Global value chains and the effects of outsourcing and offshoring on firms: Evidence from matched firm-employee data

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November 2015

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This paper studies the effects of outsourcing and offshoring on the skill structure of firms. The study verifies whether controlling for both activities in one model alters previous empirical studies, which controlled only for one factor in their models; whether controlling for destination country of outsourcing and offshoring brings new insights; and whether controlling for occupational level of workers when defining skills brings additional contribution to the results. Regarding the latter, besides the conventional approach for defining skills, i.e. the educational level, skills are also defined by three major occupational groups; Managers, Professionals and Technicians. To empirically estimate the abovementioned hypotheses, a matched employer-employee dataset for Slovenian manufacturing and service firms during 1997 to 2010, and the methods for panel data analysis were used. Results of the model on average show a positive impact of offshoring on the skill share of firms, while the results for outsourcing are uncommon. When controlling for high- and low-income countries, the results for manufacturing firms show a positive and similar effect of offshoring to both groups of countries on the share of skilled employees. In service firms, results show a weaker impact of offshoring to high-income countries on the relative employment of skilled, compared to offshoring to low-income countries. When taking into account also occupational levels for defining skills, the results show that the impact of education differs between occupational groups, indicating that firms differentiate between more and less educated individuals within the same occupational group.

Keywords: offshoring, outsourcing, skill structure of firms.

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1 Introduction

Globalisation has changed the world dramatically in the most recent decades. According to International Monetary Fund (IMF), trade liberalization and technology improvements led to lower trade barriers and to the drop of transportation and communication costs (IMF, 2013). In line with these changes, transnational companies (TNCs) change and adjust the structure and organization of their value added activities, where offshoring and outsourcing are among their main methods of strategic positioning. Forecasts on increasing internationalization specify that firms will carry out even more of their activities outside of their enterprises in the future; for instance through increasing foreign direct investment (FDI) flows, or through increasing foreign affiliate activity (UNCTAD, 2013).

By evaluating the effect of offshoring and outsourcing on the skill structure of firms, empirical studies confirm an important impact of offshoring and outsourcing on the skill structure of firms in developed countries. On average, studies conclude that offshoring and outsourcing have a positive impact on employment of skilled labour. Among these are for example Mion and Zhu (2013), studying the effects of Chinese imports on Belgian manufacturing firms, Hijzen et al. (2005), studying the UK market, Strauss-Kahn (2003), studying French manufacturing industries, Egger and Egger (2003), studying the impact of trade liberalization between Western and Eastern Europe, where the country of interest is Austria, and Feenstra and Hanson (1996), studying the United States labour market. Feenstra and Hanson (1996) demonstrate that increased import competition from low-wage countries presents an important channel which transfers labour demand towards more skilled workers. Hijzen et al. (2005) explain this is a consequence of relocating the unskilled labour-intensive production to countries, abundant with unskilled labour, whereas high-technology stages of productions continue to be produced in developed countries.

The motivation for this paper draws upon the forecasts, made by UNCTAD, which assign an even greater role to offshoring and outsourcing activities in the future, and by adding to the existing evidence on the effects of outsourcing and offshoring on the labour market. First aim of the paper is to include both measures of strategic positioning of firms, outsourcing and offshoring, in one model and to test whether their positive effect on the relative employment of skilled is present

also when accounting for both factors in one model. To the best of my knowledge, previous empirical studies took into account only one of the measures in the models at a time. However, since separate models of the previous studies confirmed the positive impact of offshoring and outsourcing on the labour demand, and since both are expected to increase in the future, I believe it is important to account for both aspects in one model.

Second aim is to test whether offshoring and outsourcing from high-income countries have a different impact on the skill share of firms as compared to offshoring and outsourcing from low-income countries. It is important to make this distinction since aforementioned studies indicate shifts of unskilled-intensive parts of production to countries, abundant with relatively less skilled labour. Therefore, it is essential to account for the destination country of outsourcing and offshoring, as this enables new interpretation of results and controls for potential differences of partner's performance. Regarding the abovementioned studies, one would expect that outsourcing from high-income countries and offshoring to low-income countries would have a positive impact on the relative employment of skilled workers. The reasoning behind this claim is that outsourcing from high-income countries enables firms to have an access to technologically more advanced intermediate inputs, which in turn demand employment of highly skilled workers. On the other hand, offshoring to low-income countries is expected to shift some of the more manually-intensive parts of production abroad and to keep the high value added departments in domestic country (as for example research, sales, marketing, finance, etc.).

Final aim is to test the robustness of these results to a more detailed definition of skills, which takes into account also occupational classification of workers and not only the level of their formal education. It is important to test this since workers gain their skills not only by formal education but also through various forms of vocational trainings and throughout their working career. One would expect that taking into consideration also occupational classification when defining skills should further increase the explanatory power of the model.

To sum up, the empirical analysis addresses the following hypotheses: (i) controlling for both phenomena – offshoring and outsourcing – in one model alters previous empirical studies, which control only for one factor in their model; (ii) controlling for destination country of outsourcing and offshoring brings new insights to the results; and (iii) controlling for occupational level of workers when defining skills brings additional contribution to the results of the paper.

To assess the effects of outsourcing and offshoring on the skill structure of firms, a matched firm-employee panel dataset for Slovenian firms in the period from 1997 to 2010 is used. Empirical analysis is split in two parts. The basic model analyses

the impact of offshoring and outsourcing on the skill structure of firms, using a conventional definition of skilled workers, which defines skills only by the level of formal education. In the model extensions, the analysis first differentiates between offshoring to and outsourcing from high- and low-income countries. Additional extension of the model introduces a novel definition of skills, which takes into account not only formal educational level of workers but also their occupational classification. Taking into account statistically significant results, I find that offshoring has a positive impact on the relative employment of tertiary educated workers in manufacturing firms, while the results for outsourcing are uncommon. When controlling also for the income height of countries, offshoring to low- and high-income countries shows a similar and positive impact on the relative employment of skilled in manufacturing firms. Furthermore, when controlling also for occupational level when defining skills, results indicate that offshoring to high-income countries has a stronger impact on the relative employment of Professionals in manufacturing firms than offshoring to low-income countries. On the other hand, results for service firms show that offshoring to high-income countries has a weaker impact on the relative employment of Technicians, compared to offshoring to low-income countries. When combining both definitions of skilled; i.e. educational and occupational level, the results for manufacturing firms do not change significantly, while the results in service firms show that offshoring to low- and high-income countries has a similar and positive impact on the relative employment of tertiary educated Managers. The results for outsourcing are on average not statistically significant. The impact of education therefore differs between occupational groups, indicating that firms differentiate between employing different workers within the same occupational group, which is true especially for Managers in service firms. In addition, this also confirms that firms have greater incentives for hiring more educated workers.

The remainder of the paper is organised as follows. In the next section, a brief summary of the relevant literature is given. Section three introduces the methodology used in the empirical part, whereas section four describes the data and presents descriptive statistics. The empirical analysis and discussion of results are included in section five. The last section summarises and concludes.

2 Literature review

Literature review starts with a brief discussion on the theoretical models, which explore effects of outsourcing and offshoring on the labour demand. Grossman and Rossi-Hansberg (2008) developed a theoretical model that studies the impacts of the falling costs of offshoring on the factor prices in the home country. Authors

differentiate between trade in goods, which is the conventional meaning of trade, and trade in tasks, which relates to adding a value to goods in different locations. The model concludes that offshoring influences firms' performance positively, since it allows them to hire some factors abroad at a lower price. On the other hand, offshoring also brings costs as the monitoring and management of workers is hindered due to long distances. In the model, authors take into account the effects of trade in tasks, by controlling also for skilled workers. Their model indicates that trade in tasks gives rise to shared gains for all domestic factors (Grossman, & Rossi-Hansberg, 2008).

Another theoretical model was formed by Mitra and Ranjan (2009), who study the relation between offshoring and unemployment, where they define offshoring as the sourcing of inputs from foreign countries. The model differentiates between two situations; one is when the labour is perfectly mobile and another when this is not the case. In the case of perfect labour mobility, offshoring causes wages to increase and unemployment to decrease, whereas in the case of imperfect labour mobility, there is a possibility for unemployment to increase in the offshoring sector, but at the same time, the unemployment decreases in the other sector.

Finally, Egger and Egger (2003) developed a theoretical model, in which they focus on a small country case, treated as home country, which produces industrialized good and has a possibility to outsource a low-skilled part of its production to low-wage foreign countries. Results indicate that outsourcing increases with the decrease of trade barriers. In a competitive labour market framework, outsourcing increases relative wages of high-skilled labour, while it does not affect relative employment. However, in a unionized framework, outsourcing increases both, relative wages and relative employment of high-skilled labour in the domestic country.

Compared to rather scarce theoretical analyses on the effects of outsourcing and offshoring on the labour market, empirical studies are more abundant. Feenstra and Hanson (1996, 1999) analyse the impact of outsourcing in the United States. Results of their earlier paper point to an increase of the relative demand for skilled labour due to increased outsourcing. However, the result does not hold for all time periods (Feenstra, & Hanson, 1996). In their later paper, Feenstra and Hanson (1999) focus on comparing the effects of outsourcing and technology on wages. They conclude that both phenomena impact the relative wages of non-production workers positively, where the impact of technology is larger, compared to outsourcing activities (Feenstra, & Hanson, 1999).

Amiti and Wei (2005a, 2005b) explore the effects of service outsourcing and offshoring in the UK and US, respectively. For the UK market, the authors find that job growth and outsourcing are not negatively correlated at the sectorial level

(Amiti, & Wei, 2005a), whereas for the US market, the authors find a positive effect of offshoring on productivity, while the effect on employment differs according to the disaggregation of industries. More precisely, when industries are finely disaggregated, the results point to a negative effect. On the other hand, when industries are defined on a broader level, the negative effect disappears. This leads to a conclusion that, although offshoring might affect employment negatively within industries, dismissed workers renew their employment in other growing industries (Amiti, & Wei, 2005b).

Hijzen et al. (2005) also examine the effects of outsourcing on the UK labour market. Results indicate that outsourcing affects the demand for unskilled labour negatively and together with technological change leads to changes in the skill structure of manufacturing industries (Hijzen et al., 2005). Parallel conclusions on the effect of increased outsourcing were made by Strauss-Kahn (2003), who concludes that outsourcing influences the relative employment of unskilled workers in French manufacturing industries negatively. In addition, Egger and Egger (2003) empirically tested the effect of outsourcing in Austria, as a consequence of trade liberalisation in the Central and Eastern Europe. Authors find that outsourcing increases relative employment of high-skilled labour (Egger, & Egger, 2003).

Furthermore, while Michel and Rycx (2009) find no major influence of materials or business services offshoring on the employment in Belgian firms, they highlight the importance of distinguishing between manufacturing and service industries. Traditionally, only manufacturing industries were related to offshoring, since their products are easily tradable. However, improvements in information and communication technologies had a significantly positive impact on offshoring in service industries (Michel, & Rycx, 2009). It is therefore important to compare the impact of outsourcing and offshoring in both, manufacturing and service firms. This was confirmed also by De Backer and Yamano (2012), who compare the increase of offshoring in different countries, where the analysis was done separately for manufacturing and service industries. Although offshoring increased in the observed period from 1995 to 2005 in both, manufacturing and service industries, the increase was on average bigger in the latter. Importing intermediates from abroad is however on average still more important in manufacturing industries (De Backer, & Yamano, 2012). Similar conclusions were made by Horgos (2006), using German data. Author concludes that outsourcing activities are concentrated in high-skilled manufacturing industries, while service industries show the highest increase of outsourcing activities (Horgos, 2006).

A noteworthy restraint of empirical studies, presented in previous paragraphs, is in the type of data used. The studies used data, disaggregated only at the industry

level and therefore could not control for firm-specific and individual-specific characteristics that may have an impact on the skill structure of firms. Moreover, identifying the labour demand curve is more challenging when using industry-level data (Hijzen, & Swaim, 2010). Since firm-level data became more accessible in the recent years, current studies estimate the effects of outsourcing and offshoring on the labour market also in terms of firm-level data.

Konings and Murphy (2006) evaluate substitution of workers between parents and their affiliates in European multinational enterprises. Due to the lack of information on the skill composition of workers, authors were not able to estimate the effect of outsourcing on the skill demand of workers, but were able to differentiate between regions with different wage costs. Contrary to the common beliefs, their results indicate to employment relocations between parent firms and their affiliates, both based in the North EU, but they find no significant employment flows between the parent and affiliates, based in the South EU, and Central and Eastern Europe (Konings and Murphy, 2006).

