less skilled. In addition, material and service offshoring to low/middle-income countries decrease the relative demands for the youngest workers, while they mostly increase the relative demands for older workers. These findings are explained by the relative abundance of offshoring destinations in skills and in aspects of employment associated with workers' age profiles, such as the level of human capital and expertise, the returns to training and the level of employment protection.

Keywords: offshoring; relative labour demand; age-skill profile

JEL Classification: F14, F16, F66, J21, J23, J24, J31

*I thank participants at numerous conferences, workshops and seminars for their comments and suggestions. Special thanks are extended to Rosario Crinò, Francesco Di Comite, Gino Gancia, Maarten Goos, David Kang, Nicholas Lazarou, Jay Lee, Fabio Mariani, Julien Martin, Ilaria Maselli, María Navarro Paniagua, Peter Neary, William Parienté, Andrea Pirrone, Thomas Sampson, Vincent Vandenberghe, Jan Van Hove, Christian Viegelahn, Ian Walker, and Maurizio Zanardi. I gratefully acknowledge financial support from the Fonds de la Recherche Scientifique – FNRS under Grant number "2.4624.12". All errors are mine.

†Lancaster University Management School, Economics Department, LA1 4YX, Lancaster, UK, e-mail: s.blanas@lancaster.ac.uk, tel: +44 15 24 59 22 01

1 Introduction

The age profile of a worker is a crucial criterion of human resource management as it is associated with important aspects of employment; namely, the gradual acquisition of human capital and the returns to training, the level of expertise and work experience, the strength of ties with employers, as well as the employment protection level and the wage evolution over time (Blossfeld et al., 2005; Blossfeld et al., 2009; OECD, 2011). Therefore, when the representative firm makes optimal labour utilisation adjustments through offshoring, it may consider not only the skill profile of a worker, which the existing literature has exclusively focused on,[1] but also her age profile.

As offshoring is unlikely to be age-neutral, my main objective in this paper is to study its impact on the age-skill composition of labour demand. In doing so, I provide novel empirical evidence on how material and service offshoring lead to within-skill inter-generational and cross-skill intra-generational inequalities in developed countries. Importantly, I distinguish throughout the empirical analysis between high-income and low/middle-income offshoring destination countries as the motives for offshoring to these two destination types differ. The different motives imply that the representative firm makes optimal adjustments in the utilisation of different labour types in each of the two cases. Also, the descriptive statistics of this paper reveal important qualitative and quantitative differences in the trends of material and service offshoring to high-income and low/middle-income destinations.

The analysis conducted is particularly relevant also because of demographic ageing and the increasing trend in early retirement experienced by many developed countries in recent decades (OECD, 2006a; Buchholz et al., 2009). These trends have important socio-economic implications, most notably, the requirement for greater inter-generational pecuniary transfers from younger to older workers and the ensuing financial pressure on public pension schemes

[1] A voluminous literature has emerged in recent decades studying the impact of offshoring on the skill composition of labour demand. The skill profile of a worker is mostly captured by her education level. Some early studies, though, make the crude distinction between non-production and production workers in order to proxy for the skilled and unskilled workers, respectively. The main findings of this literature are that material and service offshoring increase the relative demand for more skilled workers, while they decrease the relative demand for the low-skilled. For relevant empirical evidence on the effects of material offshoring on the skill composition of labour demand, see among others: Feenstra & Hanson (1996, 1999) for the US, B. Anderton & Brenton (1999) for the UK, Strauss-Kahn (2004) for France, Egger & Egger (2005) for Austria, R. Anderton et al. (2002) and Hansson (2005) for Sweden, Helg & Tajoli (2005) for Italy and Germany, Minondo & Rubert (2006) for Spain, Hsieh & Woo (2005) for Hong Kong, Yan (2006) for Canada, and Geishecker (2006) for Germany. For relevant empirical evidence on the effects of service offshoring on the skill composition of labour demand, see among others: Crinò (2010) for the US, Geishecker & Görg (2011) for the UK, and Crinò (2012) for 9 European developed countries.

and welfare states (European Policy Committee, 2001, 2003, 2006).

The sample that I use for the empirical analysis is a panel of 20 manufacturing and service industries of 12 developed countries over the period 1995–2005. EU KLEMS is the main source of information on labour and other production-related variables. Labour variables correspond to heterogeneous workers in age and skill who form nine relevant groups. Skill is proxied by the worker's level of education. For the construction of the measures of material and service offshoring, I draw information on imported material and service inputs from the World Input-Output Database (WIOD). In order to distinguish between high-income and low/middle-income offshoring destination countries, I use the World Bank's Historical Country Classification By Income.

The minimisation of the translog cost function of the representative firm yields a system of nine wage bill share equations, with each equation corresponding to one of the nine age-skill groups of workers. In the benchmark analysis, I treat all explanatory variables as endogenous and estimate the system by Iterated Three-Stage Least Squares (I3SLS). As instruments for each explanatory variable, I use its first and second lags. For material and service offshoring to high-income and low/middle-income destinations which are the key explanatory variables, I construct additional instruments. These are the first two lags of offshoring measures corresponding to three countries that are not included in the benchmark sample as they do not provide information on labour variables by age and skill. The three selected countries are France, Ireland and Sweden, whose levels and trends of offshoring are very similar to those of the 12 countries of the benchmark sample. In order to ensure that the first- and second-lagged measures of material and service offshoring of these three countries to high-income destinations are exogenous instruments, I exclude trade between these countries and the 12 countries of the sample.

The findings of the empirical analysis firmly support the argument that the age profile of a worker is at least as crucial a criterion as the skill to be taken into account by firms while they make optimal labour utilisation adjustments through offshoring. In particular, I find that material and service offshoring to high-income countries decrease the relative demands for older more skilled workers, while they increase the relative demands for the youngest less skilled. In addition, I find that material and service offshoring to low/middle-income countries decrease the relative demands for the youngest workers of all skills, while they mostly increase the relative demands for older workers. These findings are explained by the relative abundance of offshoring destinations in skills and in aspects of employment associated with workers' age profiles, such as the level of human capital and expertise, the returns to training and the level of employment protection.

The remainder of the paper is structured as follows. In Section 2, I describe the theoretical background of the effects of offshoring on the age-skill composition of labour demand, after discussing the reasons for which the age profile of a worker is a crucial criterion of human resource management. In Section 3, I describe the data and provide descriptive statistics for offshoring and key labour variables which motivate the subsequent econometric analysis. In Section 4, I present the econometric model and discuss the estimation strategy. In Section 5, I present the main results and the robustness checks, while in Section 6, I conclude and provide some suggestions for further research.

2 Theoretical background

In this section, I first discuss the reasons for which the age profile of a worker is a crucial criterion of human resource management. Then, I describe the theoretical background of the empirical analysis on the effects of material and service offshoring on the relative demands for heterogeneous workers in age and skill.

Human resource management and the age profile of workers

The literature highlights several reasons for which the age profile of a worker is among the most prominent criteria of firms' human resource management. To start with, employers place a high value on the advantage of older workers over younger workers of the same education level in human capital development, know-how and expertise, especially, when these are employer-specific (OECD, 2011). Employers also value highly their greater work experience –although this might have become less important in recent years (Buchholz et al., 2009)– and their stronger ties with them, implying loyalty and stronger commitment (OECD, 2011). In addition, the recent reforms towards the flexibilisation of the labour market in many developed countries and the shift of firms' pay schemes from seniority-related to performance-related have been borne disproportionately by young labour market entrants, while older workers have enjoyed relatively high employment protection and seniority wages (Blossfeld et al., 2005; Blossfeld et al., 2009; Blossfeld et al., 2011; OECD, 2011; Hofäcker, 2012).[2]

[2]Seniority wages are earnings linked to age and in some cases exceed the wages that would have been

However, the older workers' relatively high employment protection and seniority wages may adversely affect their hiring rates and employment levels, since employers deem them as a relatively costly labour force.[3] In addition, the increasing demand for new skills induced by globalisation has rendered certain skills of older workers outmoded. On top of that, older workers have lower returns to training relative to younger workers due to the shorter time horizon that they have in order to recoup their investment in training (Hutchens, 1988; Blossfeld et al., 2006; Hofäcker, 2012) and the smaller benefits from human capital accumulation (Heckman, 2000). There is also evidence that these returns are even lower for older workers of low skill (Mayhew & Rijkers, 2004). The anticipated relatively low returns to training of older workers determine both employers' and older workers' practices in this regard. Specifically, employers are less willing to invest in training of older workers and older workers themselves –especially, those close to retirement age–, are less willing to engage in training activities.[4] Finally, negative stereotypes of employers about older workers result in discrimination against them (OECD, 2006a; OECD, 2011), and ultimately, may impact hiring decisions and human resource management (Dalen & Henkens, 2005; Schröder et al., 2009; Neumark, 2009).

In summary, the age profile is an essential worker characteristic capturing the gradual acquisition of human capital of a worker and her returns to training, her level of expertise and work experience, the strength of her ties to an employer, her employment protection level, and the evolution of her wage over time. Therefore, the representative firm, while optimising its labour utilisation through offshoring, is likely to take into account not only the education

paid, had the only criterion been the productivity level of the worker. This practice has been justified by economists as a way of firms to build strong ties with their employees (Lazear, 1981). OECD (2011) reports that the age-earnings relationship has been monotonically increasing in Austria, Belgium, France, Germany and the Netherlands, while it has been hump-shaped in Ireland, Japan and the UK. In addition, Hellerstein & Neumark (1995) and Hellerstein et al. (1999), with the use of Israeli and US firm-level data, respectively, find no evidence that older workers are overpaid relative to their productivity. Mahlberg et al. (2013) reach the same conclusion, using matched employer-employee data for Austria. By contrast, Vandenberghe et al. (2013) use Belgian firm-level data and find a negative impact of larger shares of older workers on firm productivity that is not compensated by lower labour costs, thereby indicating the existence of seniority wages in these firms that are not justified by the levels of productivity and employability of their older workers.

[3]Lanciano & Nitta (2010) examine the downsizing process that French and Japanese firms in the declining steel industry have undergone in recent decades and find that this process, with the support of relevant government policy measures, has been mostly characterised by age management. In addition, OECD (2011) reports that the hiring rate and employment level of workers aged 50–64 are negatively associated with employment protection, while OECD (2006b) and Dorn & Sousa-Poza (2010) find these associations to be weak. There also seems to be a strong negative association between hiring rates and seniority wages (Daniel & Heywood, 2007; OECD, 2011).

[4]O'Mahony & Peng (2009) provide evidence on workers rejecting training opportunities, especially the older and unskilled ones. In addition, OECD (2003) reports a large age gap in training participation in Australia, Austria, Finland, the Netherlands and the United Kingdom. Regarding overall training participation rates, these differ substantially across countries. For instance, they are much lower in Hungary, Italy and Portugal than in Switzerland and the Nordic countries (OECD, 2011).

level of a worker which defines her skill, but also her age profile.

Offshoring and the relative demands for heterogeneous workers in age and skill

The production process of the representative firm is conceptualised in terms of tasks (Grossman & Rossi-Hansberg, 2008) and therefore, material and service offshoring refer to the transfer of manufacturing and service tasks, respectively, abroad.[5] The distinction, though, between high-income and low/middle-income offshoring destination countries is crucial as the motives for offshoring to the two destination types differ. The different motives imply that the firm makes optimal adjustments in the utilisation of different labour types in each of the two cases.

The main motive of the representative firm of a high-income country to offshore manufacturing and service tasks to other high-income countries is to gain access to very highly-specialised and therefore, scarce human capital. This is because high-income destination countries are relatively abundant in older workers of relatively high education who acquire exceptional know-how, expertise and work experience that are highly valued by their own employers and other firms as well. Given also the relatively low returns to training of older workers, the representative firm is incentivised to offshore to high-income destinations in order to source the additional know-how and expertise that its own older workers of relatively high education do not possess. Therefore, offshoring to high-income destinations is expected to substitute for older and relatively high-educated domestic workers, resulting in a decrease in their relative demands. By contrast, it is expected to complement domestic workers of lower education and mostly of young age, resulting in an increase in their relative demands.

The main motive of the representative firm of a high-income country to offshore manufacturing and service tasks to low/middle-income destination countries is to take advantage of wage cost differentials. As low/middle-income countries are relatively abundant in low-educated workers with common know-how and expertise and of mostly young age, the manufacturing and service tasks that are offshored to these countries mostly require utilisation of workers with such characteristics. In recent decades, these countries have also experienced an increase in the pool of workers with relatively high education, who are mostly of young age and possess common know-how and expertise. The increasing pool of these workers explains the recent increasing trend in offshoring to these countries of tasks such as reading of X-rays,

[5]The transfer of tasks can occur inside or outside the boundaries of the firm. In the first case, the representative firm engages in FDI, while in the second case, it engages in foreign outsourcing.

software development, tax forms preparation (Grossman & Rossi-Hansberg, 2008). As the utilisation of common know-how and expertise possessed by domestic workers of all education levels and of mostly young age is relatively expensive, the representative firm is incentivised to offshore to low/middle-income countries in order to acquire common know-how and expertise at a lower cost. Given also the stronger ties of older workers with their employers and their higher employment protection and more rigid wages relative to younger workers, offshoring to low/middle-income countries is expected to substitute for young domestic workers of all education levels, resulting in a decrease in their relative demands. By contrast, it is expected to mostly complement older domestic workers of different education levels.

3 Data and descriptive statistics

In the first part of this section, I describe the data and the construction of variables. In the second part, I present descriptive statistics for material and service offshoring, and for key labour variables such as the wage bill and employment shares of the nine age-skill groups of workers and their real hourly wages.

