UNIVERSITY OF LJUBLJANA
FACULTY OF ECONOMICS

MOJCA LINDIČ

INTERNATIONALIZATION OF FIRMS AND SKILL STRUCTURE

DOCTORAL DISSERTATION

Ljubljana, 2016

AUTHORSHIP STATEMENT

The undersigned Mojca Lindič, a student at the University of Ljubljana, Faculty of Economics, (hereafter: FELU), declare that I am the author of the doctoral dissertation entitled Internationalization of firms and skill structure, written under supervision of Full Professor Jože Damijan, PhD.

In accordance with the Copyright and Related Rights Act (Official Gazette of the Republic of Slovenia, Nr. 21/1995 with changes and amendments) I allow the text of my doctoral dissertation to be published on the FELU website.

I further declare

- the text of my doctoral dissertation to be based on the results of my own research;
- the text of my doctoral dissertation to be language-edited and technically in adherence with the FELU's Technical Guidelines for Written Works which means that I
    - cited and / or quoted works and opinions of other authors in my doctoral dissertation in accordance with the FELU's Technical Guidelines for Written Works and
    - obtained (and referred to in my doctoral dissertation) all the necessary permits to use the works of other authors which are entirely (in written or graphical form) used in my text;
- to be aware of the fact that plagiarism (in written or graphical form) is a criminal offence and can be prosecuted in accordance with the Copyright and Related Rights Act (Official Gazette of the Republic of Slovenia, Nr. 55/2008 with changes and amendments);
- to be aware of the consequences a proven plagiarism charge based on the submitted doctoral dissertation could have for my status at the FELU in accordance with the relevant FELU Rules on Doctoral Dissertation.

Date of public defence: 15 April 2016
Committee Chair: prof. dr. Črt Kostevc
Supervisor: prof. dr. Jože Damijan
Member: prof. dr. Katja Zajc Kejžar
Member: Professor Jozef Konings

Ljubljana, 15 April 2016 Author's signature:

Acknowledgements

This doctoral dissertation would not be possible to complete without the help of many people.

Foremost, I would like to express my gratitude to my mentor, prof. dr. Jože Damijan, for his guidance, valuable comments and suggestions, which benefited tremendously during the course of writing this doctoral dissertation and during doctoral studies in general.

I would like to extend my gratefulness to the committee members, prof. dr. Katja Zajc Kejžar, Professor Jozef Konings, PhD, and prof. dr. Črt Kostevc, whose recommendations for improvements and constructive feedback improved this dissertation substantially. In addition, I am indebted to prof. dr. Sašo Polanec, whose help has been invaluable.

Moreover, I gratefully acknowledge challenging questions and suggestions for improvements, received from fellow students, referees and conference discussants. I would also like to thank my current and former co-workers at the Bank of Slovenia, Faculty of Economics and UMAR for their support and insightful discussions, which contributed to this dissertation. Many thanks also to organizations and individuals, who enabled an access to the data used in this dissertation; the Statistical office of the Republic of Slovenia, the Tax Authorities of Slovenia, the Bank of Slovenia, and the Agency of the Republic of Slovenia for Public Legal Records and Related Services.

Finally and incomparably, I would like to express my sincere gratitude to Matej, my parents, Luka and his family, my inimitable friends and the rest of my family, who have been the irreplaceable cornerstones on my doctoral study's path. I consider myself extremely fortunate to be surrounded by so many individuals, who supported and encouraged me unconditionally during the times of hardships. I dedicate this doctoral dissertation to you and to my little angels.

INTERNATIONALIZATION OF FIRMS AND SKILL STRUCTURE

SUMMARY

The motivation for writing this doctoral dissertation is among others derived from statistical findings and forecasts on increasing international activities of firms, and the increasing employment of tertiary educated employees. The main aim of the dissertation is to study the linkages and causalities between international trade and the skill structure of firms.