In another study using firm-level data, Biscourp and Kramarz (2007) differentiate between types of imports – imports of finished goods and imports of intermediate goods, which they define as offshoring. They find a strong and negative correlation between imports and job destruction, where this impact is especially strong for imports of finished goods, imports from low-wage countries and for larger firms. They also confirm some previous findings that these changes on average occur within firms. Controlling for innovation does not alter their result (Biscourp, & Kramarz, 2007). Furthermore, by estimating data on German manufacturing firms, Wagner (2011) confirms there is a self-selection of firms into offshoring. The analysis concludes that these firms are larger, more productive and more human capital intensive. Moreover, author also confirms some previous findings, which do not find a large negative effect of offshoring on employment (Wagner, 2011).

Focusing on trade liberalisation in China after its accession to the World Trade Organisation, Bloom et al. (2011) evaluate how this event affected technical change in European economies. They find technology improvements and productivity increases in industries, mostly affected by the increased Chinese competition, while the effect on labour demand and survival probability varies across firms. Specifically, although increased Chinese competition did not affect labour demand and survival probability in high-tech firms, they both decreased in low-tech firms. On the other hand, import competition from developed countries did not affect innovation (Bloom et al., 2011).

Mion and Zhu (2013) also studied the effects of Chinese imports, where their main interests were Belgian manufacturing firms and Belgian labour market. The

authors differentiate between imports of final and intermediate goods, and find that importing from China hurts firms in the low-tech industries. Contrary to Bloom et al. (2011) they find that import competition from China does not have a negative effect on the survival of Belgian manufacturing firms. On the whole, competition in the Belgian market has increased through increased Chinese competition and was followed by reduces in firm employment growth, and upgrades in technology and skill structure (Mion, & Zhu, 2013).

Similar conclusions were made by Lo Turco and Maggioni (2012), who focused on the effects of offshoring on the labour demand in Italian manufacturing firms, where they also differentiated between source countries. The authors conclude that importing intermediates from high-income countries does not affect employment, while the effects on the employment are negative when firms import intermediates from low-income countries.

Using Danish data and focusing on the effects of offshoring on wages, Hummels et al. (2014) find that offshoring has a positive impact on wages of skilled labour and a negative impact on the wages of unskilled labour.

To sum up the findings of presented studies in this section, liberalising trade with developing countries brings opportunities for cost reductions and technology improvements, while on the other hand it also presents threats to labour markets in the developed countries. However, the majority of studies conclude this threat is not large and is usually concentrated on the low-skilled employees. Also important is the emphasis made in several papers (see for example De Backer, & Yamano, 2012; Michel, & Rycx, 2009; and Horgos, 2006) on the significance of differentiating between manufacturing and service industries, as well as the importance of using firm-level data (Hijzen, & Swaim, 2010).

This paper employs a matched firm-employee panel dataset for Slovenian firms, to evaluate how significant is the impact of offshoring and outsourcing on the skill structure of firms. More precisely, the aim of the study is to make a thorough analysis of the impact of offshoring and outsourcing on the skill structure of Slovenian firms in the period from the year 1997 to 2010. To obtain more detailed results and to add to the existing evidence in this field of knowledge, a new dimension is introduced when defining skills, by including information on occupational structure of workers. To my best knowledge, previous analyses differentiated between skilled and unskilled workers only by looking at their educational attainment or by differentiating between production and non-production workers. However, it is important to take into account also occupational classification of workers, as skills can be acquired through employment and experience, and not only through formal educa-

tion. Specifically, workers who do not have tertiary education also occupy important positions in firms, while tertiary educated workers also occupy less demanding positions. The latter is especially true for younger workers at the beginning of their career path, whereas the former is true for experienced workers, who did not have opportunities to achieve higher formal education, but took an important position in a firm owing to their capabilities. Moreover, the analysis is further broadened by differentiating between occupational groups that define skills in order to make an even more thorough analysis. With this extension, I evaluate how employment effects of offshoring and outsourcing differ by task characteristics. Finally, while the bulk of analyses were usually concentrated on the effects of only offshoring or only outsourcing, it is important to study both factors in one model in order to increase the goodness of fit of the model. Therefore, both factors – offshoring and outsourcing – are included to the analysis. In addition, I also differentiate between outsourcing from high- and low-income countries and between offshoring to high- and low-income countries as this differentiation brings new information and deepens the analysis. While Lo Turco and Maggioni (2012) also differentiated between outsourcing from high- and low-income countries, they did not account for offshoring, skilled workers or service firms in their analysis.

As already presented in the introduction, paper's main aim is to test whether: (i) including both phenomena – offshoring and outsourcing – in one model alters previous empirical studies, which control only for one factor in their model and on average find a positive impact of the particular factor on the relative employment of skilled; (ii) controlling for destination country of outsourcing and offshoring brings new insights; especially whether outsourcing from high-income countries and offshoring to low-income countries has a positive impact on the relative employment of skilled workers; (iii) including the information on the occupational structure of workers when defining skills brings additional contribution to the results of the paper.

3 Methodology

This section presents the methodology and sets up a framework and specification of the model, which will serve for empirically testing the preceding postulates. Since it can be deduced from the presented literature that definitions of outsourcing and offshoring vary significantly across different studies, this section first presents the definitions of outsourcing and offshoring, used in the analysis. Framework and specification of the basic and extended models are presented next.

Definitions of outsourcing and offshoring differ widely in the literature. Feenstra and Hanson (1996) define outsourcing as the import of intermediate inputs by domestic firms, whereas in their more recent paper (Feenstra, & Hanson, 1999), they introduce two measures of outsourcing. First is the ratio between imported intermediate inputs, relative to total expenditure of non-energy intermediates in each industry, and the second is defined as inputs that are purchased from the same two-digit Standard Industrial Classification (SIC) industry as the good being produced (Feenstra, & Hanson, 1999). Many of the papers follow these definitions and methodology. Similar definition for outsourcing is also used in the recent reports of IMF (2013) and UNCTAD (2013), which define outsourcing as purchasing intermediates from another firm, rather than producing them within the firm. Taking into account these definitions, outsourcing in this analysis is defined as the ratio between the value of intermediate imports and the value of total material costs of a firm i in year t:

$$Outsourcing_{it} = \frac{Intermediate\ imports_{it}}{Total\ material\ costs_{it}} \tag{1}$$

where intermediate imports are defined according to the assigned Broad Economic Categories (BEC) codes. Under BEC classification, goods can be classified in three categories; capital, intermediate, and consumption goods.

Besides estimating the effects of outsourcing, this analysis also takes into account the effects of offshoring. For the latter, I again follow the definition of IMF (2013) and UNCTAD (2013), which define offshoring either as the process of relocating part or all activities to another firm, located overseas, or as foreign direct investments (FDI). For estimating the effect of offshoring, I take into account the dataset from the Bank of Slovenia, which comprises the information on the FDI flows for every Slovenian firm. This dataset gathers information on the volume of the FDI and destination country of the investment. Offshoring is denoted by introducing a dummy variable, indicating the existence of firm's FDI flows.

3.1 Framework and specification of the basic model

This part mainly follows the theoretical framework, introduced by Hummels et al. (2014). The production function of a firm i in year t is defined as:

$$Y_{it} = A_{it} f(K_{it}, H_{it}, C_{it}) \tag{2}$$

where the dependent variable, Y_{it}, is the output, A_{it} is productivity, K_{it} is the capital, H_{it} is skilled labour, and C_{it} is a composite input, consisting of domestic and

foreign inputs. The latter relate to outsourcing and/or offshoring activities and the former relate to unskilled labour and domestic inputs. As presented in the literature review, offshoring and outsourcing activities have distinct impacts on skilled and unskilled labour, where the impact on the skilled labour is on average positive, while the impact on the unskilled labour is on average negative (see for example Hummels et al., 2014; Mion, & Zhu, 2013; Hijzen et al., 2005; Strauss-Kahn, 2003; Egger, & Egger, 2003; and Feenstra, & Hanson, 1996). Since both factors affect the labour demand of firms, the model of Hummels et al. (2014) is extended by including also domestic inputs and offshoring into the model.

To implement the theoretical model in the data, I introduce P_{it} as a reduced-form of the demand for firm *i*'s products, divide the variables in the model (2) by the total number of firms' employees, separate the international activities of firms into offshoring and outsourcing, take logarithms and rearrange the equation so that the variable of interest on the left is skill share of firms:

$$-\beta(\beta-1)\ln H_{it} = \ln P_{it} + \ln A_{it} + \alpha \ln K_{it} + \\ + (1-\alpha-\beta)\ln(Out_{it} + Off_{it} + L_{it} + C_{it}) \tag{3}$$

Furthermore, following Hummels et al. (2014), the logarithm of the average wage level ($W_{it\text{-}s}$), and the logarithm of the value of exports ($X_{it\text{-}s}$) in the firm i and year t are added to the model. The latter is introduced in order to capture time varying shocks to demand for firms' output. Detailed derivation of the model is enclosed in the Appendix.

After rearranging, the empirical model hence becomes:

$$Skill\_share_{it} = \beta_0 + \beta_1 Out_{it} + \beta_2 Off_{it} + \beta_3 X_{it} + \beta_4 A_{it} + \\ + \beta_5 K_{it} + \beta_6 W_{it} + \beta_7 C_{it} + Time_t + Ind_t + \varepsilon_{it} \tag{4}$$

where the dependent variable $Skill\_share_{it}$ is the logarithm of the ratio between skilled employees and the total number of employees in the firm i and year t. Similarly to Hummels et al. (2014), skilled workers in the first part of the analysis are defined as tertiary educated workers, i.e. if they attain some form of college degree, which is normally at least 14 years of school attainment in Slovenia. As already explained, outsourcing (Out_{it}) is defined as the share of intermediate imports in the total material costs, and offshoring (Off_{it}) as the dummy variable, controlling for the outward FDI. Other explanatory variables are the following: X_{it} is a logarithm of the value of exports, A_{it} is a measure of productivity, K_{it} is a logarithm of capital per employee, W_{it} is a logarithm of the average annual wage level, and C_{it} is a

logarithm of the domestic cost level in the firm i and year t. To increase the sensitivity of results, two different measures of productivity are used; value added per employee and total factor productivity. Domestic cost level (C_{it}) was calculated as the difference between the total level of material costs and imports. Variable $Time_t$ controls for year specific effects and Ind_t denotes industry dummy variables (2-digit NACE rev. 1 industries).

Following Hummels et al. (2014), outsourcing, exports and levels of domestic costs are not scaled by firm size in order to enhance explanatory value of the model. More precisely, changes in the firm size might be the consequence of the changes in these variables. Instead, the model has been estimated with and without firm size as one of the explanatory variables.

3.2 Extensions of the model

Formation of the extended model is based on the model, presented in the previous subsection. First, the model is extended by differentiating between outsourcing from high- and low-income countries, and offshoring to high- and low-income countries. As mentioned in the literature review, Lo Turco and Maggioni (2012) also controlled for the origin of countries when analysing the impact of outsourcing on the labour demand in Italian manufacturing firms. Authors emphasize it is important to differentiate between high- and low-income countries, since different origins of outsourcing can point to a different performance level of firms. I add to the analysis of Lo Turco and Maggioni (2012) by controlling for skills, and including also service firms and offshoring into the model. Countries are classified as high- or low-income according to the definitions, made by the World Bank, where the low-income, lower-middle-income and upper-middle-income economies for a particular year are assigned as low-income countries, and high-income economies as high-income countries (WB, 2015).

The extended model, controlling for outsourcing from low- and high-income countries and offshoring to low- and high-income countries is the following:

$$\begin{aligned} Skill\_share_{it} = \beta_0 &+ \beta_1 Out_{it} + \beta_2 Out\_high_{it} + \beta_3 Off_{it} + \\ &+ \beta_4 Off\_high_{it} + \beta_5 High_{it} + \beta_6 X_{it} + \beta_7 A_{it} + \\ &+ \beta_8 K_{it} + \beta_9 W_{it} + \beta_{10} C_{it} + Time_t + Ind_t + \varepsilon_{it} \end{aligned} \tag{5}$$

where Out_high_{it} is an interaction term between outsourcing and a dummy, controlling for high-income countries, Off_high_{it} is an interaction term between offshoring and a dummy, controlling for high-income countries, and $High_{it}$ denotes a dummy variable, controlling for outsourcing from and offshoring to high-income

countries. The rest of the model in the expression (5) follows the basic model (4). As aforementioned, the presented literature suggests that outsourcing from high-income countries and offshoring to low-income countries would increase firms' skill share. The coefficients $ß_1$ and $ß_2$ reflect the impact of the outsourcing from high-income countries, while the impact of the offshoring to low-income countries is reflected in the coefficient $ß_3$.