3.1 Data and variables

For the purpose of the empirical analysis, I create a panel of 12 countries, 20 manufacturing and service industries and 11 years. All countries examined are advanced economies and are displayed in Panel A of Table 1. Panel B of the same table displays the 13 manufacturing and 7 service industries examined, which are aggregated at the two-digit level according to the NACE Rev. 1.1. The selection of countries has been driven by their development status and the availability of data on main labour variables. Also, the selected set of industries accounts for the largest share of a country's market economy and is very similar or identical to those used in previous relevant studies. The time period examined spans over 1995–2005. Its selection has been determined by the merger of the labour data with the trade data used for the construction of the measures of material and service offshoring.

<< Table 1 about here >>

EU KLEMS is the main source of information, comparable across countries, industries and years, on all labour and most of the other production-related variables along with their deflators. Regarding labour variables, it includes information on the wage bill and employment shares of heterogeneous workers in age and skill. Employment is captured by the hours of work. It also includes information on the total wage bill and the total hours worked. The youngest, middle-aged and oldest workers are those aged 15–29, 30–49, and 50 and over, respectively. Skill is captured by the level of education. Workers with at least a bachelor's degree are labeled as high-skilled (HS), those with upper-secondary education or vocational training are labeled as medium-skilled (MS), and those with lower-secondary education or no formal qualification are labeled as low-skilled (LS). Using this labour disaggregation, I capture empirically the crucial aspects of employment associated with the age profile of a worker that are described in Section 2, in addition to her education level. I compute the hourly wage for each of the nine age-skill groups of workers as the ratio of their wage bill to their hours of work. Then, I compute the relative wage for each age-skill group, that is, the ratio of the hourly wage for each age-skill group to the hourly wage for the benchmark age-skill group, which in my case is selected to be the group of the oldest low-skilled workers.

Furthermore, EU KLEMS includes information on gross output, gross fixed capital formation, total purchases of non-energy intermediate material and service inputs, and the share of investment in Information and Communication Technologies (ICT) in total capital investment. The latter is used as a proxy for technological change and ranges between 0 and 1. Since information on capital investment of Belgium is not available in the EU KLEMS database, I retrieve this information from the OECD database for Structural Analysis (STAN). As 1995 is the base year for the deflators of variables in the EU KLEMS, while in the STAN is the year 2000, I re-base the capital deflator of the STAN database so that is in line with the corresponding EU KLEMS deflator. Then, I divide the nominal gross fixed capital formation of Belgium with the re-based deflator in order to compute the real gross fixed capital formation of this country. For cross-country comparability of monetary variables, I convert these from national currencies in US dollars with the use of exchange rate data from the OECD.

Following the extant literature, I construct the measures of material and service offshoring as the shares of imported material and service inputs, respectively, in total purchases of non-energy intermediate material and service inputs.[6] I retrieve information on imported material and service inputs from the World Input-Output Database (WIOD).[7] The shares range between 0 and 1. All import values are in US dollars. The supplying industries of material and

[6] See among others: Feenstra & Hanson (1996, 1999), and Amiti & Wei (2005).

[7] For a detailed description of WIOD, see Timmer (2012).

service inputs considered are identical to the 13 sourcing manufacturing and 7 sourcing service industries, respectively, listed in Table 1. In addition, the database includes 40 supplying countries[8] and the Rest of World (RoW). The sum of imports from the 40 supplying countries and the RoW allows for the construction of the overall measures of material and service offshoring of the 12 countries examined (MOFF, SOFF). For the construction of the measures of material and service offshoring to high-income and low/middle-income countries, I use only the information on imports from the 40 supplying countries, as the RoW is unclassified.[9]

In order to classify offshoring destination countries by their income level, I rely on the World Bank's Historical Country Classification By Income. In this classification, countries are classified as high-income, upper-middle-income, lower-middle-income and low-income, according to their GNI per capita. In the benchmark case, I consider an offshoring destination country as high-income (HI) if it belongs to the group of high-income countries for at least half of the years of the period examined, 1995–2005. Similarly, I consider an offshoring destination country as low/middle-income (LMI) if it belongs to the group of upper-middle-income, lower-middle-income or low-income countries for at least half of the period examined. Alternatively, I consider the World Bank's income group(s) to which offshoring destination countries belong in 1995 (HI2, LMI2) –the first year of the sample–, as well as their OECD membership status by that year (OECD, non-OECD).[10]

Using alternative normalisations of the measures of material and service offshoring, I compute these as the shares of imported material and service inputs in gross output (Egger & Egger, 2005, Geishecker, 2006, Helg & Tajoli, 2005, Strauss-Kahn, 2004; Ekholm & Hakkala, 2005) and in gross value added (Ekholm & Hakkala, 2005). I draw information on gross value added and its deflator from EU KLEMS.

[8] These are: Australia, Austria, Bulgaria, Belgium, Brazil, Canada, China, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Indonesia, India, Ireland, Italy, Japan, Korea, Lithuania, Luxembourg, Latvia, Mexico, Malta, the Netherlands, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Turkey, Taiwan, United Kingdom, United States of America.

[9] The exclusion of imports from the RoW results in little loss of information. In particular, the sample mean of the sum of material offshoring to high- and low/middle-income countries as a share in overall material offshoring is 0.87. The corresponding sample mean for service offshoring is 0.84.

[10] The composition of high-income and low/middle-income country groups varies slightly across the three classifications. The lists of high-income and low/middle-income countries under the three alternative classifications are available upon request.

3.2 Descriptive statistics

Table 2 displays the mean values, percentage point changes and percentage changes of material offshoring (Panel A) and service offshoring (Panel B) during 1995–2005 for the whole sample and by country. The statistics are produced for material and service offshoring to all destination countries available (overall), as well as for material and service offshoring to high-income and low/middle-income countries. The highest mean values of material and service offshoring correspond to countries of relatively small size, such as Austria, Belgium, Denmark and the Netherlands.

<< Table 2 about here >>

The average material offshoring to all destination countries is greater than the corresponding average service offshoring for the whole sample and for each of the 12 countries examined. This holds also when I distinguish between high-income and low/middle-income offshoring destinations. In terms of growth rates over the period examined, aggregate material offshoring increased for some countries, while it decreased for others, namely, Belgium, Denmark, Italy, the Netherlands and the UK. Instead, the aggregate service offshoring of all 12 countries increased. As all 12 countries experienced increases in aggregate material offshoring to low/middle-income destinations, the declines in aggregate material offshoring of the 5 aforementioned countries are accounted for by declines in material offshoring to high-income destinations. The increases in aggregate service offshoring of all 12 countries are accounted for by increases in service offshoring to both high-income and low/middle-income destinations. In addition, aggregate service offshoring increased more than aggregate material offshoring for the whole sample and for Finland, Germany and Spain. Instead, it increased by less for Australia, Austria, Japan and the US. For most of the 12 countries, service offshoring to high-income destinations grew more than material offshoring to the same type of destinations, while it grew by less in the case of low/middle-income destinations.

According to the same table, the average material and service offshoring to high-income destination countries is greater than the average material and service offshoring, respectively, to low/middle-income destination countries for the whole sample and by country. However, both material and service offshoring to low/middle-income destinations grew faster than material and service offshoring to high-income destinations for the whole sample and most of the countries examined.[11] As stressed earlier, the distinction between high-income and low/middle-income offshoring destinations is primarily justified by the different motives of firms to offshore to the two destination types. The documented quantitative and, in many cases, qualitative differences in the trends of material and service offshoring to the two destination types provide additional support to this approach.

Shifting the focus from offshoring onto the nine age-skill groups of workers, Table 3 displays the mean values, percentage point changes and percentage changes of their wage bill shares (Panel A), employment shares (Panel B) and real hourly wages (Panel C) during 1995–2005 for the whole sample. According to Panels A and B, the medium-skilled workers of all three age profiles and the middle-aged high-skilled account, on average, for the highest shares of the total wage bill and total employment. Within each age group of workers, the medium-skilled also have, on average, the highest wage bill and employment shares.[12] Within each skill group of workers, the highest wage bill and employment shares are, on average, accounted for by the middle-aged.

<< Table 3 about here >>

The growth rates in Panels A and B reveal that the middle-aged and the oldest high-skilled and medium-skilled workers experienced increases in their wage bill and employment shares, while the youngest medium-skilled and low-skilled and the middle-aged and oldest low-skilled experienced declines. The youngest high-skilled workers experienced a decrease and an increase, respectively, in their wage bill and employment shares. The largest increases in the wage bill and employment shares were experienced by the oldest high-skilled workers, while the smallest increases were experienced by the middle-aged medium-skilled and the youngest high-skilled, respectively. The largest decreases in the wage bill shares were experienced by the youngest and middle-aged low-skilled, while the largest decrease in the employment shares is experienced by the middle-aged low-skilled.

[11] I obtain very similar growth rates of material and service offshoring when I normalise their measures by gross output and gross value added, as well as when I classify high-income and low/middle-income offshoring destination countries according to the World Bank's classification in 1995 and their OECD membership status by this year. Although the patterns are very similar, the mean values of the measures of material and service offshoring that are normalised by gross output are smaller than those of the benchmark measures, while the mean values of the measures of material and service offshoring that are normalised by gross value added are larger. The relevant tables are available upon request.

[12] By relying on the EU KLEMS data and creating a sample whose composition of countries, industries and years is very similar to mine, Crinò (2012) studies the skill composition of labour demand and also reports that medium-skill workers account for the highest shares of total wage bill and total employment.

The mean values of real hourly wages in Panel C indicate that, within each skill group, the oldest workers earn, on average, the highest real hourly wage, while the middle-aged workers earn, on average, the second highest. This evidence can be viewed as a compensation to older workers within a skill group for their greater human capital, work experience and stronger ties with employers. It could also be explained only by seniority, rather than higher productivity levels. Within each age group, I find evidence for skill premia, as high-skilled workers earn, on average, the highest real hourly wage, while the medium-skilled earn the second highest. This evidence is in line with the literature documenting skill premia without taking into account workers' age profiles (e.g. Hijzen et al., 2005; Crinò, 2012). In terms of growth rates, all age-skill groups of workers experienced increases in their real hourly wages except for the youngest and middle-age low-skilled and the oldest high-skilled who experienced declines. The largest and smallest increases in real hourly wages were experienced by the middle-aged high-skilled and the youngest medium-skilled, respectively. The largest decline in the real hourly wage was experienced by the youngest low-skilled.[13]

According to the three panels of Table 3, the declines in the wage bill shares of the youngest and middle-aged low-skilled workers are driven by declines in both their employment shares and real hourly wages, while the declines in the wage bill shares of the youngest medium-skilled and the oldest low-skilled workers are driven mostly by declines in their employment shares. Also, the decline in the wage bill share of the youngest high-skilled workers is driven by the lower increases in their employment shares and real hourly wages as compared to those of older more skilled workers. The increases in the wage bill shares of the middle-aged high-skilled and medium-skilled and the oldest medium-skilled workers are driven by increases in both their employment shares and real hourly wages. By contrast, the increase in the wage bill share of the oldest high-skilled is driven mostly by an increase in their employment share. The simultaneous increase in material and service offshoring, especially to low/middle-income destinations, might have had an impact on the aforementioned trends in wage bill shares. I study the causal relationship between changes in offshoring and changes in the age-skill composition of labour demand in the next sections.

[13] By conducting the analysis of Table 3 across the 12 countries of the sample, I obtain very similar descriptive statistics. These are shown in Tables A1 and A2.

4 Econometric model and estimation strategy

In this section, I derive the econometric model and discuss the strategy that I implement for its estimation.

4.1 Econometric model

According to the labour demand approach, the representative firm optimises its labour demand for given wages since labour supply is assumed to be perfectly inelastic. In my analysis, this implies that when offshoring opportunities arise, the representative firm adjusts optimally its demand for the nine age-skill groups of domestic workers. Hence, offshoring acts as a shift factor which increases or decreases the relative demand for each of the nine labour types.

Due to lack of information on the price of capital, this production factor is treated as quasi-fixed, implying that the cost function is of the short-run form (Berman et al., 1994). The cost-minimisation problem that the representative firm faces is as follows:

$$C_{SR}(W, Y, K, Z') = \min(W \cdot E') \;\; s.t. \, Y = f(E, K, Z') \tag{1}$$

C_{SR} represents the short-run cost of the firm which in my case comprises only the total wage bill. W and E are vectors of hourly wages and total hours worked, respectively, of the nine age-skill groups of workers. Y stands for output, K for capital and Z is a vector comprising labour demand shifters, namely, material and service offshoring to high-income and low/middle-income countries and the proxy for technological change.

In accord with previous studies, I consider the cost function to be of translog representation.[14] Total differentiation of the cost function with respect to prices of variable factors (i.e., wages) yields a system of nine wage bill share equations that correspond to the age-skill group of workers examined:

[14]See among others: Berman et al. (1994), Feenstra & Hanson (1996), Hijzen et al. (2005), and Crinò (2012). The translog form is preferred to other functional forms such as the CES, Cobb-Douglas and Leontief, as it imposes no *a priori* restrictions on substitutability between inputs.

$$
\begin{aligned}
Wsh^{a,s} = & \beta_{a,s} + \sum_{g \in A} \sum_{v \in S} \beta_{a,s,g,v} \ln W^{g,v} + \beta_{a,s,Y} \ln Y + \beta_{a,s,K} \ln K + \sum_{z \in Z} \beta_{a,s,z} Z, \\
& \forall a, g \in A = \{15-29, 30-49, 50+\}, \forall s, v \in S = \{HS, MS, LS\}
\end{aligned} \tag{2}
$$

The dependent variable of equation (2) is the wage bill share of the age-skill group of workers (a,s) in the total wage bill. The first set of explanatory variables comprises the log of relative wages, that is, the wage for each age-skill group of workers relative to the wage for the benchmark age-skill group of workers. The benchmark group in my case is that of the oldest low-skilled. Capital and gross output also enter the model in logs. Note, though, that the labour demand shifters in Z are not in logs, as they represent non-monetary shares ranging between 0 and 1. The coefficient estimates of material and service offshoring to high-income and low/middle-income countries in $\beta_{a,s,z}$ are the main focus of this analysis. When these are positive and statistically significant, they suggest that offshoring increases the wage bill share of the age-skill group (a,s), or equivalently, shifts this group's relative demand schedule outwards. Similarly, when they are negative and statistically significant, they suggest that offshoring decreases the wage bill share of the age-skill group (a,s), or equivalently, shifts this group's relative demand schedule inwards.