The dissertation consists of three parts. The first part studies the mechanisms of skill upgrading in trading firms by developing a theoretical model that relates the individual's incentives for acquiring higher skills to the profit-maximizing behaviour of trading firms. Taking into account the behaviour of individuals and their decisions for skill upgrading, the first part of the model shows that only the high ability individuals have incentives for acquiring higher skills, as long as they are later compensated with higher wages after entering employment. These findings are incorporated in the second part of the model, which studies the behaviour of firms, in the way that higher wage levels signal a higher employment of high ability, high skilled employees. The second part of the model concludes that high-productive firms have incentives for investing in higher technology, to employ high-skilled labour, and to engage in international trade. The decisions for technology dress-up and skill upgrading coincide with the firm's decision to start importing and exporting as the latter requires higher technology and high-skilled labour.

The second part of the dissertation confirms some of the key implications of the theoretical model, by empirically studying the linkages between firms' skill structure, importing and exporting. The analysis emphasises the importance of importing, serving as a prerequisite for increasing the technology level through importing intermediate goods and/or technology before the start of exporting. In order to analyse these linkages, a rich employer-employee panel dataset for Slovenian manufacturing firms for the period 1996-2010 was used. The dataset encompasses several databases, covering the information on the balance sheet data and the income statements of firms, their import and export activities, and the characteristics of employees. The propensity score matching and several matching techniques were applied in order to increase the robustness of results. The results show that firms with a better skill structure self-select into importing and later also sustain a higher share of skilled employees in the first and second year after the start of importing, compared to non-importing firms. Also, import starters further increase their skill share in the second year after the start of importing. Studying the impact of importing on the start of exporting shows that the start of importing intermediate goods positively influences the start of exporting in the subsequent year after the start of importing, whereas the impact in the second year is uncommon. In contrast, importing capital goods has a positive impact on the start of exporting only in the second year after the start of importing. Therefore, the

results point toward almost an immediate impact of importing intermediate goods on the start of exporting, while the impact of capital goods takes longer to show effect.

The final part of the dissertation studies the effect of outsourcing and offshoring on the skill structure of firms. The study analyses whether controlling for both activities in one model alters the previous empirical studies, which controlled only for one factor; whether controlling for a destination country of outsourcing and offshoring brings new insights; and whether controlling for the occupational level of workers brings additional contributions. Specifically, 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 estimate the abovementioned hypotheses, a matched employer-employee dataset for Slovenian manufacturing and service firms between 1997 and 2010, and the methods for panel data analysis were used (i.e. pooled OLS, fixed effects, and random effects). The results of the model on average show a positive impact of offshoring on the skill share of firms, while the impact of outsourcing is uncommon. When controlling for high- and low-income countries, the results for manufacturing firms show a positive and similar impact on the share of skilled employees for offshoring to both groups of countries. In service firms, results show a weaker impact of offshoring to high-income countries on the relative employment of skilled employees, compared to offshoring to low-income countries. When taking into account also the occupational levels for defining skills, offshoring to high-income countries shows a stronger impact on the relative employment of Professionals in manufacturing firms, as compared to offshoring to low-income countries. While the results for manufacturing firms do not vary significantly when using different definitions of skilled labour, this does not hold for the results of service firms. When defining skills only by the occupational level, offshoring to high-income countries shows a weaker impact on the relative employment of Technicians in comparison to the impact of offshoring to low-income countries. When defining skills by occupational and educational level, offshoring to high- and low-income countries shows a positive and similar impact on the relative employment of tertiary educated Managers. The impact of education therefore differs between occupational groups, indicating that firms differentiate between more and less educated individuals within the same occupational group.

This doctoral dissertation contributes to the field of knowledge in several ways. First, besides analysing the behaviour of heterogeneous firms, the theoretical model also studies the behaviour of individuals and their decision for skill upgrading. This is important since individuals' decisions later influence the labour demand of firms. Second, when studying the sequencing between importing, skill upgrading and exporting, different types of importing were taken into account to further deepen the explanatory power of the analysis. Finally, the analysis introduces a novel approach for defining skills, by controlling also for the occupational level of workers. This is important since individuals do not obtain skills only while acquiring education, but also during the course of employment.