Subsequently, the extension of the model also uses different definitions of skills. In the previous analyses, workers were usually defined as skilled after achieving a particular skill level or by being involved in non-production processes. I believe this arrangement is inadequate as formal education is not the only factor which defines the skill level of workers. Strictly speaking, besides formal education and training, workers acquire skills also through experience and informal training. Therefore, it is important to use occupational level when defining skills of workers, in order to take into account also the nature of the tasks and duties of workers' jobs. Four different skill levels could be applied to ten major groups of occupations, which are classified by the International Labour Organization (ILO). The setting of the present paper takes into account a version of the International Standard Classification of Occupations (ISCO), the ISCO-88 classification, which shares the same boundaries of the four skill levels as the ISCO-08 classification. The top two skill levels, 3 and 4, with the skill level 4 being the highest, relate to tertiary education and correspond to three major groups: "Managers" (skill levels 3 and 4), "Professionals" (skill level 4) and "Technicians" (skill level 3) (ILO, 2012; and Elias, & Birch, 1994). These three major groups of occupations define skilled workers in the extended model. "Managers" include legislators, senior officials and managers, whose main tasks consist of determining, formulating and supervising the implementation of government policies, laws and public regulations, or planning, directing and coordinating the policies and activities of enterprises, organisations, or departments. "Professionals" work in the fields of physical, life, or social sciences, or humanities and are responsible for increasing the existing stock of knowledge, finding solutions to the problems by applying scientific and artistic concepts and theories, and transferring their knowledge to others. Finally, "Technicians" include technicians and associate professionals who have technical knowledge and experience in the fields of physical, life, or social sciences, or humanities. Their main tasks include carrying out technical work and teaching at particular educational levels, related with the abovementioned fields (ILO, 2014).

4 Data and descriptive statistics

By combining different databases, a rich firm-level and employee-level panel dataset for Slovenian firms was obtained, covering the period from the year 1997 to 2010. The dataset comprises information on the balance sheets data and income statements of Slovenian firms, their export and import activities (i.e. value of exports and imports, type of exported and imported goods, and destination of exports and imports), characteristics of employees (i.e. gender, age, gross wage, educational level, and occupational level), and the information on the foreign direct investments of Slovenian firms. The latter gathers information on the FDI flows for a particular Slovenian firm. The dataset links the following databases: personal income-tax data, transaction-level data on exports and imports of goods, Statistical Registry of Employees, firm-level accounting data and FDI, and was provided by the Statistical office of the Republic of Slovenia (SORS), the Tax Authorities of Slovenia (TARS), the Bank of Slovenia, and the Agency of the Republic of Slovenia for Public Legal Records and Related Services (AJPES).

After observing vast differences between manufacturing and service firms (Table 1), and taking into account aforementioned emphasis on the importance of separating the analysis for manufacturing and service firms (see for example De Backer & Yamano, 2012; Michel & Rycx, 2009; and Horgos, 2006), the empirical analysis was carried out independently for the two types of firms. Manufacturing firms on average employ higher number of employees and tertiary educated employees, compared to service firms. Furthermore, especially in the more recent years, manufacturing firms on average employ slightly older employees than service firms, where age can be considered as a proxy for experience of employees (Zoghi, 2010). When comparing the average annual gross wages for the recent years, manufacturing firms on average pay their employees lower wages than service firms. However, when comparing the average wages of tertiary educated employees, manufacturing firms pay higher average wages than service firms. Manufacturing firms on average also have lower skill shares than service firms. The latter differences in the average gross wages and the skill shares could be the outcome of different occupational and educational structure of employees in manufacturing and service firms, which will be presented in one of the upcoming paragraphs. For brevity, the following tables present descriptive statistics for the first half of the treated period with a four-year gap, but include all information for the recent years.

Table 1. Characteristics of Slovenian manufacturing and service firms

Total							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Employment	18.1	17.3	15.5	15.2	14.2	13.0	12.2
Employment of tertiary educated	2.1	2.3	2.4	2.5	2.4	2.4	2.4
Skill share	21.7	23.2	25.0	25.4	25.9	27.0	28.1
Age	36.3	38.2	39.3	39.5	39.8	40.2	40.5
Gross wage	5,139	8,002	10,625	11,311	11,850	11,941	12,260
Gross wage of tertiary educated	8,696	12,804	16,132	16,993	17,993	17,752	17,703
Number of firms	25,216	27,064	30,908	32,799	35,833	36,814	37,882
Manufacturing firms							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Employment	41.4	38.9	35.0	34.4	31.8	27.8	26.6
Employment of tertiary educated	3.9	4.2	4.5	4.6	4.4	4.3	4.3
Skill share	14.5	14.6	15.9	16.1	16.3	17.2	18.0
Age	36.2	37.9	39.7	39.9	40.4	40.8	41.2
Gross wage	5,048	7,658	10,320	11,066	11,664	11,547	11,962
Gross wage of tertiary educated	9,785	14,154	17,397	18,267	19,232	18,868	18,808
Number of firms	5,411	5,750	6,140	6,318	6,696	6,746	6,798
Service firms							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Employment	9.7	9.9	9.6	9.6	9.3	8.9	8.5
Employment of tertiary educated	1.4	1.7	1.9	2.0	2.0	2.0	2.0
Skill share	25.1	27.4	30.1	30.9	31.7	32.9	34.1
Age	36.3	38.3	39.4	39.6	40.0	40.3	40.6
Gross wage	5,229	8,257	11,036	11,779	12,426	12,511	12,791
Gross wage of tertiary educated	8,260	12,363	15,723	16,557	17,565	17,379	17,351
Number of firms	18,037	19,047	21,527	22,729	24,773	25,647	26,495

Note. Explanations of the variables are the following: Employment: mean number of employees; Employment of tertiary educated: mean number of tertiary educated employees; Skill share: the average of the share of the tertiary educated; Age: mean age of employees; Gross wage: mean annual gross wage in €; Gross wage of tertiary educated: mean annual gross wage of tertiary educated employees in €; Number of firms: number of observations.

Source: SORS, author's calculations

In addition, I also make a comparison between offshoring and outsourcing firms (Table 2). Both types of firms are bigger in size, compared to an average firm in Table 1. The average age of employees in offshoring and outsourcing firms is also slightly higher than in the average firm. Finally, average gross wages and gross wages of tertiary educated employees are above the average, where the highest average is in the offshoring firms. A separate analysis was done also for firms that offshore to and outsource from high-income countries. Descriptive statistics for these firms show that they are on average bigger and pay higher wages than average offshoring and outsourcing firms. The table is enclosed in the Appendix.

Table 2. Characteristics of Slovenian firms which offshore and outsource

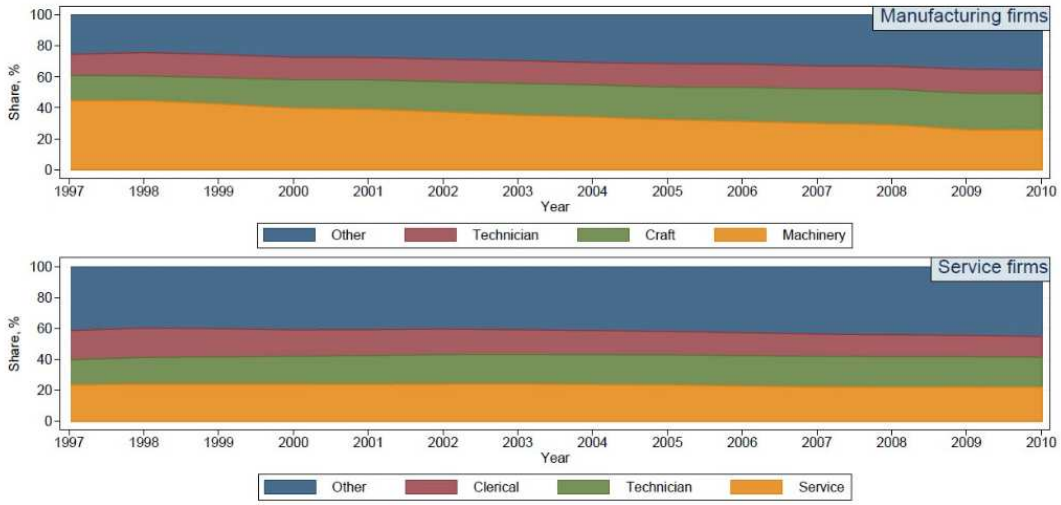
Offshoring firms							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Employment	301.9	207.3	194.3	185.6	175.0	163.6	161.3
Employment of tertiary educated	35.1	27.9	32.1	32.1	31.9	32.6	34.0
Skill share	22.5	25.7	31.8	32.9	34.5	35.4	37.6
Age	38.9	39.1	40.1	40.1	40.4	41.0	41.5
Gross wage	8,384	11,988	16,934	18,187	19,325	19,453	20,081
Gross wage of tertiary educated	15,215	19,729	24,759	26,282	27,707	27,380	27,487
Number of firms	474	831	895	943	994	957	894
Outsourcing firms							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Employment	49.7	42.1	42.2	38.5	35.4	33.9	32.0
Employment of tertiary educated	5.2	5.1	5.9	5.8	5.2	5.6	5.6
Skill share	19.8	20.4	22.6	23.0	23.5	24.6	26.8
Age	36.6	38.2	39.6	39.7	40.2	40.9	41.4
Gross wage	5,536	8,371	11,011	11,752	12,360	12,603	13,138
Gross wage of tertiary educated	10,640	15,026	18,366	19,061	19,980	20,027	20,134
Number of firms	3,520	4,171	2,841	3,089	3,153	2,751	2,495

Note. Explanations of the variables are the following: Outsourcing firms: firms that import intermediate products; Offshoring firms: firms that engage in outward FDI; Employment: mean number of employees; Employment of tertiary educated: mean number of tertiary educated employees; Skill share: the average of the share of the tertiary educated; Age: mean age of employees; Gross wage: mean annual gross wage in €; Gross wage of tertiary educated: mean annual gross wage of tertiary educated employees in €; Number of firms: number of observations.

Source: SORS, author's calculations

Next, occupational structure of manufacturing and service firms is compared by using ISCO-88 classification (Figure 1). In manufacturing firms, the share of Machinery workers has been decreasing through the period, but it is still the highest among all occupational groups. On the other hand, the share of Craft workers has been increasing through the period, but stayed the second. The third largest share in manufacturing firms belongs to Technicians, while the fourth and fifth largest shares appertain to Elementary occupations and Clerks, respectively. In service firms, on the other hand, Service workers occupy the largest share and the share remains steady throughout the observed period. The second largest share in service firms belongs to Technicians, while the third to Clerks. Among other occupational groups, Elementary occupations represent the fourth largest share and Machinery workers the fifth. Since the shares of Agricultural and Army workers represent only a minor part of the total shares in both, manufacturing and service firms, they were excluded from further empirical analysis (description of all major occupational groups is included in the Appendix).

Figure 1. Occupational structure of manufacturing and service firms in Slovenia



Source: SORS, author's calculations

Table 3 below presents descriptive statistics of the three major groups of occupations that define skilled workers in the extended model; i.e. Managers, Professionals, and Technicians. Professionals represent the highest share of tertiary educated among all groups, followed by Managers and Technicians. This allocation of shares is consistent with the ISCO-88 classes of skill levels, presented in the methodological part. Looking at the total average in the observed period, 88.7 % of Professionals, 55.1 % of Managers, and 27.4 % of Technicians were tertiary educated. Taking into account the average age of employees, Managers are on average

the oldest among all occupational groups, Professionals were on average a bit older than the average worker in the first years of the observational period, while in the recent years, they are a bit younger than the average. In contrast, Technicians are the youngest of the three groups and compared to the total population of employees. Managers earn the highest gross wages among all occupational groups, followed by Professionals as the runner-up. Technicians also have above the average wages, when looking at the total averages. However, since Professionals and Managers present more than a half of all tertiary educated workers and earn the highest wages, tertiary educated Technicians earn below the average gross wages, when taking into account only tertiary educated workers.