Linear price homogeneity and symmetry imply the following constraints on the parameters:

$$
\begin{aligned}
& \sum_{a \in A} \sum_{s \in S} \beta_{a,s} = 1; \sum_{a \in A} \sum_{s \in S} \beta_{a,s,g,v} = \sum_{g \in A} \sum_{v \in S} \beta_{g,v,a,s} = 0; \\
& \sum_{a \in A} \sum_{s \in S} \beta_{a,s,Y} = \sum_{a \in A} \sum_{s \in S} \beta_{a,s,K} = \sum_{a \in A} \sum_{s \in S} \beta_{a,s,z} = 0; \\
& \beta_{a,s,g,v} = \beta_{g,v,a,s}; \beta_{q,z} = \beta_{z,q}
\end{aligned} \tag{3}
$$

In order for the cost function to be well behaved, economic theory requires that is concave in the wages of the nine age-skill groups of workers. This is satisfied if and only if the matrix of wage elasticities is negative semi-definite. The necessary condition for negative semi-definiteness is that the own-wage elasticities which are on the diagonal of this matrix are non-positive, while the sufficient condition is that all odd-numbered and even-numbered principal minors are non-positive and non-negative, respectively. Due to the fact that the translog cost function does not meet these conditions universally, the standard approach in the literature is to test whether the necessary condition is satisfied on average (Hijzen et al., 2005; Crinò, 2012). To this purpose, I compute the own-wage elasticity of the age-skill group of workers (a,s) as the difference of unity from the ratio of the coefficient estimate of the corresponding relative wage to the sample mean of the corresponding wage bill share:

$$\epsilon^{a,s,a,s} = \frac{\beta_{a,s,a,s}}{\bar{W}sh^{a,s}} - 1, \forall a \in A, \forall s \in S. \tag{4}$$

4.2 Estimation strategy

For the estimation of the system in (2), I add to it the vector of error terms $u^{a,s}$, $\forall a \in A, \forall s \in S$, for which I assume that $u \cong N(0, \Sigma)$, where $\Sigma = E(u'u)$. Given that the right-hand side of the nine equations is identical and, as shown in equation (3), there are cross-equation constraints stemming from linear price homogeneity and symmetry, it is very likely that the error terms of the system are correlated (Berndt, 1991). When all explanatory variables are treated as exogenous, the system is estimated by Seemingly Unrelated Regressions (SUR) which implies the simultaneous estimation of equations and produces more efficient coefficient estimates. However, the estimation of all nine equations at once is not possible as their corresponding wage bill shares add up to one, resulting in the variance-covariance matrix Σ to be singular. The estimation of the system becomes feasible only after one of its equations is dropped. In my estimations, I choose to drop the equation which corresponds to the oldest low-skilled workers. As the estimates produced are not invariant to the equation dropped, SUR estimations must be iterated (ISUR). ISUR guarantees that the parameter estimates and the residual covariance matrix converge (Berndt & Wood, 1975; Hijzen et al., 2005).

In order to control for any unobserved heterogeneity across country-industry pairs, I deviate all variables of the estimating model from their mean values at the country-industry level, rather than taking their first difference.[15] I also control for any time-varying factors common to all country-industry pairs (e.g. global demand shock) by adding to the system time-specific fixed effects. Using the constraints in equation (3), I obtain estimates for the parameters excluded from the estimated equations, as well as for all parameters of the equation that is dropped from the system. Then, I apply the delta method in order to retrieve their asymptotic standard errors.

[15] First-differencing may exacerbate the bias due to measurement error in the data (Griliches & Hausman, 1986).

As the representative firm is likely to make simultaneously decisions over offshoring and optimal labour utilisation, simultaneity bias may be a crucial issue in the estimating model. I deal with it by implementing a very similar instrumentation strategy to that of other pertinent empirical studies. As instruments for material and service offshoring to high-income and low/middle-income countries, I use their first and second lags, which are expected to be strongly correlated with the instrumented variables and uncorrelated with the error terms (Crinò, 2012). I also use the first two lags of material and service offshoring to the two types of destinations of three developed countries that are not included in the benchmark sample as they do not provide information on labour variables by age and skill (Autor et al., 2013). The three selected countries are France, Ireland and Sweden, whose levels and trends of offshoring are very similar to those of the 12 countries of the benchmark sample.[16] Hence, these instruments are also expected to be strongly correlated with the four instrumented measures of material and service offshoring.

Although a demand shock to an industry in France, Ireland or Sweden can be transmitted to the same or another closely-linked industry of at least one of the 12 countries in the benchmark sample due to business-cycle synchronisation, it is unlikely that such a demand shock can be transmitted to all country-industry pairs. Even if such a possibility exists, this is tackled with the use of the first and second lags of the offshoring measures of the three selected countries. In addition, the labour markets of the 12 countries of the benchmark sample are likely to be impacted by their trade with France, Ireland and Sweden. In order to ensure that the first- and second-lagged measures of material and service offshoring of the three selected countries to high-income destinations are exogenous instruments, I exclude the imports of the three countries from the 12 countries of the benchmark sample. For these reasons, the second set of instruments is also expected to be uncorrelated with the error terms. Similar to offshoring, the decision of the representative firm over investment in Information and Communication Technologies is likely to be made simultaneously with its decision over optimal labour utilisation. Hence, another source of endogeneity in the estimating model is the proxy for technological change. I deal with this issue by instrumenting this variable with its first and second lags.

An important implication of the industry-level analysis is that the assumption that labour supply is perfectly inelastic may no longer be applicable (Hijzen, 2005). An increase in

[16] The same descriptive statistics analysis as in Table 2 for France, Ireland and Sweden is available upon request.

industry-level labour demand may increase industry-level wages sufficiently so that there will be an increase in labour supply, as workers will be more willing to work in an industry which pays higher wages. In addition, although the labour demand approach assumes that wages and output are fixed, the specific-factors demand approach considers wages and output to adjust to labour demand shocks (Egger & Egger, 2005; Hijzen, 2005). Capital utilisation may also be correlated with unobserved factors that affect the wage bill shares (Strauss-Kahn, 2004). For these reasons, relative wages, gross output and capital should also be considered as endogenous. Following the extant literature, I instrument each of these variables with its first and second lags.

Since endogeneity is a crucial issue in the estimating model, the main results are based on estimations that treat all explanatory variables as endogenous. In this case, system 2 is estimated by Iterated Three-Stages Least Squares, I3SLS (Crinò, 2012). The missing observations of lagged variables which serve as instruments in these estimations are filled with zeros (Arellano & Bond, 1991).

5 Empirical results

Table 4 displays the results from I3SLS estimations of the system of wage bill share equations corresponding to the nine age-skill groups of workers. In Panel A, all explanatory variables are treated as endogenous. The positive and statistically significant coefficient estimates of MOFF_HI in columns 2, 3 and 6 indicate that material offshoring to high-income destination countries impacts positively the wage bill shares of the youngest medium-skilled and low-skilled workers and of the middle-aged low-skilled. By contrast, it impacts negatively the wage bill shares of the middle-aged and oldest medium-skilled, as indicated by the negative and statistically significant coefficient estimates of this explanatory variable in columns 5 and 8. The coefficient estimates of MOFF_LMI indicate that material offshoring to low/middle-income destination countries impacts negatively the wage bill shares of the youngest workers of all three skill levels and of the oldest high-skilled and medium-skilled (columns 1–3, 7 and 8), while it impacts positively the wage bill share of the middle-aged workers of all three skill levels and of the oldest low-skilled (columns 4–6 and 9).

In addition, service offshoring to high-income destination countries (SOFF_HI) impacts negatively the wage bill shares of the high-skilled workers of all three age profiles and the middle-aged low-skilled (columns 1, 4, 6 and 7). It, instead, impacts positively the wage bill share of the youngest medium-skilled workers (column 2). Service offshoring to low/middle-income destination countries (SOFF_LMI) impacts negatively the wage bill shares of the youngest medium-skilled and the middle-aged low-skilled workers (columns 2 and 6), while it impacts positively the wage bill share of the oldest high-skilled (column 7). The proxy for technological change (ICT) impacts positively the wage bill shares of the high-skilled workers of all three age profiles, the youngest low-skilled and the oldest medium-skilled (columns 1, 3, 4, 7 and 8), while it impacts negatively the wage bill shares of the youngest and middle-aged medium-skilled and those of the middle-aged and oldest low-skilled (columns 2, 5, 6 and 9).

<< Table 4 about here >>

In line with economic theory, the own-wage elasticities are negative in all nine columns. The first-stage results are shown in Table B1 of the Online Appendix. The coefficient estimates of most of the selected instruments are statistically significant. The F-statistic is above 10 and its p-value is lower than 10% in all first-stage regressions. The R-squared of these regressions ranges from 18.4% to 57%. Hence, I conclude that the selected instruments are correlated with the instrumented variables. Some caution is only required for the test for over-identifying restrictions, as the Hansen J statistic (976.3), shown in Panel A of Table 4, is greater than the degrees of freedom of the system (361).[17]

In Panels B and C, I re-estimate the system while treating as endogenous only the four offshoring measures and the proxy for technological change. The set of instruments for these labour demand shifters in the estimations of Panel B is identical to that of Panel A. By contrast, the set of instruments for the same labour demand shifters in the estimations of Panel C includes only the first-lagged variables that are used as instruments in the estimations of Panel A. In both panels, the results bear a very close resemblance to those of Panel A and all own-wage elasticities are negative, in line with economic theory. The Hansen J statistic of Panel B regressions (458) is almost half of the Hansen J statistic in Panel A, but is still greater than the degrees of freedom of the system (291).[18] However, in Panel C regressions, where there is a further reduction in the number of instruments used, the Hansen J statistic (193.4) is

[17] Degrees of freedom = G * m - k, where G: number of simultaneous regressions (8), m: number of instruments (48), k: number of endogenous variables (23).

[18] Degrees of freedom = G * m - k, where G: number of simultaneous regressions (8), m: number of instruments (38), k: number of endogenous variables (13).

smaller than the degrees of freedom of the system (219),[19] indicating that the over-identifying restrictions are satisfied. In addition, the first-stage results of the I3SLS estimations of Panels B and C are satisfactory, suggesting that the selected instruments are correlated with the instrumented variables (Tables B2 and B3).

In sum, I find that material and service offshoring to high-income countries decrease the relative demands for older more skilled workers, while they increase the relative demands for the youngest less skilled. As discussed in the theoretical background, these findings are explained by the relative abundance of high-income offshoring destination countries in older workers of relatively high education who acquire exceptional know-how, expertise and work experience that are highly valued by their own employers and other firms as well. Also, I find that material and service offshoring to low/middle-income countries decrease the relative demands for the youngest workers of all skills, while they mostly increase the relative demands for older workers.[20] According to the theoretical background, these findings are explained by the relative abundance of low/middle-income offshoring destination countries in relatively young low- and high-educated workers with common know-how and expertise, implying that their wages are lower than those of workers with similar education levels, know-how and expertise in high-income countries. Technological change favours mainly more skilled workers, validating empirically the term "skill-biased technological change" (SBTC), even when controlling for the worker's age profile. In particular, it increases the relative demands for the high-skilled of all age profiles and the oldest medium-skilled, while it decreases the relative demands for the younger medium-skilled and the older low-skilled.

Robustness checks

In the remainder of this section, I discuss the robustness of the main results. In relatively rigid labour markets, changes in wage bill shares are mostly explained by adjustments in employment rather than in wages. For this reason, in Panel A of Table 5, I estimate the benchmark system of equations with employment shares as the dependent variables in lieu of

[19] Degrees of freedom = G * m - k, where G: number of simultaneous regressions (8), m: number of instruments (29), k: number of endogenous variables (13).

[20] In additional estimations where I treat all explanatory variables as endogenous, I show that the benchmark results are insensitive to changing the composition of instruments for the four measures of material and service offshoring. First, I add the current values of the four measures of offshoring of France, Ireland and Sweden to the benchmark set of instruments (Panel A of Table C1). Second, I replace the first and second lags of the four measures of offshoring of France, Ireland and Sweden with their current values. Third, I instrument the four measures of offshoring using only their first and second lags. The results tables of the last two estimations are available upon request. Finally, I obtain very similar results to the benchmark ones when I treat all explanatory variables as exogenous and estimate the system by ISUR (Panel B of Table C1).

wage bill shares.[21] Two more ways of controlling for labour market rigidities are shown in Panels B and C of the same table. In Panel B, I add to the system the index of employment protection legislation strictness (EPL), developed by the OECD, capturing the limitations imposed on firms to hire and fire workers.[22] The index ranges between 1 and 6, with higher values indicating a more rigid labour market in the country. As the strength of collective representation of workers determining the wage setting process can be indicative of the degree of labour market rigidities, in Panel C, I add to the system union density (UD), also developed by the OECD. Union density is computed as the share of members in labour unions in total employment. The additional controls in the regressions of Panel B and C are treated as endogenous and are instrumented with their first and second lags. In all three cases, the main results remain largely unchanged, indicating their robustness to cross-country labour market heterogeneity.

In additional robustness checks, shown in Table 6, I control for factors which may be correlated with material and service offshoring. As higher economic integration implies an increase in imports of both intermediates and final output, I control in the regressions of Panel A for import penetration (MPEN), that is, for the share of imports of consumption goods in domestic consumption.[23] For the construction of this variable, I use data from the OECD Bilateral Trade Database by Industry and End-Use Category. In the regressions of Panel B, I control for material input intensity (IIM_EMP) and service input intensity (IIS_EMP). These are computed as the ratios of purchases of material and service inputs to total employment, respectively. The intuition for this check is that when intermediate input intensity of a firm's production increases, the engagement of the firm in material and service offshoring is likely to increase as well. Material and service offshoring is also likely to increase in an industry which experiences a positive productivity shock. I control for this possibility in the regressions of Panel C to which I add labour productivity (LPROD). This is measured as the share of value added in total hours worked. Data on material and service input intensity, as well as on labour productivity are collected from EU KLEMS. Same as in the previous table, the additional controls in the regressions of all panels of Table 6 are treated as endogenous and are instrumented with their first and second lags. Controlling for these concomitant factors

[21] For a similar approach, see Strauss-Kahn (2004), Egger & Egger (2005), Hansson (2005), Helg & Tajoli (2005), and Minondo & Rubert (2006).