Keywords: importing, exporting, skill structure of firms, offshoring, outsourcing.

INTERNACIONALIZACIJA PODJETIJ TER STRUKTURA ZNANJA ZAPOSLENIH

POVZETEK

Motivacija za pisanje doktorske disertacije izhaja iz statističnih podatkov za zadnje obdobje, ki – z izjemo obdobja gospodarske recesije – kažejo rast uvoza in izvoza ter rast deležev in stopenj zaposlenosti terciarno izobraženih. Namen doktorske disertacije je analiza povezav in vzročnosti med mednarodno trgovino in strukturo zaposlenih.

Prvi del doktorske disertacije v teoretičnem modelu analizira strukturo znanja zaposlenih v mednarodno delujočih podjetjih. Model najprej analizira posameznikove odločitve glede nadgrajevanja znanja, kjer rezultati kažejo, da se za dodatno izobraževanje odločijo le najbolj sposobni posamezniki, če so za to kasneje v času zaposlitve kompenzirani z višjim plačilom. Ti zaključki so kasneje vključeni v drugi del modela, ki analizira odločitve podjetij, in sicer v predpostavki, da višji stroški plač signalizirajo višje stopnje zaposlenosti visoko usposobljenih in visoko izobraženih posameznikov. Zaključki modela kažejo pozitivne učinke na visoko produktivna podjetja, če ta vlagajo v visoko tehnologijo, če izboljšajo strukturo zaposlenih in če pričnejo z mednarodno aktivnostjo. Odločitev podjetja za izboljšanje tehnologije se sklada z odločitvijo za začetek uvažanja in izvažanja, saj mednarodne aktivnosti podjetij zahtevajo višjo raven tehnologije in boljšo strukturo znanja zaposlenih.

Izsledki teoretičnega modela so bili v nadaljevanju analizirani v empiričnem modelu, katerega namen je bil predvsem preverba, ali se podjetja z boljšo izobrazbeno strukturo zaposlenih odločijo za začetek uvažanja; ali imajo uvozniki boljšo izobrazbeno strukturo kot podjetja, ki ne uvažajo; ter ali uvoz preko dostopa do vmesnih proizvodov in/ali do tehnologije služi kot sredstvo povišanja ravni tehnologije podjetja pred začetkom izvažanja. Za potrebe analize so bili uporabljeni panelni podatki na ravni podjetij in zaposlenih v predelovalnih dejavnostih v Sloveniji v obdobju od leta 1996 do 2010. Podatki združujejo baze z informacijami o bilancah stanja in izkazih uspeha podjetij, uvozu in izvozu, ter lastnostih zaposlenih. Zgoraj omenjene hipoteze so bile analizirane z metodo *propensity score matching*, z namenom večje robustnosti rezultatov pa je bilo uporabljenih več različic *matching* tehnik. Rezultati kažejo, da začnejo uvažati podjetja z relativno boljšo strukturo znanja zaposlenih ter da podjetja po začetku uvažanja tudi ohranijo boljšo strukturo znanja zaposlenih v primerjavi s podjetji, ki ne uvažajo. Poleg tega podjetja v drugem letu po začetku uvažanja še izboljšajo strukturo znanja zaposlenih. V nadaljevanju sem z analizo proučevala vpliv uvažanja na začetek izvažanja. Rezultati nakazujejo, da je eno leto po začetku uvažanja vmesnih proizvodov vpliv na začetek izvažanja pozitiven, medtem ko je vpliv v drugem letu neznačilen. Po drugi strani pa ima začetek uvažanja kapitalskih dobrin pozitiven vpliv na začetek izvažanja šele v drugem letu po začetku uvažanja. Ti rezultati nakazujejo na skoraj takojšen vpliv začetka uvažanja

vmesnih dobrin na začetek izvažanja, medtem ko se vpliv začetka uvažanja kapitalskih dobrin zgodi z zamikom.