Descriptive statistics of other occupational groups (included in the Appendix) reveal that other groups present only a minor share in the tertiary educated workers. The highest share in the total employment on average occupy Machinery workers, followed by Craft workers, Elementary workers, Service workers, and Clerical workers, while the highest earners among these groups are on average Clerical workers, followed by Machinery workers, Craft workers, Service workers and Elementary workers. This distribution of occupations is also the reason for higher average wages in manufacturing firms and higher average skill shares in service firms.

Table 3. Characteristics of employees in skilled occupations

Managers							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Share in the total employment	5.6	5.5	6.1	6.1	6.3	6.8	7.0
Share in the tertiary educated	25.2	23.4	22.6	21.8	21.7	21.8	21.1
Age	41.5	43.0	43.7	43.7	43.6	43.9	43.9
Gross wage	8,972	14,125	18,436	19,530	20,398	20,231	20,301
Gross wage of tertiary educated	12,859	18,988	24,080	25,517	26,755	26,237	26,092
Professionals							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Share in the total employment	3.9	4.5	5.7	6.0	6.2	7.0	7.8
Share in the tertiary educated	31.2	31.6	33.9	34.1	34.2	34.6	34.8
Age	38.4	38.5	38.6	38.7	39.0	39.2	39.4
Gross wage	9,756	14,707	17,803	18,642	19,792	19,750	19,503
Gross wage of tertiary educated	10,277	15,411	18,455	19,462	20,732	20,750	20,622
Technicians							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Share in the total employment	15.6	16.2	16.8	16.7	16.5	16.9	16.9
Share in the tertiary educated	32.2	31.7	30.9	30.7	30.1	29.3	29.1
Age	35.7	37.5	38.6	38.7	39.1	39.5	39.9
Gross wage	6,113	9,389	12,166	12,980	13,891	13,970	14,246
Gross wage of tertiary educated	8,377	12,484	15,190	16,077	17,127	16,993	17,006

Note. Explanations of the variables are the following: Share in the total employment: share of a particular occupational group in the total employment (in %); Share in the tertiary educated: share of a particular occupational group in the total number of tertiary educated employees (in %); Age: mean age of a particular occupational group; Gross wage: mean annual gross wage a particular occupational group in €; Gross wage of skilled: mean annual gross wage a particular occupational group in €.

Source: SORS, author's calculations

5 Empirical analysis

As explained in the methodological part, the empirical analysis is split into two parts. The basic model measures the effect of outsourcing and offshoring on the skill structure of firms. Later, the first extension of the model differentiates between outsourcing from high- and low-income countries and offshoring to high- and low-income countries, while in the second extension, alternative definition of skilled employees is introduced, taking into account information on the occupational level of employees.

5.1 Basic model

Basic model analyses the effect of outsourcing and offshoring on the skill structure in Slovenian firms. First, the models are estimated with the pooled ordinary least squares and with methods for panel data analysis; fixed effects and random effects. Following Hummels et al. (2014), standard errors are clustered at firm levels. The applied procedures follow the methods of Cameron and Trivedi (2009). Due to cluster-robust standard errors and an unbalanced panel dataset, a robust version of the Hausman test is needed in order to compare fixed and random effects models (Cameron, & Trivedi, 2009). In accordance, the method proposed by Schaffer and Stillman (2010) is applied, while the Sargan-Hansan test is reported in the tables. As introduced in the methodology part, tertiary educated workers are defined as skilled in the basic model. For brevity, only the estimates of the variables of interest – i.e. outsourcing and offshoring – are presented in the main tables, while the complete results are enclosed in the Appendix.

Taking into account only the results of the most preferred model, according to the Sargan-Hansen test, i.e. the fixed effects, offshoring shows a positive impact on the share of skilled workers in manufacturing firms, while the effect of outsourcing and offshoring seem to have no impact on the skill structure in service firms (Table 4).

Table 4. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.132***	0.063**	0.094***	0.325***	0.035	0.157**
	[3.10]	[2.05]	[3.21]	[3.55]	[0.50]	[2.15]
Outsourcing	0.824	0.212	0.606*	0.212	0.081	0.243
	[1.03]	[0.61]	[1.83]	[0.34]	[0.27]	[0.88]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.074	0.068		0.034	0.023
R-squared (between)		0.108	0.195		0.042	0.228
R-squared (overall)	0.229	0.116	0.201	0.236	0.049	0.219
Sargan-Hansen statistics		354.150***			691.538***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated workers are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Outsourcing: share of intermediate imports in the total material costs. Control variables used: logarithm of the capital per employee in a firm, logarithm of the total factor productivity per employee in a firm, logarithm of the value of exports, logarithm of the average annual gross wage level, logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

For robustness checks, the models were estimated by adding firm size as one of the control variables. In addition, value added was substituted for the total factor productivity. In the main tables, total factor productivity is calculated using the proposed method of Levinsohn and Petrin (2003). Levinsohn and Petrin (2003) extend the model of Olley and Pakes (1996) by substituting intermediate inputs, instead of investments, when estimating production function. Authors argue one of the main benefits of this procedure is data driven as the procedure can be used also for firms with zero investments, while another advantage is the result of intermediate inputs being more responsive to the total productivity term than investments (see for example Levinsohn, & Petrin, 2003; and Petrin, Poi, & Levinsohn, 2004). Both measures – the Levinsohn-Petrin measured total factor productivity and the value added – have been for example used in Damijan, Konings and Polanec (2014).

Robustness checks on average confirm results from the basic model on the positive effect of offshoring on the skill share in manufacturing firms. The robustness checks are included in the Appendix.

5.2 Extensions of the model

In order to obtain new information, two extensions of the basic model have been made. First extension differentiates between outsourcing from high- and low-income countries and offshoring to high- and low-income countries. Second extension includes information on occupational level of workers when defining skills. Again, the following tables include only the estimates of the variables of interest, while the estimates of the control variables are enclosed in the Appendix.

5.2.1 Differentiation between high- and low-income countries

Differentiating between outsourcing from high- and low-income countries and offshoring to high- and low-income countries enables estimation on whether a particular type of source country of offshoring and outsourcing has a more significant impact on the skill structure of domestic firms.

Adding the interaction terms for high-income countries shows that the effect of outsourcing and offshoring on the share of high skilled employees is different for different source countries, especially when including also the alternative definition of skills, which will be presented in the subsequent subsection. Again, according to the Sargan-Hansen statistics, the most preferred results are obtained with the fixed effects method, so the following conclusions concentrate on the results of this method. For manufacturing firms, offshoring to low-income countries shows a statistically significant positive impact on the share of skilled employees. Since the coefficient on the interaction term between offshoring and high-income countries is statistically insignificant, it follows that offshoring to high-income countries does not have a stronger impact on the relative employment of skilled employees than offshoring to low-income countries. Hence, offshoring to low- and high-income countries has a similar and positive impact on the share of skilled employees in manufacturing firms. Furthermore, while offshoring to low-income countries in service firms does not show to have a statistically significant impact on the skill share of firms, the negative and statistically significant interaction term indicates that offshoring to high-income countries has a weaker impact on the relative employment of skilled than offshoring to low-income countries. Outsourcing does not show to have an impact on the skill share of firms in neither type of firms.

Table 5. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, differentiating between high- and low-income countries (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.183***	0.052*	0.082***	0.304***	0.066	0.174**
	[3.90]	[1.67]	[2.75]	[2.86]	[0.91]	[2.46]
Offshoring_high	-0.132**	0.038	0.041	0.074	-0.130*	-0.067
	[-2.32]	[1.14]	[1.21]	[0.54]	[-1.68]	[-0.72]
Outsourcing	-0.347	-0.567	-0.393	-0.602	-0.358	-0.207
	[-0.18]	[-0.58]	[-0.43]	[-0.36]	[-0.64]	[-0.31]
Outsourcing_high	1.340	0.939	1.193	0.972	0.490	0.513
	[0.58]	[0.89]	[1.19]	[0.52]	[0.73]	[0.66]
High	0.090*	0.001	0.017	-0.020	0.007	-0.003
	[1.84]	[0.03]	[0.77]	[-0.51]	[0.29]	[-0.15]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.074	0.068		0.034	0.023
R-squared (between)		0.109	0.196		0.041	0.228
R-squared (overall)	0.230	0.116	0.201	0.236	0.048	0.219
Sargan-Hansen statistics		369.865***			703.304 ***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated workers are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries. Control variables used: logarithm of the capital per employee in a firm, logarithm of the total factor productivity per employee in a firm, logarithm of the value of exports, logarithm of the average annual gross wage level, logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

5.2.2 Alternative definition of skills

To this point, workers were defined as skilled when reaching tertiary level of education. However, since workers gain important skills also through working in firms and not only by obtaining formal education, information on occupational level of workers is added to the definition of skills, as explained in the methodology part. In order to further increase contribution of the analysis, differentiation between

high- and low-income countries has been made also in this part of the analysis. As in the previous sections, the most preferred method, according to the Sargan-Hansen test, is the fixed effects, so the following conclusions relate to the results of this method.

Table 6. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, using occupational classification for defining skills (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.145***	0.040	0.058**	0.161**	0.040	0.086*
	[3.84]	[1.57]	[2.44]	[2.16]	[0.79]	[1.82]
Offshoring_high	-0.017	0.014	0.013	-0.072	-0.171*	-0.139
	[-0.39]	[0.55]	[0.54]	[-0.53]	[-1.68]	[-1.13]
Outsourcing	2.326	0.886	1.035	-1.086	-0.294	-0.190
	[1.15]	[1.09]	[1.34]	[-0.77]	[-0.24]	[-0.19]
Outsourcing_high	-1.383	-0.492	-0.516	1.345	-0.263	-0.237
	[-0.56]	[-0.53]	[-0.57]	[0.84]	[-0.20]	[-0.21]
High	0.051	0.001	0.010	0.024	-0.023	-0.018
	[1.11]	[0.06]	[0.49]	[0.69]	[-1.15]	[-1.01]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.032	0.026		0.019	0.013
R-squared (between)		0.022	0.135		0.062	0.204
R-squared (overall)	0.186	0.031	0.152	0.206	0.057	0.192
Sargan-Hansen statistics		1,372.538***			397.351***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where Managers, Professionals, and Technicians in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries. Control variables used: logarithm of the capital per employee in a firm, logarithm of the total factor productivity per employee in a firm, logarithm of the value of exports, logarithm of the average annual gross wage level, logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations.

When defining skilled employees only by their occupational level; i.e. when they are classified as Managers, Professionals or Technicians, the results are no more statistically significant for manufacturing firms, while the results for service firms remain unvaried.

Next, to further exploit the advantages of taking into account information on occupational level, the effect of offshoring and outsourcing on firms' skill share is estimated using disaggregated data for each of the three major skilled occupational groups. The following table presents only the results of the most preferred method according to the Sargan-Hansen test (that is the fixed effects), while the results of all methods are included in the Appendix.

When defining skills only by the occupational level and disaggregating the data by the three major skilled occupational groups (Table 7), results for manufacturing firms show a statistically significant impact of offshoring only on the relative employment of Professionals, while the results in service firms are statistically significant only for Technicians. The positive and statistically significant coefficient on the interaction term between offshoring and high-income countries for Professionals in manufacturing firms indicates that offshoring to high-income countries has a stronger impact on the relative employment of Professionals in manufacturing firms than offshoring to low-income countries. Furthermore, while offshoring to low-income countries in service firms does not show to have a statistically significant impact on the relative employment of the treating occupations, the negative and statistically significant interaction term for Technicians indicates that offshoring to high-income countries has a weaker impact on the relative employment of Technicians in service firms, compared to offshoring to low-income countries.