[22] This index comprises 18 items which are gathered in three main areas: 1) employment protection of regular workers against individual dismissal, 2) specific requirements for collective dismissals, 3) information on temporary forms of employment.

[23] Import penetration is calculated as $\frac{M}{Y+M-X}$, where Y: gross output, M: imports, X: exports.

does not alter quantitatively and qualitatively the benchmark results.

In the final group of robustness checks, shown in Table 7, I ensure that the main results are insensitive to the use of alternative measures of material and service offshoring. The measures of material and service offshoring in the regressions of Panel A are computed as the shares of imported material and service inputs, respectively, in gross output.[24] The measures of material and service offshoring in the regressions of Panel B are constructed according to the World Bank's classification of high-income and low/middle-income countries in 1995.

6 Conclusion

By providing novel empirical evidence on the impact of offshoring on the age-skill composition of labour demand, this paper firmly supports the argument that the age profile of a worker is at least as crucial a criterion as the skill to be taken into account by firms while they make optimal labour utilisation adjustments through offshoring. The analysis is conducted on a sample of manufacturing and service industries in 12 developed countries for the period 1995–2005. Its main findings are that material and service offshoring to high-income countries decrease the relative demands for older more skilled workers, while they increase the relative demands for the youngest less skilled. In addition, material and service offshoring to low/middle-income countries decrease the relative demands for the youngest workers of all skills, while they mostly increase the relative demands for older workers. These findings are explained by the relative abundance of offshoring destinations in skills and in aspects of employment associated with workers' age profiles, such as the level of human capital and expertise, the returns to training and the level of employment protection.

Despite the novelty of the aforementioned findings, further research with the use of matched employer-employee data could account for the role of offshoring in inducing workers to become unemployed, to exit permanently the labour market (e.g. early retirement of older workers), or to switch to another employer operating in the same industry or another industry. In addition, offshoring may impact the terms and conditions under which workers of different age and skill profiles are employed, such as their levels of job insecurity and earnings volatility, their bargaining power vis-à-vis their employers, and the levels of their contribution to

[24] I also estimate regressions in which material and service offshoring are normalised by value added. In these regressions, I replace gross output, as the measure of production, with value added. The results obtained are very similar to the benchmark ones and are available upon request.

non-wage costs (e.g. health insurance and social security costs). As changes in labour demand elasticities can capture changes in employment terms and conditions (Rodrik, 1997), future research could study the effects of offshoring on the elasticities of demand for heterogeneous workers in age and skill.

References

Amiti, M., & Wei, S.-J. (2005). Fear of Service Outsourcing: Is It Justified? *Economic Policy*, *20*(42), 308–347.

Anderton, B., & Brenton, P. (1999). Outsourcing and Low-skilled Workers in the UK. *Bulletin of Economic Research*, *51*(4), 267–286.

Anderton, R., Brenton, P., & Oscarsson, E. (2002). What's Trade Got to Do with It? Relative Demand for Skills within Swedish Manufacturing. *Review of World Economics (Weltwirtschaftliches Archiv)*, *138*(4), 629–651.

Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies*, *58*(2), 277–297.

Autor, D. H., Dorn, D., & Hanson, G. H. (2013). The China Syndrome: Local Labor Market Effects of Import Competition in the United States. *American Economic Review*, *103*(6), 2121–2168.

Berman, E., Bound, J., & Griliches, Z. (1994). Changes in the Demand for Skilled Labor within U.S. Manufacturing: Evidence from the Annual Survey of Manufactures. *The Quarterly Journal of Economics*, *109*(2), 367–397.

Berndt, E. R. (1991). *The Practice of Econometrics, Classic and Contemporary.* Reading, MA: Addison-Wesley.

Berndt, E. R., & Wood, D. O. (1975). Technology, Prices, and the Derived Demand for Energy. *The Review of Economics and Statistics*, *57*(3), 259–268.

Blossfeld, H.-P., Buchholz, S., Bukodi, E., & Kurz, K. (2009). *Young Workers, Globalization and the Labor Market - Comparing Early Working Life in Eleven Countries.* Cheltenham (UK) and Northampton (MA, USA): Edward Elgar.

Blossfeld, H.-P., Buchholz, S., & Hofäcker, D. (2006). *Globalization, Uncertainty and Late Careers in Society.* London & New York: Routledge.

Blossfeld, H.-P., Hofäcker, D., & Bertolini, S. (2011). *Youth on Globalised Labour Markets: Rising Uncertainty and its Effects on Early Employment and Family Lives in Europe.* Opladen & Farmington Hills: Barbara Budrich.

Blossfeld, H.-P., Klijzing, E., Mills, M., & Kurz, K. (2005). *Globalization, Uncertainty and Youth in Society*. London et al.: Routledge.

Buchholz, S., Hofäcker, D., Mills, M., Blossfeld, H.-P., Kurz, K., & Hofmeister, H. (2009). Life Courses in the Globalization Process: The Development of Social Inequalities in Modern Societies. *European Sociological Review*, *25*(1), 53–71.

Crinò, R. (2010). Service Offshoring and White-Collar Employment. *Review of Economic Studies*, *77*(2), 595–632.

Crinò, R. (2012). Service Offshoring and the Skill Composition of Labour Demand. *Oxford Bulletin of Economics and Statistics*, *74*(1), 20–57.

Dalen, H. P. V., & Henkens, K. (2005). The Double Standard in Attitudes Toward Retirement – The Case of the Netherlands. *The Geneva Papers on Risk and Insurance - Issues and Practice*, *30*(4), 693–710.

Daniel, K., & Heywood, J. S. (2007). The Determinants of Hiring Older Workers: UK Evidence. *Labour Economics*, *14*(1), 35–51.

Dorn, D., & Sousa-Poza, A. (2010). "Voluntary" and "Involuntary" Early Retirement: an International Analysis. *Applied Economics*, *42*(4), 427–438.

Egger, H., & Egger, P. (2005). Labor Market Effects of Outsourcing under Industrial Interdependence. *International Review of Economics & Finance*, *14*(3), 349–363.

Ekholm, K., & Hakkala, K. (2005). *The Effect of Offshoring on Labor Demand: Evidence from Sweden* (Working Paper Series No. 654). Research Institute of Industrial Economics.

European Policy Committee. (2001). Budgetary Challenges Posed by Ageing Populations: The Impact on Public Spending on Pensions, Health and Long-Term Care for the Elderly and Possible Indicators of the Long-Term Sustainability of Public Finances. *European Commission (ECFIN), Brussels*.

European Policy Committee. (2003). The Impact of Ageing Populations on Public Finances: Overview of Analysis Carried Out at EU Level and Proposals for a Future Work Programme. *European Commission (ECFIN), Brussels*.

European Policy Committee. (2006). The Impact of Ageing on Public Expenditure: Projections for the EU25 Member States on Pensions, Health Care, Long-Term Care, Education and Unemployment Transfers (2004-2050). *European Commission (ECFIN), Brussels*.

Feenstra, R. C., & Hanson, G. H. (1996). Globalization, Outsourcing, and Wage Inequality. *American Economic Review*, *86*(2), 240–245.

Feenstra, R. C., & Hanson, G. H. (1999). The Impact of Outsourcing and High-Technology Capital on Wages: Estimates For the United States, 1979–1990. *The Quarterly Journal of Economics*, *114*(3), 907–940.

Geishecker, I. (2006). Does Outsourcing to Central and Eastern Europe Really Threaten Manual Workers' Jobs in Germany? *The World Economy*, *29*(5), 559–583.

Geishecker, I., & Görg, H. (2011). Services Offshoring and Wages: Evidence from Micro Data. *Oxford Economic Papers*.

Griliches, Z., & Hausman, J. A. (1986). Errors in Variables in Panel Data. *Journal of Econometrics*, *31*(1), 93–118.

Grossman, G. M., & Rossi-Hansberg, E. (2008). Trading Tasks: A Simple Theory of Offshoring. *American Economic Review*, *98*(5), 1978–1997.

Hansson, P. (2005). Skill Upgrading and Production Transfer within Swedish Multinationals. *Scandinavian Journal of Economics*, *107*(4), 673–692.

Heckman, J. (2000). Policies to Foster Human Capital. *Research in Economics*, *54*(1), 3–56.

Helg, R., & Tajoli, L. (2005). Patterns of International Fragmentation of Production and the Relative Demand for Labor. *The North American Journal of Economics and Finance*, *16*(2), 233–254.

Hellerstein, J. K., & Neumark, D. (1995). Are Earnings Profiles Steeper Than Productivity Profiles? Evidence from Israeli Firm-Level Data. *The Journal of Human Resources*, *30*(1), 89–112.

Hellerstein, J. K., Neumark, D., & Troske, K. R. (1999). Wages, Productivity, and Worker Characteristics: Evidence from Plant? Level Production Functions and Wage Equations. *Journal of Labor Economics*, *17*(3), 409–446.

Hijzen, A. (2005). A Bird's Eye View of International Outsourcing: Data, Measurement and Labour Demand Effects. *Economie Internationale*(104), 45–63.

Hijzen, A., Görg, H., & Hine, R. C. (2005). International Outsourcing and the Skill Structure of Labour Demand in the United Kingdom. *Economic Journal*, *115*(506), 860–878.

Hofäcker, D. (2012). *Globalisation and the Labour Market Situation of Older Workers: Exploring Trends, Challenges and Strategies for Adaptation* (Tech. Rep.). Thematic Review Seminar on "Employment Policies to Promote Active Ageing".

Hsieh, C.-T., & Woo, K. T. (2005). The Impact of Outsourcing to China on Hong Kong's Labor Market. *American Economic Review*, *95*(5), 1673–1687.

Hutchens, R. M. (1988). Do Job Opportunities Decline with Age? *Industrial and Labor Relations Review*, *42*(1), 89–99.

Lanciano, E., & Nitta, M. (2010). How Do Japanese and French Firms in Steel Industry Address the Institutional Change and the Globalization? Employment Adjustment and Age Management in a Downsizing Context. In *International Sociology Association.* Goteborg, Sweden.

Lazear, E. P. (1981). Agency, Earnings Profiles, Productivity, and Hours Restrictions. *American Economic Review*, *71*(4), 606–620.

Mahlberg, B., Freund, I., Cuaresma, J. C., & Prskawetz, A. (2013). Ageing, Productivity and Wages in Austria. *Labour Economics*, *22*(Supplement C), 5–15. (Supplement: Ageing and Productivity)

Mayhew, K., & Rijkers, B. (2004). *How to Improve Human Capital of Older Workers or the Sad Tale of the Magic Bullet* (Tech. Rep.). EC-OECD Seminar on Human Capital and Labour Market Performance.

Minondo, A., & Rubert, G. (2006). The Effect of Outsourcing on the Demand for Skills in the Spanish Manufacturing Industry. *Applied Economics Letters*, *13*(9), 599–604.

Neumark, D. (2009). The Age Discrimination in Employment Act and the Challenge of Population Aging. *Research on Aging*, *31*(1), 41–68.

OECD. (2003). *OECD Employment Outlook.* Paris: OECD Publishing.

OECD. (2006a). *Live longer, work longer.* Paris: OECD Publishing.

OECD. (2006b). *OECD Employment Outlook.* Paris: OECD Publishing.

OECD. (2011). *Pensions at a Glance 2011: Retirement-Income Systems in OECD and G20 countries.* Paris: OECD Publishing.

O'Mahony, M., & Peng, F. (2009). *Skill bias, age and organizational change* (MPRA Paper No. 38767). University Library of Munich, Germany.

Rodrik, D. (1997). *Has Globalization Gone Too Far?* (Tech. Rep.). Washington, DC: Institute for International Economics.

Schröder, H., Hofäcker, D., & Muller-Camen, M. (2009). HRM and the Employment of Older Workers: Germany and Britain Compared. *International Journal of Human Resources Development and Management*, *9*, 162–179.

Strauss-Kahn, V. (2004). The Role of Globalization in the Within-Industry Shift Away from Unskilled Workers in France. In *Challenges to Globalization: Analyzing the Economics* (pp. 209–234). National Bureau of Economic Research, Inc.

Timmer, M. (2012). *The World Input-Output Database (WIOD): Contents, Sources and Methods* (Tech. Rep. No. Version 0.9). European Commission Research Directorate General.

Vandenberghe, V., Waltenberg, F., & Rigo, M. (2013). Ageing and Employability. Evidence from Belgian Firm-Level Data. *Journal of Productivity Analysis*, *40*(1), 111–136.

Yan, B. (2006). Demand for Skills in Canada: The Role of Foreign Outsourcing and Information-Communication Technology. *The Canadian Journal of Economics*, *39*(1), 53–67.

Tables with main descriptive statistics

Table 1: Countries and industries

Panel A: Countries			
No.	Country Name	No.	Country Name
1	Australia	7	Italy
2	Austria	8	Japan
3	Belgium	9	Netherlands
4	Denmark	10	Spain
5	Finland	11	United Kingdom
6	Germany	12	United States of America
Panel B: Industries			
NACE Rev 1.1	Industry Name	NACE Rev 1.1	Industry Name
15–16	Food products, Beverages and Tobacco	30–33	Electrical and Optical Equipment
17–19	Textiles, Textile Products, Leather and Footwear	34–35	Transport Equipment
20	Wood and Products of Wood and Cork	36–37	Manufacturing n.e.c.; Recycling
21–22	Pulp, Paper, Paper Products, Printing and Publishing	50	Wholesale and Retail; motor vehicles
23	Coke, Refined Petroleum Products and Nuclear Fuel	51	Wholesale, expect motor vehicles
24	Chemicals and Chemical Products	52	Retail, except motor vehicles
25	Rubber and Plastics Products	60–63	Transportation and storage
26	Other Non-Metallic Mineral Products	64	Post and Telecommunications
27–28	Basic Metals and Fabricated Metal Products	70	Real Estate
29	Machinery and Equipment, n.e.c.	71–74	Other business activities

Source: EU KLEMS.