Table 7. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, for the major skilled occupational groups (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Managers	**Professionals**	**Technicians**	**Managers**	**Professionals**	**Technicians**
Offshoring	-0.002	0.046	-0.019	0.056	0.128	-0.046
	[-0.07]	[1.02]	[-0.59]	[0.59]	[1.37]	[-0.60]
Offshoring_high	0.032	0.096**	-0.026	-0.062	0.053	-0.258**
	[0.83]	[2.20]	[-0.73]	[-0.37]	[0.39]	[-2.51]
Outsourcing	0.531	-1.030	1.154	0.210	-0.134	0.036
	[0.83]	[-1.11]	[1.04]	[0.36]	[-0.29]	[0.03]
Outsourcing_high	-0.560	1.474	-0.785	-0.600	0.264	0.298
	[-0.61]	[1.19]	[-0.61]	[-0.84]	[0.49]	[0.24]
High	-0.009	0.025	-0.031	0.008	0.008	-0.021
	[-0.38]	[1.21]	[-1.17]	[0.34]	[0.42]	[-0.77]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)	0.036	0.057	0.036	0.016	0.027	0.035
R-squared (between)	0.022	0.212	0.149	0.012	0.057	0.062
R-squared (overall)	0.030	0.202	0.133	0.014	0.070	0.061
Sargan-Hansen statistics	458.321***	217.669***	542.600***	122.457***	367.532***	307.545***

*Note. Econometric method: FE: fixed effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated Managers, Professionals, and Technicians in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries. Control variables used: logarithm of the capital per employee in a firm, logarithm of the total factor productivity per employee in a firm, logarithm of the value of exports, logarithm of the average annual gross wage level, logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Finally, both definitions for skills are combined, defining workers as skilled if they meet both criteria; i.e. if they attain tertiary education and are classified as Managers, Professionals, or Technicians. Results from Table 8 do not show statistically significant effects for the most preferred method. When separating the analysis by the three major occupational groups (Table 9), the results again confirm that in manufacturing firms, offshoring to low-income countries does not show to have a statistically significant impact on the relative employment of tertiary educated Professionals. However, coefficient on the interaction term points to a stronger impact of offshoring to high-income countries on the relative employment of tertiary educated Professionals, compared to offshoring to low-income countries. In service firms, the result is statistically significant only for Managers, where offshoring to low-income countries has a positive impact on the relative employment of tertiary educated Managers. Since the coefficient on the interaction term between offshoring and high-income countries is statistically insignificant, it follows that offshoring to high-income countries does not have a stronger impact on the relative employment of tertiary educated Managers, compared to offshoring to low-income countries. Offshoring to low- and high-income countries therefore has a similar and positive impact on the relative employment of tertiary educated Managers in service firms. These results suggest that the effect of educational level is not common, but it instead differs between different occupational groups, where the strongest impact is on Technicians and Managers in service firms, and Professionals in manufacturing firms. While the results for Technicians are no longer statistically significant when the skills of employees are defined by both, educational and occupational level, the results for Managers indicate that firms have greater incentives for hiring more skilled workers. In addition, when taking into account only tertiary educated Professionals in manufacturing firms, the coefficient it slightly higher. Therefore, the results indicate that firms differentiate between more and less educated individuals within the same occupational group, where the positive effects of offshoring are concentrated on the tertiary educated Managers in service firms and tertiary educated Professionals in manufacturing firms. Among the three occupational groups that define skills, the majority of Managers and Professionals were on average tertiary educated and the both groups occupied the largest share in the tertiary educated. Also, with regard to the definitions of the ISCO classification, the two groups also perform the most demanding tasks among all occupational groups.

Table 8. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, using educational level and occupational classification for defining skills (observation period: 1997-2010, only tertiary educated)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.215***	0.048	0.080***	0.411***	0.107	0.214***
	[4.45]	[1.56]	[2.76]	[3.76]	[1.52]	[3.08]
Offshoring_high	-0.111*	0.051	0.056*	0.106	-0.015	0.036
	[-1.89]	[1.57]	[1.73]	[0.78]	[-0.15]	[0.35]
Outsourcing	-1.452	-0.884	-0.638	-0.218	0.058	0.221
	[-1.11]	[-0.82]	[-0.62]	[-0.13]	[0.15]	[0.43]
Outsourcing_high	2.852*	1.074	1.295	0.376	-0.145	-0.133
	[1.72]	[0.92]	[1.15]	[0.20]	[-0.33]	[-0.24]
High	0.089*	0.010	0.024	-0.001	-0.006	-0.011
	[1.84]	[0.41]	[1.05]	[-0.03]	[-0.28]	[-0.53]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.068	0.061		0.036	0.025
R-squared (between)		0.118	0.209		0.077	0.247
R-squared (overall)	0.254	0.129	0.222	0.258	0.083	0.239
Sargan-Hansen statistics		414.314***			709.736***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where Managers, Professionals, and Technicians in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries. Control variables used: logarithm of the capital per employee in a firm, logarithm of the total factor productivity per employee in a firm, logarithm of the value of exports, logarithm of the average annual gross wage level, logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table 9. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, for the major skilled occupational groups (observation period: 1997-2010, only tertiary educated)

	Manufacturing firms			*Service firms*		
	Managers	**Professionals**	**Technicians**	**Managers**	**Professionals**	**Technicians**
Offshoring	0.020	0.028	0.048	0.189**	0.085	0.052
	[0.54]	[0.64]	[1.28]	[2.19]	[1.17]	[0.53]
Offshoring_high	0.055	0.113***	0.062	-0.168	0.038	0.139
	[1.34]	[2.66]	[1.49]	[-1.06]	[0.31]	[1.16]
Outsourcing	0.032	-1.126	-0.011	-0.313	0.113	0.147
	[0.05]	[-1.38]	[-0.02]	[-0.76]	[0.36]	[0.32]
Outsourcing_high	-0.003	1.165	0.121	0.432	-0.133	0.221
	[-3.30E-03]	[1.28]	[0.19]	[0.95]	[-0.40]	[0.49]
High	0.017	0.033*	0.002	1.370E-04	0.001	-0.005
	[0.81]	[1.74]	[0.07]	[0.01]	[0.05]	[-0.25]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)	0.039	0.066	0.056	0.014	0.026	0.025
R-squared (between)	0.011	0.199	0.139	0.022	0.056	0.047
R-squared (overall)	0.013	0.196	0.133	0.026	0.067	0.048
Sargan-Hansen statistics	242.157***	288.775***	248.219***	328.416***	371.799***	284.611***

*Note. Econometric method: FE: fixed effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated Managers, Professionals, and Technicians in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries. Control variables used: logarithm of the capital per employee in a firm, logarithm of the total factor productivity per employee in a firm, logarithm of the value of exports, logarithm of the average annual gross wage level, logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

6 Conclusion

This paper studies the impact of offshoring and outsourcing on the relative employment of skilled employees in Slovenian manufacturing and service firms. Using a matched firm-level and employee-level dataset for the period from 1997 to 2010, the study broadens and contributes to the previous studies in several ways. The analysis incorporates both measures; offshoring and outsourcing, in one model, and differentiates between outsourcing from high- and low-income countries, and offshoring to high- and low-income countries. Furthermore, different definitions of skills are applied in order to increase the explanatory value of the model. The basic model uses a conventional definition of skills, defining workers as skilled when they attain tertiary education. However, since workers develop additional knowledge and expertise after entering employment, taking into account solely the level of formal education when defining skills ignores the knowledge acquired during the course of employment. Consequently, occupational classification is used to define skills in the model extensions, where three major occupational groups define workers as skilled; Managers, Professionals and Technicians.

The main findings of the analysis are the following. First, offshoring has a stronger effect on the relative employment of skilled workers than outsourcing. Second, when controlling for high- and low-income countries, offshoring to low- and high-income countries has a similar and positive effect on the relative share of skilled employees in manufacturing firms. In service firms, offshoring to low-income countries does not have a statistically significant impact on the skill share of firms, while offshoring to high-income countries shows a weaker impact on the skill share than offshoring to low-income countries. These results partially confirm the hypothesis made on the expected positive effect of offshoring to low-income countries, while the hypothesis for the expected positive effect of outsourcing from high-income countries cannot be confirmed. Finally, taking into account occupational level when defining skills increases the explanatory power of the model and serves as an additional robustness check. In manufacturing firms, the results do not vary significantly when defining skilled only by the occupational level or when defining skilled by both, occupational and educational level. Results point to a stronger impact of offshoring to high-income countries on the relative employment of Professionals in manufacturing firms than offshoring to low-income countries. In addition, when taking into account only tertiary educated Professionals, compared to all Professionals in manufacturing firms, the coefficient on the interaction term slightly increases. On the other hand, results for service firms vary depending on the definition

of skilled. When defining skilled only by the occupational level, results point to a weaker impact of offshoring to high-income countries on the relative employment of Technicians, compared to offshoring to low-income countries. When defining skilled by using both definitions, results confirm a positive and similar impact of offshoring to high- and low-income countries on the relative employment of tertiary educated Managers. The impact of education therefore differs between occupational groups and is mostly concentrated on the tertiary educated Managers in service firms and tertiary educated Professionals in manufacturing firms, indicating that firms differentiate between more and less educated individuals within the same occupational group. This finding indicates that firms have greater incentives for hiring skilled workers.

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Appendix A: Derivation of the model

First, consider the following production function for firm i in year t:

$$Y_{it} = A_{it} K_{it}^{\alpha} H_{it}^{\beta} C_{it}^{1-\alpha-\beta} \tag{A1}$$

As already mentioned, the dependent variable, Y_{it}, is the output, A_{it} is productivity, K_{it} is the capital, H_{it} is skilled labour, and C_{it} is a composite input, consisting of domestic and foreign inputs $(C_{it}=D_{it}+F_{it})$, where the latter relate to outsourcing and/or offshoring activities, whereas the former relate to domestic costs and unskilled labour.

As in Hummels et al. (2014), I introduce P_{it} as a reduced-form of the demand for firm i's products and derive the demand for skilled labour of firm i in year t, by making derivatives of the equation (A1):

$$P_{it} \frac{\partial Y_{it}}{\partial H_{it}} = P_{it} A_{it} K_{it}^{\alpha} \beta H_{it}^{\beta-1} C_{it}^{1-\alpha-\beta} \tag{A2}$$

First, foreign inputs of firms, F_{it}, are separated into outsourcing (Out_{it}) and offshoring (Off_{it}) activities $(F_{it}=Out_{it}+Off_{it})$, and domestic inputs of firms, D_{it}, are separated into unskilled labour (L_{it}) and domestic costs (C_{it}); $(D_{it}=L_{it}+C_{it})$. Next, I take logarithms of the equation (A2) and get the following:

$$\begin{aligned} \ln P_{it} + \ln A_{it} + \alpha \ln K_{it} + \beta(\beta-1)\ln H_{it} + \\ + (1-\alpha-\beta)\ln(Out_{it} + Off_{it} + L_{it} + C_{it}) = 0 \end{aligned} \tag{A3}$$

To implement equation (A3) in the data, the equation is first rearranged so that the variable of interest is skill structure of firms:

$$\begin{aligned} -\beta(\beta-1)\ln H_{it} = \ln P_{it} + \ln A_{it} + \alpha \ln K_{it} + \\ + (1-\alpha-\beta)\ln(Out_{it} + Off_{it} + L_{it} + C_{it}) \end{aligned} \tag{A4}$$

Next, the variables are scaled with the total number of employees in a firm. However, as already explained, following Hummels et al. (2014) I do not scale outsourcing, exports and levels of domestic costs by firm size in order to enhance explanatory value of the model. Furthermore, as in Hummels et al. (2014), logarithm of the value of exports (X_{it}) is introduced to capture time varying shocks to demand of firms' output (P_{it}), and the logarithm of the average wage level in the firm i and year t (W_{it}).

Observed model is therefore the following:

$$\begin{aligned} Skill\_share_{it} = \beta_0 + \beta_1 Out_{it} + \beta_2 Off_{it} + \beta_3 X_{it} + \beta_4 A_{it} + \beta_5 K_{it} + \\ + \beta_6 W_{it} + \beta_7 C_{it} + Time_t + Ind_t + \varepsilon_{it} \end{aligned} \tag{A5}$$

Appendix B: Description of ISCO-88 major occupational groups

ISCO-88 classification arranges occupations in ten major groups. The first major group are "Managers", which include legislators, senior officials and managers, whose main tasks consist of determining, formulating and supervising the implementation of government policies, laws and public regulations, or planning, directing and coordinating the policies and activities of enterprises, organisations, or departments. Next major group are "Professionals", who work in the fields of physical, life, or social sciences, or humanities. They are responsible for increasing the existing stock of knowledge, finding solutions to the problems by applying scientific and artistic concepts and theories, and transferring their knowledge to others. Another major group, "Technicians", include technicians and associate professionals who have technical knowledge and experience in the fields of physical, life, or social sciences, or humanities. Their main tasks include carrying out technical work and teaching at particular educational levels, related with the abovementioned fields. Furthermore, the group "Clerks" define occupations, which possess the knowledge and skills of organising, storing, computing and retrieving information. Their main tasks are performing secretarial duties, operating different office machines, recording and computing numerical data, and performing various customer-oriented clerical duties. The group "Service workers" include service, shop, and market sales workers, whose main tasks consist of providing personal and protective services, and to sell goods in shops or at markets. In addition, a group "Agricultural workers" consist of skilled agricultural and fishery workers, who produce farm, forestry and fishery products, and sell them to purchasers, marketing organisations or at markets. Next, the group "Craft workers" include craft and other related trade workers whose main tasks include extracting raw materials, constructing buildings and other structures, and making various products and handicraft goods. Moreover, a group "Machine operators" include plant and machine operators and assemblers, who operate and monitor large scale, and often highly automated, industrial machinery and equipment. "Elementary occupations" combine occupations whose main tasks in general include simple and routine tasks, by using the hand-held tools and in some cases considerable amount of physical effort. Finally, the group "Armed forces" include individuals, who are serving in the armed forces on a voluntary or compulsory basis and are also restricted to accept civilian employment (ILO, 2014).

Appendix C: Tables

Table C1. Characteristics of Slovenian firms which offshore to and outsource from high-income countries

Firms, offshoring to high-income countries							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Employment	509.4	421.3	407.8	309.1	214.2	200.4	199.3
Employment of tertiary educated	56.3	55.0	63.5	59.1	39.6	40.1	42.1
Skill share	23.83	25.49	31.46	32.6	34.69	35.85	37.5
Age	39.5	39.5	40.1	40.1	40.6	41.2	41.7
Gross wage	8,930	12,782	17,741	20,128	19,547	19,894	20,481
Gross wage of tertiary educated	15,835	21,712	26,789	29,254	27,963	27,881	28,004
Firms, outsourcing from high-income countries							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Employment	52.1	43.7	44.6	41.1	37.1	35.5	34.3
Employment of tertiary educated	5.5	5.4	6.3	5.9	5.4	5.8	6.0
Skill share	19.48	20.41	22.17	22.53	23.51	25.03	26.2
Age	36.6	38.2	39.6	39.8	40.2	41.0	41.5
Gross wage	5,552	8,430	11,112	11,816	12,425	12,792	13,305
Gross wage of tertiary educated	10,730	15,251	18,644	19,342	20,073	20,294	20,569

Note. Explanations of the variables are the following: Outsourcing firms: firms that import intermediate products; Offshoring firms: firms that engage in outward FDI; Employment: mean number of employees; Employment of tertiary educated: mean number of tertiary educated employees; Skill share: the average of the share of the tertiary educated; Age: mean age of employees; Gross wage: mean annual gross wage in €; Gross wage of tertiary educated: mean annual gross wage of tertiary educated employees in €.

Source: SORS, author's calculations

Table C2. Characteristics of employees in unskilled occupations

Clerical workers							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Share in the total employment	12.0	10.5	9.7	9.5	9.3	9.5	9.4
Share in the tertiary educated	4.5	4.7	5.9	6.3	6.4	6.6	6.8
Age	35.0	37.1	38.7	38.8	39.3	39.7	39.9
Gross wage	5,203	8,126	10,451	11,064	11,622	11,730	12,044
Gross wage of tertiary educated	7,357	11,217	12,981	13,593	14,419	14,482	14,626
Service workers							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Share in the total employment	11.1	11.3	11.2	11.4	11.5	12.1	12.3
Share in the tertiary educated	1.3	1.6	2.3	2.8	3.0	3.3	3.6
Age	33.0	35.0	36.4	36.7	37.2	37.6	38.0
Gross wage	4,225	6,369	8,286	8,862	9,365	9,458	9,859
Gross wage of tertiary educated	6,698	9,654	11,006	11,411	12,295	12,286	12,766
Craft workers							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Share in the total employment	15.8	16.8	17.8	18.0	18.2	17.9	17.4
Share in the tertiary educated	0.4	0.7	1.3	1.4	1.5	1.6	1.7
Age	35.0	36.6	38.2	38.3	38.6	39.1	39.6
Gross wage	4,553	6,827	9,054	9,615	10,218	10,244	10,631
Gross wage of tertiary educated	6,689	10,606	13,804	14,393	15,984	15,680	15,744
Machinery workers							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Share in the total employment	27.8	23.1	19.0	18.2	17.5	15.8	15.5
Share in the tertiary educated	4.9	5.9	2.5	2.3	2.4	2.1	2.0
Age	35.3	37.4	39.4	39.7	40.1	40.6	41.2
Gross wage	4,582	7,120	9,468	10,154	10,601	10,529	11,241
Gross wage of tertiary educated	6,210	8,512	12,522	13,744	14,427	14,645	16,352
Elementary workers							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Share in the total employment	7.2	11.2	13.1	13.5	13.8	13.4	13.1
Share in the tertiary educated	0.1	0.2	0.5	0.5	0.6	0.6	0.7
Age	35.8	36.5	37.9	38.1	38.5	39.2	40.0
Gross wage	3,664	5,400	7,031	7,483	7,700	7,815	8,385
Gross wage of tertiary educated	4,942	6,463	8,340	8,702	9,619	9,334	9,571

Note. Explanations of the variables are the following: Share in the total employment: share of a particular occupational group in the total employment (in %); Share in the tertiary educated: share of a particular occupational group in the total number of tertiary educated employees (in %); Age: mean age of a particular occupational group; Gross wage: mean gross annual wage a particular occupational group in €; Gross wage of tertiary educated: mean gross annual wage of tertiary educated employees in €.

Source: SORS, author's calculations

Table C3. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.132***	0.063**	0.094***	0.325***	0.035	0.157**
	[3.10]	[2.05]	[3.21]	[3.55]	[0.50]	[2.15]
Outsourcing	0.824	0.212	0.606*	0.212	0.081	0.243
	[1.03]	[0.61]	[1.83]	[0.34]	[0.27]	[0.88]
log(capital per emp)	0.026*	0.020	0.027**	0.021*	-0.008	0.003
	[1.68]	[1.61]	[2.43]	[1.80]	[-0.85]	[0.45]
log(tfp)	-0.002	-0.018	-0.023	0.040**	-0.083***	-0.049***
	[-0.13]	[-1.07]	[-1.54]	[2.41]	[-6.00]	[-4.12]
log(export value)	0.004	0.001	0.002	-0.002	0.002	0.001
	[1.21]	[0.40]	[1.10]	[-0.66]	[0.93]	[0.34]
log(gross wage)	0.545***	0.199***	0.247***	0.605***	0.150***	0.256***
	[9.42]	[5.20]	[6.40]	[15.7]	[5.99]	[9.82]
log(domestic costs)	0.161***	0.049**	0.104***	0.124***	0.065***	0.085***
	[9.02]	[2.31]	[6.96]	[9.26]	[3.98]	[7.75]
Constant	-5.224***	-0.606	-2.621***	-6.307***	-0.905	-2.194***
	[-5.10]	[-0.97]	[-5.70]	[-15.2]	[-1.32]	[-6.53]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.074	0.068		0.034	0.023
R-squared (between)		0.108	0.195		0.042	0.228
R-squared (overall)	0.229	0.116	0.201	0.236	0.049	0.219
Sargan-Hansen statistics		354.150***			691.538***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated workers are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Outsourcing: share of intermediate imports in the total material costs; log(capital per emp): logarithm of the capital per employee in a firm; log(tfp): logarithm of the total factor productivity per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C4. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, robustness checks: include firm size as explanatory variable (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.133***	0.064**	0.092***	0.256***	0.028	0.120
	[3.11]	[2.06]	[3.10]	[2.75]	[0.40]	[1.62]
Outsourcing	0.831	0.164	0.491	0.023	-0.085	0.022
	[1.04]	[0.47]	[1.48]	[0.037]	[-0.28]	[0.078]
log(capital per emp)	0.025	0.024*	0.033***	0.027**	0.007	0.016**
	[1.57]	[1.81]	[2.89]	[2.32]	[0.82]	[2.05]
log(tfp)	-0.005	-0.002	0.008	0.142***	-0.001	0.040***
	[-0.17]	[-0.12]	[0.46]	[5.77]	[-0.073]	[2.93]
log(export value)	0.004	0.001	0.002	-0.003	0.002	0.001
	[1.21]	[0.38]	[0.99]	[-0.71]	[0.94]	[0.39]
log(gross wage)	0.545***	0.195***	0.239***	0.557***	0.119***	0.222***
	[9.29]	[5.05]	[6.18]	[14.4]	[4.86]	[8.73]
log(domestic costs)	0.162***	0.036	0.078***	0.068***	0.003	0.016
	[6.36]	[1.52]	[3.96]	[3.64]	[0.19]	[1.22]
log(employment)	-0.004	0.035	0.062**	0.171***	0.232***	0.222***
	[-0.098]	[0.97]	[2.15]	[5.01]	[6.73]	[8.67]
Constant	-5.235***	-0.538	-2.476***	-5.900***	-0.488	-1.628***
	[-5.05]	[-0.85]	[-5.14]	[-13.8]	[-0.73]	[-4.73]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,951	18,951	18,951	29,599	29,599	29,599
R-squared (within)		0.074	0.068		0.040	0.028
R-squared (between)		0.112	0.194		0.048	0.224
R-squared (overall)	0.074	0.120	0.200	0.040	0.055	0.216
Sargan-Hansen statistics		357.793***			665.504***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated workers are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Outsourcing: share of intermediate imports in the total material costs; log(capital per emp): logarithm of the capital per employee in a firm; log(tfp): logarithm of the total factor productivity per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level; log(employment): logarithm of the number of employees. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C5. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms; robustness checks: exchange total factor productivity for value added (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.135***	0.064**	0.097***	0.308***	0.030	0.162**
	[3.14]	[2.06]	[3.31]	[3.39]	[0.42]	[2.19]
Outsourcing	0.818	0.216	0.617*	0.166	0.108	0.275
	[1.03]	[0.62]	[1.89]	[0.27]	[0.36]	[0.98]
log(capital per emp)	0.023	0.019	0.025**	0.006	-0.006	0.001
	[1.51]	[1.55]	[2.27]	[0.50]	[-0.64]	[0.17]
log(value added per emp)	0.014	-0.009	-0.005	0.125***	-0.041***	0.003
	[0.46]	[-0.50]	[-0.29]	[5.35]	[-2.78]	[0.23]
log(export value)	0.004	0.001	0.002	-0.003	0.002	0.001
	[1.28]	[0.41]	[1.19]	[-0.68]	[0.89]	[0.29]
log(gross wage)	0.538***	0.199***	0.245***	0.566***	0.148***	0.248***
	[9.19]	[5.20]	[6.36]	[14.6]	[5.90]	[9.51]
log(domestic costs)	0.161***	0.054**	0.112***	0.101***	0.076***	0.090***
	[11.3]	[2.45]	[7.51]	[8.04]	[4.53]	[7.99]
Constant	-5.282***	-0.721	-2.878***	-6.281***	-1.332*	-2.591***
	[-5.27]	[-1.16]	[-6.83]	[-16.1]	[-1.91]	[-7.93]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,951	18,951	18,951	29,599	29,599	29,599
R-squared (within)		0.075	0.069		0.031	0.020
R-squared (between)		0.101	0.193		0.048	0.233
R-squared (overall)	0.230	0.109	0.199	0.237	0.053	0.223
Sargan-Hansen statistics		419.160***				703.551***