Table 2: Offshoring for the whole sample and by country

Panel A: Mean values, percentage point and percentage changes of material offshoring during 1995–2005									
Country	Mean			Percentage point change			Percentage change		
	Overall	HI	LMI	Overall	HI	LMI	Overall	HI	LMI
Whole sample	0.093	0.066	0.014	0.022	0.002	0.013	26.18	3.70	142.57
Australia	0.073	0.048	0.010	0.005	-0.010	0.005	7.31	-19.92	81.66
Austria	0.213	0.176	0.023	0.064	0.036	0.021	36.98	23.59	177.97
Belgium	0.250	0.219	0.017	-0.022	-0.038	0.012	-8.51	-16.09	105.92
Denmark	0.169	0.140	0.014	-0.004	-0.019	0.008	-2.07	-12.95	73.40
Finland	0.147	0.112	0.020	0.036	-0.001	0.030	25.79	-1.12	256.56
Germany	0.150	0.107	0.026	0.054	0.018	0.027	43.24	18.25	192.94
Italy	0.103	0.076	0.011	-0.007	-0.015	0.004	-5.91	-17.81	40.27
Japan	0.034	0.019	0.007	0.017	0.005	0.006	62.77	29.33	110.11
Netherlands	0.184	0.150	0.015	-0.029	-0.038	0.003	-14.27	-21.77	25.53
Spain	0.135	0.114	0.010	0.019	0.002	0.008	15.80	1.52	129.92
United Kingdom	0.133	0.107	0.011	-0.031	-0.035	0.005	-20.98	-28.39	51.93
United States	0.080	0.050	0.016	0.024	-0.000	0.018	32.26	-0.68	166.18
Panel B: Mean values, percentage point and percentage changes of service offshoring during 1995–2005									
Country	Mean			Percentage point change			Percentage change		
	Overall	HI	LMI	Overall	HI	LMI	Overall	HI	LMI
Whole sample	0.027	0.019	0.004	0.010	0.005	0.003	43.68	31.85	79.48
Australia	0.036	0.021	0.006	0.000	-0.005	0.004	1.42	-20.11	74.51
Austria	0.086	0.043	0.023	0.004	0.004	0.012	4.19	7.92	57.73
Belgium	0.098	0.081	0.007	0.005	-0.004	0.004	5.36	-4.78	82.09
Denmark	0.095	0.070	0.021	0.075	0.066	0.004	115.64	144.57	21.22
Finland	0.070	0.047	0.017	0.024	0.017	0.006	39.56	42.42	38.41
Germany	0.035	0.021	0.009	0.015	0.008	0.003	59.05	52.58	44.37
Italy	0.032	0.021	0.007	0.005	0.004	-0.000	17.83	19.78	-1.44
Japan	0.012	0.008	0.002	0.003	0.002	0.001	37.39	25.84	122.20
Netherlands	0.111	0.074	0.007	0.023	0.009	0.010	23.46	13.02	214.14
Spain	0.036	0.023	0.006	0.021	0.017	0.003	90.38	121.83	64.23
United Kingdom	0.035	0.028	0.004	0.017	0.007	0.003	59.28	28.41	130.36
United States	0.017	0.012	0.002	0.005	0.001	0.002	29.46	6.65	181.59

Notes: Overall: offshoring to all countries available; HI (LMI): offshoring to countries classified as high-income (upper-middle-income, lower-middle-income and low-income) for at least half of the period 1995–2005 by the World Bank's Historical Country Classification By Income.
Source: Author's calculations based on WIOD and EU KLEMS.

Table 3: Wage bill shares, employment shares, and hourly wages for the whole sample

Panel A: Mean values, percentage point and percentage changes of wage bill shares during 1995–2005									
		15–29			30–49			50+	
	HS	MS	LS	HS	MS	LS	HS	MS	LS
Mean	0.048	0.150	0.026	0.151	0.355	0.069	0.043	0.111	0.048
Percentage point change	-0.001	-0.067	-0.014	0.063	0.007	-0.037	0.026	0.044	-0.019
Percentage change	-1.65	-35.64	-43.64	53.17	1.98	-42.64	86.72	51.36	-33.23
Panel B: Mean values, percentage point and percentage changes of employment shares during 1995–2005									
		15–29			30–49			50+	
	HS	MS	LS	HS	MS	LS	HS	MS	LS
Mean	0.046	0.197	0.046	0.094	0.344	0.087	0.023	0.104	0.059
Percentage point change	0.001	-0.069	-0.015	0.039	0.034	-0.035	0.017	0.047	-0.019
Percentage change	2.19	-29.04	-29.03	51.46	10.56	-33.85	114.61	60.64	-28.22
Panel C: Mean values, percentage point and percentage changes of real hourly wages during 1995–2005									
		15–29			30–49			50+	
	HS	MS	LS	HS	MS	LS	HS	MS	LS
Mean	21.011	15.308	11.443	32.326	20.791	15.959	37.305	21.543	16.492
Percentage point change	1.543	0.217	-1.414	3.903	0.650	-0.495	-1.039	1.122	0.636
Percentage change	7.62	1.43	-11.20	13.09	3.14	-3.04	-2.71	5.36	4.02

Notes: HS: high-skilled; MS: medium-skilled; LS: low-skilled. Real hourly wages are in US dollars.
Source: Author's calculations based on EU KLEMS.

Tables with main empirical results

Table 4: Offshoring and wage bill shares

Panel A: All explanatory variables treated as endogenous									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI	0.023	0.076**	0.10***	0.038	-0.22***	0.096**	-0.018	-0.064**	-0.031
	[0.02]	[0.04]	[0.02]	[0.03]	[0.05]	[0.05]	[0.02]	[0.03]	[0.02]
MOFF_LMI	-0.13***	-0.13*	-0.18***	0.12*	0.23**	0.24**	-0.11***	-0.25***	0.21***
	[0.04]	[0.08]	[0.04]	[0.07]	[0.1]	[0.1]	[0.04]	[0.07]	[0.05]
SOFF_HI	-0.048*	0.24***	-0.0081	-0.18***	0.085	-0.11*	-0.099***	0.055	0.056
	[0.02]	[0.05]	[0.03]	[0.04]	[0.07]	[0.07]	[0.03]	[0.05]	[0.03]
SOFF_LMI	0.0043	-0.035***	0.00086	0.0061	0.021	-0.030*	0.020***	0.018	-0.0043
	[0.006]	[0.01]	[0.007]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.009]
ICT	0.025***	-0.055***	0.014*	0.045***	-0.033*	-0.065***	0.026***	0.078***	-0.035***
	[0.007]	[0.01]	[0.008]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.010]
Obs					2525				
R^2	0.129	0.480	0.297	0.666	0.255	0.425	0.542	0.510	0.016
Own-wage elasticity	-0.609	-0.891	-0.287	-0.515	-0.649	-1.470	-1.184	-0.721	-0.689
Hansen J statistic					976.3				
Instruments	First and second lags of instrumented variables								
	First and second lags of material and service offshoring of France, Ireland and Sweden								
Panel B: Only material and service offshoring and proxy for technological change treated as endogenous									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI	0.0043	0.16***	0.062***	-0.015	-0.22***	0.073	0.0068	-0.064**	0.00027
	[0.02]	[0.04]	[0.02]	[0.03]	[0.05]	[0.05]	[0.02]	[0.03]	[0.02]
MOFF_LMI	-0.12***	-0.0071	-0.20***	0.099*	0.47***	-0.23***	-0.096***	-0.072	0.16***
	[0.03]	[0.07]	[0.03]	[0.06]	[0.09]	[0.08]	[0.03]	[0.06]	[0.04]
SOFF_HI	-0.056***	0.17***	0.019	-0.14***	0.082	-0.093*	-0.085***	0.091**	0.011
	[0.02]	[0.04]	[0.02]	[0.04]	[0.06]	[0.05]	[0.02]	[0.04]	[0.03]
SOFF_LMI	0.0057	-0.030**	-0.0016	0.0067	0.018	-0.030**	0.017**	0.012	0.0018
	[0.006]	[0.01]	[0.007]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.008]
ICT	0.024***	-0.067***	0.011	0.042***	-0.057***	-0.0089	0.025***	0.056***	-0.027***
	[0.006]	[0.01]	[0.007]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.008]
Obs					2525				
R^2	0.191	0.543	0.455	0.680	0.265	0.556	0.562	0.601	0.179
Own-wage elasticity	-0.451	-0.633	-0.417	-0.418	-0.411	-1.208	-1.185	-0.736	-0.297
Hansen J statistic					458				
Instruments	First and second lags of instrumented variables								
	First and second lags of material and service offshoring of France, Ireland and Sweden								
Panel C: Only material and service offshoring and proxy for technological change treated as endogenous									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI	0.0063	0.10**	-0.038	-0.020	0.073	0.0014	-0.095***	-0.088**	0.058*
	[0.02]	[0.05]	[0.03]	[0.04]	[0.07]	[0.06]	[0.03]	[0.04]	[0.03]
MOFF_LMI	-0.11***	-0.042	-0.22***	0.13**	0.50***	-0.23***	-0.11***	-0.062	0.15***
	[0.03]	[0.07]	[0.04]	[0.06]	[0.10]	[0.08]	[0.04]	[0.06]	[0.05]
SOFF_HI	-0.055***	0.16***	-0.015	-0.14***	0.20***	-0.14***	-0.12***	0.096***	0.025
	[0.02]	[0.04]	[0.02]	[0.04]	[0.06]	[0.05]	[0.02]	[0.04]	[0.03]
SOFF_LMI	0.0051	-0.025*	0.013*	0.0090	-0.030	-0.015	0.033***	0.016	-0.0055
	[0.007]	[0.01]	[0.007]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.009]
ICT	0.024***	-0.078***	-0.000083	0.044***	-0.028	-0.0076	0.014*	0.051***	-0.020**
	[0.007]	[0.01]	[0.007]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.009]
Obs					2525				
R^2	0.193	0.545	0.410	0.678	0.235	0.549	0.521	0.602	0.136
Own-wage elasticity	-0.454	-0.657	-0.376	-0.418	-0.499	-1.205	-1.206	-0.750	-0.281
Hansen J statistic					193.4				
Instruments	First lag of instrumented variables								
	First lag of material and service offshoring of France, Ireland and Sweden								

Notes: Iterated Three-Stages Least Squares (I3SLS) with asymptotic standard errors in square brackets. All variables are deviated from their country-industry mean values. Time-specific fixed effects included. For the description of the variables, see Table D1. HI (LMI): countries classified as high-income (upper-middle-income, lower-middle-income and low-income) for at least half of the period 1995–2005 by the World Bank's Historical Country Classification By Income. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 5: Labour market rigidities

Panel A: Employment shares (Esh) as the dependent variables									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Esh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI	0.011	0.070	0.10***	0.0088	-0.20***	0.15***	-0.017	-0.075***	-0.048*
	[0.02]	[0.05]	[0.03]	[0.02]	[0.04]	[0.04]	[0.01]	[0.03]	[0.03]
MOFF_LMI	-0.11***	0.012	-0.27***	0.036	0.12	0.26***	-0.090***	-0.20***	0.23***
	[0.04]	[0.1]	[0.06]	[0.05]	[0.1]	[0.10]	[0.03]	[0.07]	[0.06]
SOFF_HI	-0.068***	0.36***	-0.0052	-0.14***	-0.081	-0.11*	-0.070***	0.031	0.089**
	[0.02]	[0.07]	[0.04]	[0.03]	[0.07]	[0.06]	[0.02]	[0.04]	[0.04]
SOFF_LMI	0.0072	-0.053***	0.0000051	0.0098	0.039**	-0.036**	0.014***	0.022**	-0.0033
	[0.006]	[0.02]	[0.010]	[0.008]	[0.02]	[0.02]	[0.005]	[0.01]	[0.009]
ICT	0.028***	-0.072***	0.021**	0.028***	0.0016	-0.060***	0.011**	0.078***	-0.036***
	[0.007]	[0.02]	[0.01]	[0.009]	[0.02]	[0.02]	[0.005]	[0.01]	[0.01]
Obs					2525				
R^2	0.035	0.219	0.382	0.492	0.277	0.459	0.468	0.618	0.052
Own-wage elasticity	-1.385	-1.446	-0.663	-0.995	-1.046	-1.384	-1.689	-1.092	-0.952
Hansen J statistic					1001.2				
Instruments	First and second lags of all explanatory variables								
	First and second lags of material and service offshoring of France, Ireland and Sweden								
Panel B: Index of employment protection legislation strictness (EPL)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI	0.026	0.11***	0.13***	0.036	-0.22***	0.11**	-0.043**	-0.11***	-0.042*
	[0.02]	[0.04]	[0.02]	[0.03]	[0.05]	[0.05]	[0.02]	[0.03]	[0.02]
MOFF_LMI	-0.12***	-0.21**	-0.17***	0.16**	0.16	0.26**	-0.068*	-0.22***	0.21***
	[0.04]	[0.08]	[0.04]	[0.07]	[0.1]	[0.1]	[0.04]	[0.07]	[0.05]
SOFF_HI	-0.045*	0.20***	0.0092	-0.15***	0.039	-0.090	-0.078***	0.066	0.049
	[0.03]	[0.05]	[0.03]	[0.04]	[0.07]	[0.07]	[0.03]	[0.04]	[0.03]
SOFF_LMI	0.0025	-0.035***	-0.0045	0.00066	0.025	-0.031*	0.020***	0.022**	0.000090
	[0.006]	[0.01]	[0.007]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.009]
ICT	0.022***	-0.032**	0.012	0.031**	-0.015	-0.065***	0.012	0.066***	-0.031***
	[0.008]	[0.02]	[0.009]	[0.01]	[0.02]	[0.02]	[0.008]	[0.01]	[0.01]
EPL	-0.00014	-0.011***	-0.0013	0.0028	-0.0065*	0.0011	0.0061***	0.0077***	0.0010
	[0.001]	[0.003]	[0.001]	[0.002]	[0.004]	[0.003]	[0.001]	[0.002]	[0.002]
Obs					2525				
R^2	0.102	0.489	0.336	0.683	0.245	0.411	0.555	0.556	0.070
Own-wage elasticity	-0.482	-0.410	-0.208	-0.464	-0.752	-1.581	-1.169	-0.625	-0.482
Hansen J statistic					1075.5				
Instruments	First and second lags of all explanatory variables								
	First and second lags of material and service offshoring of France, Ireland and Sweden								
Panel C: Union density (UD)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI	0.025	0.068**	0.11***	0.043	-0.23***	0.11**	-0.018	-0.068**	-0.037*
	[0.02]	[0.03]	[0.02]	[0.03]	[0.05]	[0.05]	[0.02]	[0.03]	[0.02]
MOFF_LMI	-0.061	-0.19**	-0.20***	0.25***	0.41***	0.10	-0.16***	-0.23***	0.092*
	[0.04]	[0.08]	[0.05]	[0.07]	[0.1]	[0.1]	[0.04]	[0.07]	[0.05]
SOFF_HI	-0.017	0.22***	-0.0018	-0.12***	0.095	-0.10	-0.12***	0.039	0.018
	[0.02]	[0.05]	[0.03]	[0.04]	[0.07]	[0.07]	[0.03]	[0.04]	[0.03]
SOFF_LMI	-0.0036	-0.027**	0.0014	-0.0085	0.0067	-0.022	0.026***	0.018	0.0094
	[0.006]	[0.01]	[0.008]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.008]
ICT	0.016**	-0.048***	0.016**	0.029**	-0.055***	-0.047**	0.033***	0.076***	-0.020**
	[0.007]	[0.01]	[0.008]	[0.01]	[0.02]	[0.02]	[0.008]	[0.01]	[0.009]
UD	0.15***	-0.11*	-0.079**	0.28***	0.54***	-0.46***	-0.13***	0.090*	-0.29***
	[0.03]	[0.06]	[0.03]	[0.05]	[0.09]	[0.08]	[0.03]	[0.05]	[0.04]
Obs					2525				
R^2	0.131	0.512	0.271	0.646	0.187	0.361	0.533	0.517	0.122
Own-wage elasticity	-0.352	-0.813	-0.0663	-0.660	-0.400	-1.670	-1.289	-0.682	-1.148
Hansen J statistic					960.7				
Instruments	First and second lags of all explanatory variables								
	First and second lags of material and service offshoring of France, Ireland and Sweden								

Notes: Iterated Three-Stages Least Squares (I3SLS) with asymptotic standard errors in square brackets. All variables are deviated from their country-industry mean values. Time-specific fixed effects included. All explanatory variables treated as endogenous. For the description of the variables, see Table D1. HI (LMI): countries classified as high-income (upper-middle-income, lower-middle-income and low-income) for at least half of the period 1995–2005 by the World Bank's Historical Country Classification By Income. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 6: Other concomitant factors

Panel A: Import penetration (MPEN)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI	0.027	0.075**	0.10***	0.041	-0.21***	0.087*	-0.018	-0.065**	-0.036
	[0.02]	[0.04]	[0.02]	[0.03]	[0.05]	[0.05]	[0.02]	[0.03]	[0.03]
MOFF_LMI	-0.15***	-0.13	-0.18***	0.12*	0.19	0.28**	-0.11***	-0.25***	0.23***
	[0.04]	[0.08]	[0.04]	[0.07]	[0.1]	[0.1]	[0.04]	[0.07]	[0.06]
SOFF_HI	-0.027	0.23***	-0.019	-0.16***	0.15*	-0.16**	-0.11***	0.059	0.029
	[0.03]	[0.05]	[0.03]	[0.04]	[0.08]	[0.07]	[0.03]	[0.05]	[0.04]
SOFF_LMI	0.0010	-0.034**	0.0022	0.0037	0.012	-0.023	0.021***	0.018	-0.00040
	[0.007]	[0.01]	[0.008]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.009]
ICT	0.025***	-0.052***	0.015*	0.044***	-0.037*	-0.064***	0.028***	0.075***	-0.035***
	[0.007]	[0.01]	[0.008]	[0.01]	[0.02]	[0.02]	[0.008]	[0.01]	[0.01]
MPEN	0.013***	-0.013	-0.0080*	0.015**	0.048***	-0.035***	-0.0073*	0.0061	-0.020***
	[0.004]	[0.009]	[0.005]	[0.007]	[0.01]	[0.01]	[0.004]	[0.007]	[0.006]
Obs					2525				
R^2	0.024	0.460	0.262	0.652	0.058	0.335	0.513	0.505	-0.111
Own-wage elasticity	-0.633	-0.997	-0.290	-0.496	-0.724	-1.517	-1.179	-0.727	-0.630
Hansen J statistic					863.8				
Instruments	First and second lags of all explanatory variables								
	First and second lags of material and service offshoring of France, Ireland and Sweden								

Panel B: Material and service input intensity of production (IIM_EMP, IIS_EMP)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI	0.017	0.10***	0.072***	0.027	-0.13**	0.034	-0.034*	-0.027	-0.061**
	[0.02]	[0.04]	[0.02]	[0.03]	[0.05]	[0.05]	[0.02]	[0.04]	[0.03]
MOFF_LMI	-0.11***	-0.066	-0.22***	0.058	0.30**	0.17	-0.13***	-0.23***	0.23***
	[0.04]	[0.08]	[0.05]	[0.07]	[0.1]	[0.1]	[0.04]	[0.08]	[0.05]
SOFF_HI	-0.050*	0.13**	0.043	-0.10**	0.031	-0.039	-0.087***	0.056	0.013
	[0.03]	[0.05]	[0.03]	[0.05]	[0.08]	[0.07]	[0.03]	[0.05]	[0.04]
SOFF_LMI	0.0055	-0.024*	-0.0049	0.0094	0.017	-0.037**	0.019***	0.015	-0.00024
	[0.006]	[0.01]	[0.007]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.008]
ICT	0.020***	-0.055***	0.015*	0.031**	-0.010	-0.069***	0.025***	0.082***	-0.038***
	[0.007]	[0.01]	[0.008]	[0.01]	[0.02]	[0.02]	[0.008]	[0.01]	[0.010]
ln IIM_EMP	-0.0014	-0.018**	0.010**	0.011	-0.023**	0.021**	0.0061	-0.0070	0.0012
	[0.004]	[0.008]	[0.004]	[0.007]	[0.01]	[0.01]	[0.004]	[0.007]	[0.005]
ln IIS_EMP	0.0024	0.013*	-0.0098**	0.0059	0.0093	-0.017*	-0.0047	0.0053	-0.0038
	[0.003]	[0.007]	[0.004]	[0.006]	[0.010]	[0.009]	[0.004]	[0.006]	[0.005]
Obs					2525				
R^2	0.140	0.516	0.324	0.673	0.224	0.406	0.530	0.490	0.075
Own-wage elasticity	-0.529	-0.497	-0.299	-0.558	-0.771	-1.460	-1.172	-0.801	-0.599
Hansen J statistic					1032.3				
Instruments	First and second lags of all explanatory variables								
	First and second lags of material and service offshoring of France, Ireland and Sweden								

Panel C: Labour productivity (LPROD)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI	0.020	0.065*	0.11***	0.038	-0.27***	0.12***	0.0046	-0.058*	-0.027
	[0.02]	[0.04]	[0.02]	[0.03]	[0.05]	[0.05]	[0.02]	[0.03]	[0.02]
MOFF_LMI	-0.11***	-0.11	-0.22***	0.12*	0.48***	0.13	-0.19***	-0.27***	0.17***
	[0.04]	[0.08]	[0.05]	[0.07]	[0.1]	[0.1]	[0.04]	[0.07]	[0.05]
SOFF_HI	-0.051*	0.21***	0.022	-0.17***	-0.029	-0.053	-0.045	0.067	0.052
	[0.03]	[0.06]	[0.03]	[0.05]	[0.08]	[0.07]	[0.03]	[0.05]	[0.04]
SOFF_LMI	0.0055	-0.029**	-0.0048	0.0057	0.046**	-0.042**	0.0086	0.015	-0.0052
	[0.007]	[0.01]	[0.008]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.009]
ICT	0.026***	-0.050***	0.014*	0.047***	-0.035*	-0.059***	0.020**	0.073***	-0.037***
	[0.007]	[0.01]	[0.008]	[0.01]	[0.02]	[0.02]	[0.008]	[0.01]	[0.010]
LPROD	-0.0025	-0.0053	0.0045	-0.00086	-0.029***	0.010	0.013***	0.0043	0.0048
	[0.002]	[0.005]	[0.003]	[0.004]	[0.007]	[0.006]	[0.003]	[0.004]	[0.003]
Obs					2525				
R^2	0.141	0.510	0.287	0.666	0.206	0.446	0.514	0.516	0.059
Own-wage elasticity	-0.583	-0.759	-0.285	-0.525	-0.738	-1.436	-1.109	-0.704	-0.682
Hansen J statistic					1010.3				
Instruments	First and second lags of all explanatory variables								
	First and second lags of material and service offshoring of France, Ireland and Sweden								

Notes: Iterated Three-Stages Least Squares (I3SLS) with asymptotic standard errors in square brackets. All variables are deviated from their country-industry mean values. Time-specific fixed effects included. All explanatory variables treated as endogenous. For the description of the variables, see Table D1. HI (LMI): countries classified as high-income (upper-middle-income, lower-middle-income and low-income) for at least half of the period 1995–2005 by the World Bank's Historical Country Classification By Income. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 7: Alternative normalisation and alternative country classification

Panel A: Offshoring to high-income and low/middle-income countries countries normalised by gross output									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_Y_HI	0.067**	0.21***	0.16***	0.0044	-0.45***	0.20**	0.0055	-0.16***	-0.041
	[0.03]	[0.07]	[0.03]	[0.05]	[0.09]	[0.08]	[0.03]	[0.06]	[0.04]
MOFF_Y_LMI	-0.17***	-0.28**	-0.32***	0.21*	0.72***	0.17	-0.23***	-0.35***	0.26***
	[0.06]	[0.1]	[0.07]	[0.1]	[0.2]	[0.2]	[0.06]	[0.1]	[0.08]
SOFF_Y_HI	-0.024	0.38***	-0.060	-0.24***	0.32**	-0.22	-0.28***	0.046	0.086
	[0.05]	[0.1]	[0.06]	[0.09]	[0.1]	[0.1]	[0.05]	[0.09]	[0.07]
SOFF_Y_LMI	0.17*	-0.52**	-0.11	0.14	0.99***	-0.50*	-0.14	0.074	-0.11
	[0.10]	[0.2]	[0.1]	[0.2]	[0.3]	[0.3]	[0.1]	[0.2]	[0.1]
ICT	0.028***	-0.063***	0.010	0.050***	-0.032	-0.059***	0.027***	0.073***	-0.035***
	[0.007]	[0.02]	[0.008]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.010]
Obs					2535				
R^2	0.114	0.461	0.337	0.659	0.226	0.439	0.541	0.531	0.022
Own-wage elasticity	-0.499	-0.734	-0.272	-0.483	-0.508	-1.469	-1.190	-0.718	-0.692
Hansen J statistic					970.4				
Instruments	First and second lags of all explanatory variables								
	First and second lags of material and service offshoring of France, Ireland and Sweden normalised by gross output								
Panel B: Offshoring to high- and low/middle-income countries (alternative country classification)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI2	0.024	0.080**	0.11***	0.036	-0.23***	0.096**	-0.017	-0.064**	-0.033
	[0.02]	[0.04]	[0.02]	[0.03]	[0.05]	[0.05]	[0.02]	[0.03]	[0.02]
MOFF_LMI2	-0.12***	-0.14*	-0.18***	0.13*	0.24**	0.25**	-0.11***	-0.26***	0.21***
	[0.04]	[0.08]	[0.04]	[0.07]	[0.1]	[0.1]	[0.04]	[0.07]	[0.05]
SOFF_HI2	-0.048*	0.24***	-0.0098	-0.17***	0.089	-0.11	-0.100***	0.054	0.054
	[0.03]	[0.05]	[0.03]	[0.04]	[0.07]	[0.07]	[0.03]	[0.05]	[0.03]
SOFF_LMI2	0.0038	-0.035**	0.00053	0.0056	0.021	-0.030*	0.020***	0.018	-0.0033
	[0.006]	[0.01]	[0.007]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.009]
ICT	0.025***	-0.054***	0.014*	0.045***	-0.033*	-0.065***	0.026***	0.078***	-0.035***
	[0.007]	[0.01]	[0.008]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.010]
Obs					2525				
R^2	0.128	0.479	0.294	0.668	0.253	0.423	0.540	0.510	0.019
Own-wage elasticity	-0.599	-0.883	-0.291	-0.508	-0.637	-1.474	-1.182	-0.729	-0.683
Hansen J statistic					974.6				
Instruments	First and second lags of all explanatory variables								
	First and second lags of material and service offshoring of France, Ireland and Sweden (alternative country classification)								

Notes: Iterated Three-Stages Least Squares (I3SLS) with asymptotic standard errors in square brackets. All variables are deviated from their country-industry mean values. Time-specific fixed effects included. All explanatory variables treated as endogenous. For the description of the variables, see Table D1. HI (LMI): countries classified as high-income (upper-middle-income, lower-middle-income and low-income) for at least half of the period 1995–2005 by the World Bank's Historical Country Classification By Income. HI2 (LMI2): countries classified in 1995 as high-income (upper-middle-income, lower-middle-income and low-income) by the World Bank's Historical Country Classification By Income. *** significant at 1%, ** significant at 5%, * significant at 10%.