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated workers are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Outsourcing: share of intermediate imports in the total material costs; log(capital per emp): logarithm of the capital per employee in a firm; log(value added per emp): logarithm of the value added per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C6. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, robustness checks: include firm size as explanatory variable; robustness checks: exchange total factor productivity for value added (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.133***	0.064**	0.093***	0.253***	0.028	0.120
	[3.12]	[2.06]	[3.13]	[2.72]	[0.39]	[1.62]
Outsourcing	0.798	0.152	0.473	0.023	-0.089	0.020
	[0.99]	[0.44]	[1.43]	[0.04]	[-0.29]	[0.07]
log(capital per emp)	0.024	0.024*	0.031***	0.007	0.007	0.010
	[1.50]	[1.84]	[2.76]	[0.62]	[0.79]	[1.29]
log(value added per emp)	0.017	0.001	0.012	0.146***	0.004	0.043***
	[0.54]	[0.07]	[0.72]	[5.94]	[0.26]	[3.18]
log(export value)	0.004	0.001	0.002	-0.003	0.002	0.001
	[1.25]	[0.40]	[1.02]	[-0.71]	[0.94]	[0.39]
log(gross wage)	0.537***	0.195***	0.238***	0.555***	0.118***	0.221***
	[9.16]	[5.05]	[6.17]	[14.3]	[4.82]	[8.70]
log(domestic costs)	0.157***	0.034	0.076***	0.067***	0.002	0.015
	[6.14]	[1.45]	[3.83]	[3.62]	[0.11]	[1.16]
log(employment)	0.006	0.038	0.057**	0.065***	0.235***	0.193***
	[0.20]	[1.20]	[2.38]	[2.69]	[7.68]	[8.85]
Constant	-5.235***	-0.534	-2.466***	-5.886***	-0.498	-1.646***
	[-5.05]	[-0.85]	[-5.14]	[-13.9]	[-0.74]	[-4.79]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,951	18,951	18,951	29,599	29,599	29,599
R-squared (within)		0.076	0.070		0.040	0.028
R-squared (between)		0.107	0.192		0.049	0.225
R-squared (overall)	0.230	0.115	0.199	0.238	0.056	0.216
Sargan-Hansen statistics			427.403***			663.622***

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated workers are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Outsourcing: share of intermediate imports in the total material costs; log(capital per emp): logarithm of the capital per employee in a firm; log(value added per emp): logarithm of the value added per employee; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level; log(employment): logarithm of the number of employees. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C7. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, differentiating between high- and low-income countries (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.183***	0.052*	0.082***	0.304***	0.066	0.174**
	[3.90]	[1.67]	[2.75]	[2.86]	[0.91]	[2.46]
Offshoring_high	-0.132**	0.038	0.041	0.074	-0.130*	-0.067
	[-2.32]	[1.14]	[1.21]	[0.54]	[-1.68]	[-0.72]
Outsourcing	-0.347	-0.567	-0.393	-0.602	-0.358	-0.207
	[-0.18]	[-0.58]	[-0.43]	[-0.36]	[-0.64]	[-0.31]
Outsourcing_high	1.340	0.939	1.193	0.972	0.49	0.513
	[0.58]	[0.89]	[1.19]	[0.52]	[0.73]	[0.66]
High	0.090*	0.001	0.017	-0.020	0.007	-0.003
	[1.84]	[0.034]	[0.77]	[-0.51]	[0.29]	[-0.15]
log(capital per emp)	0.026*	0.020	0.027**	0.021*	-0.008	0.003
	[1.69]	[1.61]	[2.43]	[1.79]	[-0.85]	[0.45]
log(tfp)	-0.002	-0.018	-0.023	0.040**	-0.083***	-0.049***
	[-0.088]	[-1.08]	[-1.54]	[2.41]	[-6.00]	[-4.12]
log(export value)	0.004	0.001	0.002	-0.003	0.002	0.001
	[1.07]	[0.42]	[1.15]	[-0.71]	[0.94]	[0.31]
log(gross wage)	0.540***	0.200***	0.247***	0.604***	0.149***	0.256***
	[9.38]	[5.21]	[6.40]	[15.7]	[5.99]	[9.82]
log(domestic costs)	0.161***	0.049**	0.104***	0.124***	0.064***	0.085***
	[9.01]	[2.33]	[6.94]	[9.26]	[3.97]	[7.75]
Constant	-5.305***	-0.608	-2.638***	-6.289***	-0.901	-2.190***
	[-5.17]	[-0.98]	[-5.74]	[-15.1]	[-1.31]	[-6.50]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.074	0.068		0.034	0.023
R-squared (between)		0.109	0.196		0.041	0.228
R-squared (overall)	0.230	0.116	0.201	0.236	0.048	0.219
Sargan-Hansen statistics		369.865***			703.304 ***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated workers are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries; log(capital per emp): logarithm of the capital per employee in a firm; log(tfp): logarithm of the total factor productivity per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C8. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, using occupational classification for defining skills (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.145***	0.040	0.058**	0.161**	0.040	0.086*
	[3.84]	[1.57]	[2.44]	[2.16]	[0.79]	[1.82]
Offshoring_high	-0.017	0.014	0.013	-0.072	-0.171*	-0.139
	[-0.39]	[0.55]	[0.54]	[-0.53]	[-1.68]	[-1.13]
Outsourcing	2.326	0.886	1.035	-1.086	-0.294	-0.190
	[1.15]	[1.09]	[1.34]	[-0.77]	[-0.24]	[-0.19]
Outsourcing_high	-1.383	-0.492	-0.516	1.345	-0.263	-0.237
	[-0.56]	[-0.53]	[-0.57]	[0.84]	[-0.20]	[-0.21]
High	0.051	0.001	0.010	0.024	-0.023	-0.018
	[1.11]	[0.056]	[0.49]	[0.69]	[-1.15]	[-1.01]
log(capital per emp)	2.970E-04	-0.004	3.570E-04	0.011	-0.008	-0.004
	[0.022]	[-0.37]	[0.038]	[1.02]	[-0.94]	[-0.58]
log(tfp)	0.110***	0.021	0.032**	0.147***	-0.015	0.026**
	[6.26]	[1.19]	[2.10]	[10.0]	[-1.05]	[2.16]
log(export value)	-0.006**	-0.001	-0.002	0.003	0.002	0.002
	[-2.26]	[-0.48]	[-0.93]	[0.81]	[0.92]	[1.11]
log(gross wage)	0.413***	0.208***	0.240***	0.374***	0.173***	0.230***
	[7.39]	[5.52]	[6.45]	[12.8]	[7.29]	[9.95]
log(domestic costs)	0.065***	-0.007	0.019	0.033***	0.013	0.010
	[3.98]	[-0.35]	[1.29]	[2.83]	[0.81]	[0.93]
Constant	-2.433***	1.292**	-0.095	-1.902***	1.914***	0.378
	[-3.86]	[2.34]	[-0.17]	[-5.30]	[4.69]	[1.15]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.032	0.026		0.019	0.013
R-squared (between)		0.022	0.135		0.062	0.204
R-squared (overall)	0.186	0.031	0.152	0.206	0.057	0.192
Sargan-Hansen statistics		1,372.538***			397.351 ***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where Managers, Professionals, and Technicians in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries; log(capital per emp): logarithm of the capital per employee in a firm; log(tfp): logarithm of the total factor productivity per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C9. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, for the occupational group "Managers" (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.170***	-0.002	0.007	0.179	0.056	0.043
	[3.40]	[-0.07]	[0.22]	[1.60]	[0.59]	[0.50]
Offshoring_high	0.068	0.032	0.027	-0.121	-0.062	-0.089
	[1.31]	[0.83]	[0.72]	[-0.67]	[-0.37]	[-0.55]
Outsourcing	4.070*	0.531	0.578	-1.904	0.210	-0.118
	[1.75]	[0.83]	[0.91]	[-1.06]	[0.36]	[-0.21]
Outsourcing_high	-3.510	-0.560	-0.746	2.035	-0.6	-0.307
	[-1.24]	[-0.61]	[-0.82]	[1.04]	[-0.84]	[-0.45]
High	0.085	-0.009	-0.001	0.005	0.008	0.013
	[1.64]	[-0.38]	[-0.063]	[0.11]	[0.34]	[0.58]
log(capital per emp)	0.013	0.024**	0.021*	-0.011	0.019*	0.011
	[0.88]	[1.97]	[1.90]	[-0.87]	[1.89]	[1.31]
log(tfp)	0.141***	0.026	0.045***	0.134***	0.007	0.030**
	[6.98]	[1.47]	[2.82]	[7.78]	[0.48]	[2.39]
log(export value)	-0.004	0.001	-3.500E-04	0.003	-0.001	-0.001
	[-1.15]	[0.25]	[-0.17]	[0.83]	[-0.47]	[-0.43]
log(gross wage)	0.359***	0.252***	0.266***	0.296***	0.172***	0.192***
	[6.79]	[5.88]	[6.53]	[8.98]	[6.92]	[8.35]
log(domestic costs)	-0.085***	-0.055***	-0.068***	-0.030**	-0.002	-0.027**
	[-4.70]	[-2.68]	[-4.44]	[-2.10]	[-0.13]	[-2.13]
Constant	-0.331	0.533	-0.554	-0.71	0.385	-0.019
	[-0.47]	[0.90]	[-0.95]	[-1.40]	[0.91]	[-0.048]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.036	0.033		0.016	0.013
R-squared (between)		0.022	0.067		0.012	0.038
R-squared (overall)	0.113	0.030	0.083	0.052	0.014	0.040
Sargan-Hansen statistics		458.321***			122.457***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where Managers in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries; log(capital per emp): logarithm of the capital per employee in a firm; log(tfp): logarithm of the total factor productivity per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C10. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, for the occupational group "Professionals" (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.235***	0.046	0.100**	0.327***	0.128	0.249***
	[4.00]	[1.02]	[2.47]	[3.18]	[1.37]	[2.97]
Offshoring_high	0.041	0.096**	0.113***	0.421***	0.053	0.114
	[0.57]	[2.20]	[2.68]	[2.79]	[0.39]	[0.88]
Outsourcing	-0.521	-1.030	-0.744	0.456	-0.134	0.048
	[-0.76]	[-1.11]	[-0.87]	[0.36]	[-0.29]	[0.11]
Outsourcing_high	1.034	1.474	1.583	0.176	0.264	0.233
	[1.07]	[1.19]	[1.30]	[0.11]	[0.49]	[0.44]
High	0.027	0.025	0.035*	0.050*	0.008	0.018
	[0.87]	[1.21]	[1.85]	[1.82]	[0.42]	[1.02]
log(capital per emp)	-0.019*	0.009	0.008	0.020***	-0.004	0.006
	[-1.87]	[0.89]	[0.96]	[2.63]	[-0.48]	[1.10]
log(tfp)	-0.057***	-0.044***	-0.057***	-0.061***	-0.071***	-0.061***
	[-4.38]	[-3.31]	[-5.19]	[-5.24]	[-6.68]	[-7.03]
log(export value)	0.001	0.001	0.002	0.001	0.002	0.002
	[0.30]	[0.36]	[1.18]	[0.38]	[1.43]	[1.21]
log(gross wage)	0.336***	0.055**	0.110***	0.349***	0.074***	0.146***
	[8.84]	[2.41]	[5.16]	[14.7]	[4.46]	[9.51]
log(domestic costs)	0.160***	0.073***	0.125***	0.065***	0.062***	0.065***
	[14.0]	[3.56]	[10.8]	[7.36]	[4.89]	[8.45]
Constant	-4.416***	-1.177**	-1.786***	-3.382***	-1.679***	-1.637***
	[-8.39]	[-2.28]	[-2.70]	[-12.6]	[-3.15]	[-7.94]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.057	0.051		0.027	0.020
R-squared (between)		0.212	0.313		0.057	0.190
R-squared (overall)	0.313	0.202	0.294	0.208	0.070	0.196
Sargan-Hansen statistics		217.669***			367.532***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where Professionals in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries; log(capital per emp): logarithm of the capital per employee in a firm; log(tfp): logarithm of the total factor productivity per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C11. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, for the occupational group "Technicians" (observation period: 1997-2010)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	-0.054	-0.019	-0.006	0.031	-0.046	0.047
	[-1.07]	[-0.59]	[-0.21]	[0.25]	[-0.60]	[0.66]
Offshoring_high	-0.234***	-0.026	-0.033	-0.199	-0.258**	-0.168*
	[-3.93]	[-0.73]	[-0.95]	[-1.11]	[-2.51]	[-1.82]
Outsourcing	-1.239	1.154	1.225	3.336**	0.036	0.860
	[-0.82]	[1.04]	[1.09]	[2.17]	[0.029]	[0.74]
Outsourcing_high	2.101	-0.785	-0.436	-3.421**	0.298	-0.342
	[1.25]	[-0.61]	[-0.34]	[-2.08]	[0.24]	[-0.29]
High	-0.002	-0.031	-0.018	-0.006	-0.021	-0.036
	[-0.041]	[-1.17]	[-0.72]	[-0.14]	[-0.77]	[-1.46]
log(capital per emp)	1.370E-04	-0.016	-0.006	0.011	-0.035***	-0.021**
	[0.01]	[-1.14]	[-0.52]	[0.94]	[-3.28]	[-2.38]
log(tfp)	-0.059***	-0.076***	-0.080***	-0.125***	-0.141***	-0.139***
	[-3.03]	[-3.86]	[-4.79]	[-7.58]	[-8.59]	[-10.5]
log(export value)	-0.002	0.001	0.001	-0.001	0.001	0.001
	[-0.71]	[0.49]	[0.36]	[-0.15]	[0.27]	[0.32]
log(gross wage)	0.284***	0.065*	0.104***	0.175***	0.013	0.064***
	[5.69]	[1.71]	[2.98]	[5.98]	[0.55]	[3.19]
log(domestic costs)	0.233***	0.117***	0.179***	0.248***	0.136***	0.198***
	[14.4]	[5.04]	[11.8]	[19.1]	[6.92]	[16.5]
Constant	-5.389***	-0.737	-2.071***	-4.510***	0.24	-1.670***
	[-11.4]	[-1.04]	[-2.85]	[-11.2]	[0.45]	[-5.32]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.036	0.031		0.035	0.028
R-squared (between)		0.149	0.237		0.062	0.164
R-squared (overall)	0.249	0.133	0.225	0.175	0.061	0.165
Sargan-Hansen statistics		542.600***			307.545***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where Technicians in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries; log(capital per emp): logarithm of the capital per employee in a firm; log(tfp): logarithm of the total factor productivity per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C12. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, using educational level and occupational classification for defining skills (observation period: 1997-2010, only tertiary educated)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.215***	0.048	0.080***	0.411***	0.107	0.214***
	[4.45]	[1.56]	[2.76]	[3.76]	[1.52]	[3.08]
Offshoring_high	-0.111*	0.051	0.056*	0.106	-0.015	0.036
	[-1.89]	[1.57]	[1.73]	[0.78]	[-0.15]	[0.35]
Outsourcing	-1.452	-0.884	-0.638	-0.218	0.058	0.221
	[-1.11]	[-0.82]	[-0.62]	[-0.13]	[0.15]	[0.43]
Outsourcing_high	2.852*	1.074	1.295	0.376	-0.145	-0.133
	[1.72]	[0.92]	[1.15]	[0.20]	[-0.33]	[-0.24]
High	0.089*	0.010	0.024	-0.001	-0.006	-0.011
	[1.84]	[0.41]	[1.05]	[-0.029]	[-0.28]	[-0.53]
log(capital per emp)	0.015	0.024**	0.0280***	0.029***	-0.007	0.006
	[1.00]	[1.99]	[2.61]	[2.59]	[-0.76]	[0.79]
log(tfp)	-0.016	-0.028*	-0.034**	0.071***	-0.064***	-0.031***
	[-0.81]	[-1.68]	[-2.33]	[4.26]	[-4.81]	[-2.66]
log(export value)	0.003	0.001	0.003	-5.360E-05	0.002	0.001
	[0.83]	[0.66]	[1.33]	[-0.014]	[0.94]	[0.48]
log(gross wage)	0.573***	0.213***	0.260***	0.637***	0.182***	0.281***
	[10.6]	[6.49]	[7.77]	[16.5]	[7.67]	[11.3]
log(domestic costs)	0.161***	0.032	0.089***	0.116***	0.059***	0.075***
	[9.22]	[1.62]	[6.20]	[8.85]	[3.87]	[7.15]
Constant	-6.237***	-0.509	-2.577***	-6.993***	-1.401**	-2.578***
	[-9.73]	[-0.88]	[-5.92]	[-17.5]	[-2.04]	[-7.95]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.068	0.061		0.0357	0.025
R-squared (between)		0.118	0.209		0.0769	0.247
R-squared (overall)	0.254	0.129	0.222	0.258	0.083	0.239
Sargan-Hansen statistics		414.314***			709.736***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated Managers, Professionals, and Technicians in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries; log(capital per emp): logarithm of the capital per employee in a firm; log(tfp): logarithm of the total factor productivity per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C13. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, for the occupational group "Managers" (observation period: 1997-2010, only tertiary educated)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.178***	0.020	0.044	0.421***	0.189**	0.226***
	[3.59]	[0.54]	[1.22]	[3.58]	[2.19]	[2.80]
Offshoring_high	-0.016	0.055	0.058	-0.064	-0.168	-0.158
	[-0.26]	[1.34]	[1.41]	[-0.35]	[-1.06]	[-1.03]
Outsourcing	-0.349	0.032	0.212	-0.588	-0.313	-0.187
	[-0.24]	[0.053]	[0.35]	[-0.34]	[-0.76]	[-0.42]
Outsourcing_high	1.641	-0.003	0.096	0.627	0.432	0.311
	[0.91]	[-3.30E-03]	[0.12]	[0.35]	[0.95]	[0.63]
High	0.064	0.017	0.027	-0.047	1.370E-04	-0.009
	[1.52]	[0.81]	[1.34]	[-1.29]	[0.01]	[-0.51]
log(capital per emp)	0.020	0.021*	0.023**	0.021**	0.006	0.011*
	[1.46]	[1.93]	[2.39]	[2.01]	[0.83]	[1.65]
log(tfp)	0.007	0.017	0.012	0.084***	-0.010	0.007
	[0.39]	[0.99]	[0.78]	[5.57]	[-0.88]	[0.75]
log(export value)	0.003	0.004*	0.004**	0.002	4.710E-04	2.390E-04
	[1.14]	[1.95]	[2.39]	[0.52]	[0.25]	[0.14]
log(gross wage)	0.406***	0.172***	0.202***	0.375***	0.095***	0.147***
	[8.90]	[5.44]	[6.44]	[11.8]	[5.14]	[7.98]
log(domestic costs)	0.021	-0.025	0.003	0.043***	0.030**	0.028***
	[1.32]	[-1.37]	[0.26]	[3.45]	[2.13]	[2.89]
Constant	-3.110***	0.175	-1.883***	-3.811***	-1.193*	-1.307***
	[-5.34]	[0.31]	[-3.97]	[-10.5]	[-1.93]	[-4.62]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.039	0.034		0.014	0.009
R-squared (between)		0.011	0.062		0.022	0.106
R-squared (overall)	0.101	0.013	0.065	0.118	0.026	0.103
Sargan-Hansen statistics		242.157***			328.416***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated Managers in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries; log(capital per emp): logarithm of the capital per employee in a firm; log(tfp): logarithm of the total factor productivity per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C14. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, for the occupational group "Professionals" (observation period: 1997-2010, only tertiary educated)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.258***	0.028	0.087**	0.348***	0.085	0.220***
	[4.43]	[0.64]	[2.23]	[3.50]	[1.17]	[3.19]
Offshoring_high	0.057	0.113***	0.131***	0.420***	0.038	0.097
	[0.79]	[2.66]	[3.14]	[2.83]	[0.31]	[0.81]
Outsourcing	-0.286	-1.126	-0.823	0.684	0.113	0.245
	[-0.49]	[-1.38]	[-1.11]	[0.57]	[0.36]	[0.81]
Outsourcing_high	0.504	1.165	1.233	-0.578	-0.133	-0.137
	[0.73]	[1.28]	[1.46]	[-0.42]	[-0.40]	[-0.40]
High	0.039	0.033*	0.042**	0.051*	0.001	0.012
	[1.36]	[1.74]	[2.45]	[1.89]	[0.05]	[0.72]
log(capital per emp)	-0.016*	0.012	0.012	0.014*	-0.005	0.004
	[-1.74]	[1.31]	[1.56]	[1.91]	[-0.75]	[0.70]
log(tfp)	-0.050***	-0.044***	-0.055***	-0.053***	-0.064***	-0.055***
	[-4.17]	[-3.72]	[-5.68]	[-4.73]	[-6.19]	[-6.52]
log(export value)	0.002	0.001	0.002*	1.020E-04	0.002	0.001
	[0.76]	[0.71]	[1.72]	[0.041]	[1.11]	[0.72]
log(gross wage)	0.327***	0.055***	0.107***	0.344***	0.076***	0.144***
	[8.83]	[2.69]	[5.49]	[14.6]	[4.75]	[9.63]
log(domestic costs)	0.150***	0.068***	0.116***	0.060***	0.050***	0.058***
	[14.0]	[4.98]	[13.6]	[7.21]	[4.16]	[7.80]
Constant	-4.256***	-1.199***	-2.367***	-3.232***	-1.426***	-1.583***
	[-8.35]	[-3.38]	[-8.75]	[-12.3]	[-2.60]	[-8.01]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.066	0.058		0.026	0.019
R-squared (between)		0.199	0.318		0.056	0.188
R-squared (overall)	0.325	0.196	0.303	0.207	0.067	0.194
Sargan-Hansen statistics		288.775***			371.799***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated Professionals in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries; log(capital per emp): logarithm of the capital per employee in a firm; log(tfp): logarithm of the total factor productivity per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations

Table C15. The effect of outsourcing and offshoring on the skill share in Slovenian manufacturing and service firms, for the occupational group "Technicians" (observation period: 1997-2010, only tertiary educated)

	Manufacturing firms			*Service firms*		
	Pooled OLS	**FE**	**RE**	**Pooled OLS**	**FE**	**RE**
Offshoring	0.195***	0.048	0.089**	0.378***	0.052	0.180**
	[3.68]	[1.28]	[2.55]	[3.57]	[0.53]	[2.19]
Offshoring_high	-0.141**	0.062	0.060	0.155	0.139	0.189*
	[-2.28]	[1.49]	[1.51]	[0.98]	[1.16]	[1.77]
Outsourcing	-1.068*	-0.011	-0.004	0.455	0.147	0.440
	[-1.81]	[-0.02]	[-0.01]	[0.56]	[0.32]	[1.04]
Outsourcing_high	2.164**	0.121	0.573	-0.343	0.221	0.091
	[2.10]	[0.19]	[0.97]	[-0.41]	[0.49]	[0.21]
High	0.018	0.002	0.007	-0.001	-0.005	-0.015
	[0.51]	[0.07]	[0.34]	[-0.041]	[-0.25]	[-0.76]
log(capital per emp)	0.003	-0.009	0.000	0.002	-0.020**	-0.009
	[0.30]	[-0.80]	[0.02]	[0.29]	[-2.49]	[-1.43]
log(tfp)	-0.038***	-0.052***	-0.057***	-0.078***	-0.087***	-0.083***
	[-2.80]	[-3.92]	[-5.38]	[-6.38]	[-7.33]	[-9.10]
log(export value)	-0.001	-0.002	-0.001	0.002	0.001	0.001
	[-0.50]	[-1.11]	[-0.74]	[0.88]	[0.26]	[0.37]
log(gross wage)	0.224***	0.088***	0.120***	0.259***	0.068***	0.123***
	[7.22]	[3.73]	[5.69]	[10.6]	[4.07]	[8.21]
log(domestic costs)	0.173***	0.058***	0.120***	0.133***	0.065***	0.110***
	[15.4]	[3.81]	[12.3]	[13.6]	[5.03]	[14.4]
Constant	-4.653***	-1.139***	-1.903***	-4.008***	-0.291	-1.976***
	[-13.5]	[-3.02]	[-3.71]	[-15.5]	[-0.96]	[-9.39]
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,919	18,919	18,919	29,591	29,591	29,591
R-squared (within)		0.056	0.049		0.025	0.019
R-squared (between)		0.139	0.249		0.047	0.129
R-squared (overall)	0.260	0.133	0.244	0.135	0.048	0.126
Sargan-Hansen statistics		248.219***			284.611***	

*Note. Econometric methods: Pooled OLS: pooled ordinary least squares; FE: fixed effects; RE: random effects. Dependent variable is defined as the logarithm of the ratio between skilled employees and the total number of employees, where tertiary educated Technicians in ISCO-88 classification are defined as skilled. Explanation of variables: Offshoring: dummy variable, controlling for outward FDI; Offshoring_high: dummy variable, controlling for outward FDI to high-income countries; Outsourcing: share of intermediate imports in the total material costs; Outsourcing_high: share of intermediate imports from high-income countries in the total material costs; High: dummy variable, controlling for high-income countries; log(capital per emp): logarithm of the capital per employee in a firm; log(tfp): logarithm of the total factor productivity per employee in a firm; log(export value): logarithm of the value of exports; log(gross wage): logarithm of the average annual gross wage level; log(domestic costs): logarithm of the domestic cost level. *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics in brackets, the analysis used cluster-robust standard errors.*

Source: SORS, author's calculations