Online Appendix

A Additional descriptive statistics

Table A1: Mean values of wage bill shares, employment shares, and hourly wages by country

Panel A: Mean values of wage bill shares during 1995–2005									
Country		15–29			30–49			50+	
	HS	MS	LS	HS	MS	LS	HS	MS	LS
Australia	0.029	0.087	0.102	0.084	0.268	0.228	0.027	0.087	0.089
Austria	0.007	0.189	0.054	0.051	0.410	0.100	0.021	0.127	0.042
Belgium	0.023	0.121	0.066	0.104	0.267	0.246	0.037	0.062	0.075
Denmark	0.006	0.118	0.066	0.040	0.371	0.161	0.010	0.148	0.079
Finland	0.036	0.091	0.023	0.217	0.259	0.138	0.072	0.068	0.096
Germany	0.008	0.092	0.036	0.097	0.413	0.124	0.030	0.151	0.049
Italy	0.004	0.275	0.001	0.025	0.650	0.004	0.002	0.036	0.002
Japan	0.036	0.123	0.006	0.143	0.302	0.060	0.057	0.168	0.103
Netherlands	0.009	0.160	0.015	0.062	0.488	0.051	0.016	0.173	0.026
Spain	0.026	0.081	0.104	0.096	0.158	0.286	0.038	0.044	0.167
United Kingdom	0.031	0.167	0.032	0.098	0.364	0.085	0.028	0.140	0.055
United States	0.078	0.162	0.025	0.212	0.334	0.044	0.048	0.078	0.019
Panel B: Mean values of employment shares during 1995–2005									
Country		15–29			30–49			50+	
	HS	MS	LS	HS	MS	LS	HS	MS	LS
Australia	0.026	0.099	0.151	0.056	0.237	0.246	0.016	0.076	0.092
Austria	0.006	0.199	0.093	0.034	0.380	0.120	0.008	0.112	0.048
Belgium	0.020	0.147	0.087	0.057	0.254	0.281	0.015	0.052	0.088
Denmark	0.007	0.133	0.132	0.023	0.317	0.168	0.005	0.129	0.086
Finland	0.042	0.130	0.040	0.157	0.269	0.148	0.043	0.069	0.103
Germany	0.006	0.111	0.078	0.054	0.387	0.149	0.015	0.136	0.064
Italy	0.004	0.313	0.001	0.020	0.585	0.008	0.002	0.061	0.004
Japan	0.043	0.182	0.010	0.097	0.304	0.067	0.028	0.154	0.115
Netherlands	0.008	0.214	0.026	0.033	0.465	0.069	0.007	0.145	0.032
Spain	0.026	0.101	0.166	0.052	0.134	0.321	0.015	0.028	0.158
United Kingdom	0.026	0.223	0.046	0.052	0.333	0.107	0.014	0.126	0.073
United States	0.067	0.226	0.049	0.123	0.344	0.068	0.025	0.074	0.026
Panel C: Mean values of real hourly wages during 1995–2005									
Country		15–29			30–49			50+	
	HS	MS	LS	HS	MS	LS	HS	MS	LS
Australia	15.483	12.046	9.357	21.762	15.771	13.062	23.623	15.661	13.437
Austria	23.324	19.531	11.961	31.687	22.246	17.336	46.375	23.520	18.222
Belgium	34.179	23.848	20.605	53.569	30.023	23.939	61.026	32.206	22.147
Denmark	25.828	28.105	17.109	43.367	29.101	25.866	40.439	24.397	18.218
Finland	21.113	15.986	12.077	33.320	23.261	21.835	40.326	23.926	21.900
Germany	35.684	24.109	13.579	53.427	30.878	24.110	59.293	32.002	21.471
Italy	16.591	15.823	11.836	21.055	19.975	10.440	13.191	12.661	9.137
Japan	18.205	15.097	13.888	31.369	22.214	20.840	42.083	24.306	20.395
Netherlands	24.245	16.439	11.082	40.886	23.881	16.561	54.003	27.095	18.144
Spain	15.159	11.497	9.726	28.130	17.844	13.616	39.245	24.511	15.511
United Kingdom	27.379	16.208	11.936	47.095	24.285	17.414	48.104	24.185	16.095
United States	33.322	21.516	16.978	49.749	28.587	20.236	54.453	31.419	22.571

Notes: HS: high-skilled; MS: medium-skilled; LS: low-skilled. Real hourly wages are in US dollars.
Source: Author's calculations based on EU KLEMS.

Table A2: Percentage changes of wage bill shares, employment shares, and hourly wages by country

Panel A: Percentage changes of wage bill shares during 1995–2005									
Country		15–29			30–49			50+	
	HS	MS	LS	HS	MS	LS	HS	MS	LS
Australia	15.74	-32.66	-31.15	34.12	-2.11	-22.58	302.06	66.95	18.34
Austria	131.52	-30.50	-51.17	152.83	13.13	-30.26	69.11	36.12	-21.39
Belgium	-2.13	1.85	-78.06	75.04	96.93	-50.88	62.04	111.19	-21.76
Denmark	3.90	-47.92	-58.94	120.12	21.75	-19.74	95.07	51.47	-10.60
Finland	0.37	-33.60	-62.04	32.64	4.17	-65.62	193.23	206.18	-17.11
Germany	-3.13	-14.84	-35.52	47.48	0.53	-22.03	56.30	10.85	-13.29
Italy	48.33	-18.51	-68.40	28.26	11.67	-90.08	-18.51	-27.12	-77.28
Japan	0.87	-31.33	-70.87	40.98	6.94	-84.86	83.34	90.96	-35.72
Netherlands	94.39	-51.89	-76.48	123.10	10.17	-64.54	117.80	52.51	-25.37
Spain	113.32	0.51	-34.05	102.21	93.24	-46.63	143.70	140.12	-23.58
United Kingdom	63.69	-44.90	-88.17	192.32	27.04	-65.00	135.37	68.41	-38.60
United States	-7.11	-43.59	-45.86	67.15	-1.30	-41.59	104.05	28.79	-54.62
Panel B: Percentage changes of employment shares during 1995–2005									
Country		15–29			30–49			50+	
	HS	MS	LS	HS	MS	LS	HS	MS	LS
Australia	8.61	-24.57	-24.38	36.76	10.18	-20.43	281.01	63.41	21.35
Austria	163.31	-26.04	-45.25	173.70	20.93	-24.56	97.05	43.45	-14.01
Belgium	10.13	8.46	-75.17	89.22	115.84	-44.34	98.79	163.62	-2.95
Denmark	56.42	-39.64	-50.45	175.47	34.99	-15.24	114.79	68.27	-9.53
Finland	2.87	-22.69	-46.06	49.35	9.61	-63.70	229.47	236.88	-12.66
Germany	-5.09	-8.62	-32.06	29.26	6.14	-16.84	46.07	21.42	-3.87
Italy	57.76	-11.26	-59.02	31.00	9.29	-71.19	-6.46	-15.25	-51.85
Japan	14.55	-28.23	-70.85	62.60	19.46	-82.56	142.63	107.85	-36.96
Netherlands	109.02	-47.99	-68.28	137.58	23.19	-55.60	179.80	74.99	-16.05
Spain	172.41	7.11	-40.16	138.45	140.83	-29.58	93.75	178.62	-21.54
United Kingdom	106.68	-36.43	-78.71	201.90	45.65	-56.94	151.92	102.10	-28.31
United States	-1.24	-32.94	-33.50	59.25	15.14	-21.38	123.88	38.42	-44.72
Panel C: Percentage changes of real hourly wages during 1995–2005									
Country		15–29			30–49			50+	
	HS	MS	LS	HS	MS	LS	HS	MS	LS
Australia	0.36	18.99	-0.06	29.23	27.00	24.29	-43.97	39.92	20.38
Austria	-12.83	40.06	-37.15	21.29	54.85	5.20	53.20	45.59	28.37
Belgium	19.55	26.15	16.71	42.32	33.62	22.83	41.27	25.88	20.96
Denmark	-4.56	-9.99	15.37	5.73	33.15	29.61	164.61	85.89	102.07
Finland	40.37	7.41	-6.11	21.52	14.56	18.41	14.30	9.34	12.95
Germany	20.12	39.44	37.28	31.12	41.01	45.11	31.43	39.74	36.77
Italy	-18.31	-26.19	-31.44	-13.78	-7.81	-61.53	24.25	54.35	-67.54
Japan	85.54	108.61	106.15	80.98	76.78	70.63	61.55	88.02	95.67
Netherlands	42.38	35.38	3.51	50.18	49.23	49.72	55.95	44.71	49.15
Spain	-13.02	-0.82	12.50	-10.19	-13.96	-18.98	43.60	-6.55	8.10
United Kingdom	28.36	60.19	40.20	69.52	58.79	19.83	88.63	38.25	44.26
United States	83.29	29.37	7.97	72.61	39.50	18.88	76.42	46.57	40.95

Notes: HS: high-skilled; MS: medium-skilled; LS: low-skilled.
Source: Author's calculations based on EU KLEMS.

B First-stage results of I3SLS estimations in Table 4

Table B1: First-stage results of I3SLS estimations in Panel A of Table 4

Panel A: Relative wages								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
First-stage regressions	ln $W^{15-29,HS}$	ln $W^{15-29,MS}$	ln $W^{15-29,LS}$	ln $W^{30-49,HS}$	ln $W^{30-49,MS}$	ln $W^{30-49,LS}$	ln $W^{50+,HS}$	ln $W^{50+,MS}$
ln $W^{15-29,HS}$ (t-1)	0.452***							
	[0.032]							
ln $W^{15-29,HS}$ (t-2)	0.044							
	[0.031]							
ln $W^{15-29,MS}$ (t-1)		0.432***						
		[0.049]						
ln $W^{15-29,MS}$ (t-2)		-0.216***						
		[0.047]						
ln $W^{15-29,LS}$ (t-1)			0.367***					
			[0.021]					
ln $W^{15-29,LS}$ (t-2)			0.08***					
			[0.019]					
ln $W^{30-49,HS}$ (t-1)				0.19***				
				[0.037]				
ln $W^{30-49,HS}$ (t-2)				0.132***				
				[0.038]				
ln $W^{30-49,MS}$ (t-1)					0.213***			
					[0.059]			
ln $W^{30-49,MS}$ (t-2)					0.429***			
					[0.068]			
ln $W^{30-49,LS}$ (t-1)						0.301***		
						[0.018]		
ln $W^{30-49,LS}$ (t-2)						0.127***		
						[0.018]		
ln $W^{50+,HS}$ (t-1)							0.624***	
							[0.029]	
ln $W^{50+,HS}$ (t-2)							-0.168***	
							[0.027]	
ln $W^{50+,MS}$ (t-1)								0.419***
								[0.048]
ln $W^{50+,MS}$ (t-2)								-0.263***
								[0.047]
F-statistic	49.62	70.67	29.18	34.82	65.78	42.43	42.41	61.76
F-statistic (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.48	0.57	0.349	0.391	0.552	0.441	0.441	0.536
Panel B: Capital, output, material and service offshoring, proxy for technological change								
First-stage regressions	K	Y	MOFF_HI	MOFF_LMI	SOFF_HI	SOFF_LMI	ICT	
K (t-1)	0.028***							
	[0.006]							
K (t-2)	-0.027***							
	[0.004]							
Y (t-1)		0.091***						
		[0.009]						
Y (t-2)		0.01						
		[0.007]						
MOFF_HI (t-1)			0.252***					
			[0.017]					
MOFF_HI (t-2)			-0.096***					
			[0.015]					
oc_MOFF_HI (t-1)			-0.162***					
			[0.026]					
oc_MOFF_HI (t-2)			0.101***					
			[0.024]					
MOFF_LMI (t-1)				0.261***				
				[0.02]				
MOFF_LMI (t-2)				0.124***				
				[0.02]				
oc_MOFF_LMI (t-1)				0.432***				
				[0.091]				
oc_MOFF_LMI (t-2)				0.09				
				[0.121]				

First-stage results of I3SLS estimations in Panel A of Table 4 (continued)

First-stage regressions	K	Y	MOFF_HI	MOFF_LMI	SOFF_HI	SOFF_LMI	ICT
SOFF_HI (t-1)					0.538***		
					[0.02]		
SOFF_HI (t-2)					-0.038**		
					[0.018]		
oc_SOFF_HI (t-1)					-0.13***		
					[0.025]		
oc_SOFF_HI (t-2)					0.019		
					[0.023]		
SOFF_LMI (t-1)						0.483***	
						[0.017]	
SOFF_LMI (t-2)						0.083***	
						[0.018]	
oc_SOFF_LMI (t-1)						-0.351***	
						[0.036]	
oc_SOFF_LMI (t-2)						0.194***	
						[0.034]	
ICT (t-1)							0.33***
							[0.019]
ICT (t-2)							-0.028
							[0.017]
F-statistic	21.37	66.92	17.18	58.99	52.64	62.06	12.82
F-statistic (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.279	0.556	0.235	0.525	0.496	0.537	0.184

Notes: First-stage results of Iterated Three-Stages Least Squares (I3SLS) with country-industry and time fixed effects. For the description of the variables, see Table D1. HI (LMI): countries classified as high-income (upper-middle-income, lower-middle-income and low-income) for at least half of the period 1995–2005 by the World Bank's Historical Country Classification By Income. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table B2: First-stage results of I3SLS estimations in Panel B of Table 4

	(1)	(2)	(3)	(4)	(5)
First-stage regressions	MOFF_HI	MOFF_LMI	SOFF_HI	SOFF_LMI	ICT
MOFF_HI (t-1)	0.195***				
	[0.015]				
MOFF_HI (t-2)	-0.093***				
	[0.012]				
oc_MOFF_HI (t-1)	-0.136***				
	[0.026]				
oc_MOFF_HI (t-2)	0.113***				
	[0.023]				
MOFF_LMI (t-1)		0.272***			
		[0.02]			
MOFF_LMI (t-2)		0.125***			
		[0.02]			
oc_MOFF_LMI (t-1)		0.427***			
		[0.092]			
oc_MOFF_LMI (t-2)		0.03			
		[0.121]			
SOFF_HI (t-1)			0.51***		
			[0.019]		
SOFF_HI (t-2)			-0.03*		
			[0.017]		
oc_SOFF_HI (t-1)			-0.108***		
			[0.025]		
oc_SOFF_HI (t-2)			0.012		
			[0.023]		
SOFF_LMI (t-1)				0.479***	
				[0.017]	
SOFF_LMI (t-2)				0.083***	
				[0.018]	
oc_SOFF_LMI (t-1)				-0.344***	
				[0.036]	
oc_SOFF_LMI (t-2)				0.188***	
				[0.033]	
ICT (t-1)					0.32***
					[0.018]
ICT (t-2)					-0.033**
					[0.017]
F-statistic	17.70	72.84	62.88	77.40	17.44
F-statistic (p-value)	0.000	0.000	0.000	0.000	0.000
R^2	0.2	0.52	0.482	0.535	0.198

Notes: First-stage results of Iterated Three-Stages Least Squares (I3SLS) with country-industry and time fixed effects. For the description of the variables, see Table D1. HI (LMI): countries classified as high-income (upper-middle-income, lower-middle-income and low-income) for at least half of the period 1995–2005 by the World Bank's Historical Country Classification By Income. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table B3: First-stage results of I3SLS estimations in Panel C of Table 4

First-stage regressions	(1) MOFF_HI	(2) MOFF_LMI	(3) SOFF_HI	(4) SOFF_LMI	(5) ICT
MOFF_HI (t-1)	0.125***				
	[0.011]				
oc_MOFF_HI (t-1)	-0.055***				
	[0.019]				
MOFF_LMI (t-1)		0.338***			
		[0.018]			
oc_MOFF_LMI (t-1)		0.494***			
		[0.038]			
SOFF_HI (t-1)			0.488***		
			[0.013]		
oc_SOFF_HI (t-1)			-0.1***		
			[0.015]		
SOFF_LMI (t-1)				0.532***	
				[0.012]	
oc_SOFF_LMI (t-1)				-0.169***	
				[0.0234]	
ICT (t-1)					-0.003
					[0.007]
F-statistic	18.46	90.45	81.32	94.46	22.13
F-statistic (p-value)	0.000	0.000	0.000	0.000	0.000
R^2	0.167	0.507	0.48	0.519	0.195

Notes: First-stage results of Iterated Three-Stages Least Squares (I3SLS) with country-industry and time fixed effects. For the description of the variables, see Table D1. HI (LMI): countries classified as high-income (upper-middle-income, lower-middle-income and low-income) for at least half of the period 1995–2005 by the World Bank's Historical Country Classification By Income. *** significant at 1%, ** significant at 5%, * significant at 10%.

C Additional empirical results

Table C1: Offshoring and wage bill shares (additional results)

Panel A: All explanatory variables treated as endogenous									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI	0.016	0.057*	0.093***	0.0077	-0.17***	0.073*	0.0025	-0.037	-0.043**
	[0.02]	[0.03]	[0.02]	[0.03]	[0.04]	[0.04]	[0.02]	[0.03]	[0.02]
MOFF_LMI	-0.14***	-0.11	-0.19***	0.052	0.29***	0.14	-0.093**	-0.16**	0.20***
	[0.04]	[0.08]	[0.04]	[0.06]	[0.1]	[0.09]	[0.04]	[0.07]	[0.05]
SOFF_HI	-0.055**	0.22***	-0.011	-0.18***	0.11*	-0.094	-0.089***	0.037	0.054*
	[0.02]	[0.05]	[0.03]	[0.04]	[0.07]	[0.06]	[0.03]	[0.04]	[0.03]
SOFF_LMI	0.0047	-0.030**	0.0037	0.0099	0.012	-0.027*	0.015**	0.014	-0.0022
	[0.006]	[0.01]	[0.007]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.009]
ICT	0.023***	-0.062***	0.014*	0.048***	-0.028	-0.058***	0.028***	0.071***	-0.035***
	[0.007]	[0.01]	[0.008]	[0.01]	[0.02]	[0.02]	[0.007]	[0.01]	[0.009]
Obs					2525				
R^2	0.125	0.494	0.309	0.659	0.258	0.449	0.542	0.527	0.035
Own-wage elasticity	-0.655	-0.856	-0.259	-0.526	-0.599	-1.433	-1.182	-0.788	-0.697
Hansen J statistic					1083				
Instruments	First and second lags of all explanatory variables								
	First and second lags of material and service offshoring of France, Ireland and Sweden								
	Current values of material and service offshoring of France, Ireland and Sweden								
Panel B: All explanatory variables treated as exogenous (ISUR estimations)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var: Wsh	(15–29,HS)	(15–29,MS)	(15–29,LS)	(30–49,HS)	(30–49,MS)	(30–49,LS)	(50+,HS)	(50+,MS)	(50+,LS)
MOFF_HI	0.017***	0.050***	0.051***	0.049***	-0.14***	0.083***	0.0049	-0.065***	-0.051***
	[0.006]	[0.01]	[0.006]	[0.01]	[0.02]	[0.01]	[0.007]	[0.01]	[0.008]
MOFF_LMI	-0.046***	0.066*	-0.036**	0.055*	0.049	-0.023	0.0016	-0.11***	0.041*
	[0.02]	[0.03]	[0.02]	[0.03]	[0.05]	[0.04]	[0.02]	[0.03]	[0.02]
SOFF_HI	-0.030**	0.12***	0.023*	-0.075***	0.11***	-0.039	-0.064***	-0.0011	-0.051***
	[0.01]	[0.02]	[0.01]	[0.02]	[0.03]	[0.03]	[0.01]	[0.02]	[0.02]
SOFF_LMI	-0.0037	-0.023***	-0.0089**	-0.0032	0.012	-0.028***	0.012***	0.028***	0.016***
	[0.004]	[0.008]	[0.004]	[0.007]	[0.01]	[0.010]	[0.004]	[0.007]	[0.005]
ICT	0.0074***	-0.027***	0.0012	0.016***	0.0036	-0.011*	0.0098***	0.014***	-0.014***
	[0.002]	[0.005]	[0.003]	[0.004]	[0.007]	[0.006]	[0.003]	[0.004]	[0.003]
Obs					2525				
R^2	0.215	0.570	0.477	0.691	0.310	0.561	0.573	0.620	0.213
Own-wage elasticity	-0.441	-0.629	-0.410	-0.425	-0.456	-1.241	-1.185	-0.785	-0.345

Notes: Iterated Three-Stages Least Squares (I3SLS) with asymptotic standard errors in square brackets in Panels A and C. Iterated Seemingly Unrelated Regressions (ISUR) with asymptotic standard errors in square brackets in Panel B. All variables are deviated from their country-industry mean values. Time-specific fixed effects included. For the description of the variables, see Table D1. HI (LMI): countries classified as high-income (upper-middle-income, lower-middle-income and low-income) for at least half of the period 1995–2005 by the World Bank's Historical Country Classification By Income. *** significant at 1%, ** significant at 5%, * significant at 10%.

D Description of variables

Table D1: Description of variables

Variable	Description	Source
$\text{Wsh}^{15--29,HS}$	Wage bill share of high-skilled workers aged 15–29	EU KLEMS
$\text{Wsh}^{15-29,MS}$	Wage bill share of medium-skilled workers aged 15–29	EU KLEMS
$\text{Wsh}^{15-29,LS}$	Wage bill share of low-skilled workers aged 15–29	EU KLEMS
$\text{Wsh}^{30-49,HS}$	Wage bill share of high-skilled workers aged 30–49	EU KLEMS
$\text{Wsh}^{30-49,MS}$	Wage bill share of medium-skilled workers aged 30–49	EU KLEMS
$\text{Wsh}^{30-49,LS}$	Wage bill share of low-skilled workers aged 30–49	EU KLEMS
$\text{Wsh}^{50+,HS}$	Wage bill share of high-skilled workers aged 50 and over	EU KLEMS
$\text{Wsh}^{50+,MS}$	Wage bill share of medium-skilled workers aged 50 and over	EU KLEMS
$\text{Wsh}^{50+,LS}$	Wage bill share of low-skilled workers aged 50 and over	EU KLEMS
$\text{Esh}^{15-29,HS}$	Employment share of high-skilled workers aged 15–29	EU KLEMS
$\text{Esh}^{15-29,MS}$	Employment share of medium-skilled workers aged 15–29	EU KLEMS
$\text{Esh}^{15-29,LS}$	Employment share of low-skilled workers aged 15–29	EU KLEMS
$\text{Esh}^{30-49,HS}$	Employment share of high-skilled workers aged 30–49	EU KLEMS
$\text{Esh}^{30-49,MS}$	Employment share of medium-skilled workers aged 30–49	EU KLEMS
$\text{Esh}^{30-49,LS}$	Employment share of low-skilled workers aged 30–49	EU KLEMS
$\text{Esh}^{50+,HS}$	Employment share of high-skilled workers aged 50 and over	EU KLEMS
$\text{Esh}^{50+,MS}$	Employment share of medium-skilled workers aged 50 and over	EU KLEMS
$\text{Esh}^{50+,LS}$	Employment share of low-skilled workers aged 50 and over	EU KLEMS
$\text{W}^{15-29,HS}$	Real hourly wage of high-skilled workers aged 15–29	EU KLEMS
$\text{W}^{15-29,MS}$	Real hourly wage of medium-skilled workers aged 15–29	EU KLEMS
$\text{W}^{15-29,LS}$	Real hourly wage of low-skilled workers aged 15–29	EU KLEMS
$\text{W}^{30-49,HS}$	Real hourly wage of high-skilled workers aged 30–49	EU KLEMS
$\text{W}^{30-49,MS}$	Real hourly wage of medium-skilled workers aged 30–49	EU KLEMS
$\text{W}^{30-49,LS}$	Real hourly wage of low-skilled workers aged 30–49	EU KLEMS
$\text{W}^{50+,HS}$	Real hourly wage of high-skilled workers aged 50 and over	EU KLEMS
$\text{W}^{50+,MS}$	Real hourly wage of medium-skilled workers aged 50 and over	EU KLEMS
$\text{W}^{50+,LS}$	Real hourly wage of low-skilled workers aged 50 and over	EU KLEMS
Y	Gross output	EU KLEMS
K	Capital	EU KLEMS and OECD STAN
MOFF	Share of imported material inputs from all countries available in total purchases of non-energy material and service inputs	WIOD and EU KLEMS
SOFF	Share of imported service inputs from all countries available in total purchases of non-energy material and service inputs	WIOD and EU KLEMS
MOFF_HI	Share of imported material inputs from high-income countries in total purchases of non-energy material and service inputs	WIOD and EU KLEMS
SOFF_HI	Share of imported service inputs from high-income countries in total purchases of non-energy material and service inputs	WIOD and EU KLEMS
MOFF_LMI	Share of imported material inputs from low/middle-income countries in total purchases of non-energy material and service inputs	WIOD and EU KLEMS
SOFF_LMI	Share of imported service inputs from low/middle-income countries in total purchases of non-energy material and service inputs	WIOD and EU KLEMS
MOFF_Y_HI	Share of imported material inputs from high-income countries in gross output	WIOD and EU KLEMS
SOFF_Y_HI	Share of imported service inputs from high-income countries in gross output	WIOD and EU KLEMS
MOFF_Y_LMI	Share of imported material inputs from low/middle-income countries in gross output	WIOD and EU KLEMS
SOFF_Y_LMI	Share of imported service inputs from low/middle-income countries in gross output	WIOD and EU KLEMS
MOFF_HI2	Share of imported material inputs from high-income countries in total purchases of non-energy material and service inputs (alternative country classification)	WIOD and EU KLEMS
SOFF_HI2	Share of imported service inputs from high-income countries in total purchases of non-energy material and service inputs (alternative country classification)	WIOD and EU KLEMS
MOFF_LMI2	Share of imported material inputs from low/middle-income countries in total purchases of non-energy material and service inputs (alternative country classification)	WIOD and EU KLEMS
SOFF_LMI2	Share of imported service inputs from low/middle-income countries in total purchases of non-energy material and service inputs (alternative country classification)	WIOD and EU KLEMS

Description of variables (continued)

Variable	Description	Source
oc_MOFF_HI	Share of imported material inputs of France, Ireland and Sweden from high-income countries (except for the 12 countries in the benchmark sample) in total purchases of non-energy material and service inputs	WIOD and EU KLEMS
oc_SOFF_HI	Share of imported service inputs of France, Ireland and Sweden from high-income countries (except for the 12 countries in the benchmark sample) in total purchases of non-energy material and service inputs	WIOD and EU KLEMS
oc_MOFF_LMI	Share of imported material inputs of France, Ireland and Sweden from low/middle-income countries in total purchases of non-energy material and service inputs	WIOD and EU KLEMS
oc_SOFF_LMI	Share of imported service inputs of France, Ireland and Sweden from low/middle-income countries in total purchases of non-energy material and service inputs	WIOD and EU KLEMS
ICT	Share of investment in Information and Communication Technologies in total capital investment	EU KLEMS
EPL	Index of employment protection legislation strictness	OECD
MPEN	Imports of final goods divided by the difference of exports of final goods from the sum of gross output and imports of final goods	OECD BTDIxE
UD	Share of union members in total employment	OECD
IIM_EMP	Share of intermediate material inputs in total hours worked	EU KLEMS
IIS_EMP	Share of intermediate service inputs in total hours worked	EU KLEMS
LPROD	Share of value added in total hours worked	EU KLEMS

Notes: Author's notation.