Motivacija za pisanje tretje študije, ki proučuje vpliv *outsourcinga* in *offshoringa* na strukturo znanja v podjetjih, izvira iz želje po doprinosu k obstoječim raziskavam preko vključitve obeh mer – *offshoringa* in *outsourcinga* – v en model. Analiza med drugim kontrolira tudi za visoko in nizko razvite države, definicija znanja posameznika pa vključuje tudi vrsto poklica posameznika. Tri glavne skupine poklicev definirajo posameznike z višjo stopnjo znanja: vodje (*Managers*), profesionalci (*Professionals*), in tehniki (*Technicians*). Za potrebe analize so bili ponovno uporabljeni slovenski panelni podatki na ravni zaposlenih in podjetij. Analiza je obravnavala obdobje med leti 1997 in 2010 in podjetja v predelovalnih ter storitvenih dejavnostih, uporabljene pa so bile ocenjevalne metode za panelne podatke (*pooled OLS* oziroma metoda najmanjših kvadratov, metoda fiksnih učinkov ter metoda slučajnih učinkov). Rezultati modelov v povprečju nakazujejo pozitiven vpliv *offshoringa* na strukturo znanja podjetij. Analiza v predelovalnih dejavnostih kaže, da ima *offshoring* v visoko razvite države pozitiven in podoben vpliv na strukturo znanja podjetij kot *offshoring* v nizko razvite države. V storitvenih podjetjih pa rezultati nakazujejo na šibkejši vpliv *offshoringa* v visoko razvite države v primerjavi z *offshoringom* v nizko razvite države. Ko se v definicijo znanja zaposlenih vključi tudi poklic posameznika, rezultati za predelovalna podjetja kažejo na močnejši vpliv *offshoringa* v visoko razvite države na relativno stopnjo zaposlenosti profesionalcev, v primerjavi z *offshoringom* v nizko razvite države. Rezultati za podjetja v predelovalnih dejavnostih se ne spremenijo bistveno, ko so uporabljene različne definicije ravni znanja v podjetjih. Nasprotno pa se rezultati ob uporabi različnih definicij bistveno razlikujejo v storitvenih podjetjih. Ko definicija znanja zajema le poklic posameznika, ima *offshoring* v visoko razvite države šibkejši vpliv na relativno zaposlenost tehnikov kot *offshoring* v nizko razvite države. Ko definicija znanja zajema tako poklic posameznika kot tudi stopnjo izobrazbe, pa *offshoring* v visoko razvite in nizko razvite države kaže primerljiv in pozitiven vpliv na relativno stopnjo zaposlenosti terciarno izobraženih vodij. Stopnja izobrazbe ima tako različen vpliv na zaposlenost različnih skupin poklicev.

Glavni prispevki doktorske disertacije so naslednji. Teoretični model poleg proučevanja vedenja podjetij proučuje tudi vedenje posameznikov in njihove odločitve glede vlaganja v nadaljnje izobraževanje. Proučevanje odnosa posameznikov je pomembno z vidika kasnejšega vpliva teh odločitev na povpraševanje po delovni sili podjetij. Analiza vpliva uvoza na začetek izvažanja kontrolira tudi vrsto uvoza z namenom povečanja razlagalne moči analize. Zadnja prednost pa je vključitev stopnje poklica v definicijo znanja zaposlenih. Slednje je pomembno zaradi dejstva, da je vseživljenjsko učenje vse bolj nujno in da zaposleni ne prenehajo z nadgrajevanjem svojega znanja, ko prenehajo z rednim izobraževanjem.

Ključne besede: uvoz, izvoz, struktura znanja zaposlenih, *offshoring*, *outsourcing*.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OB TABLES

INTRODUCTION

"*Every man [thus] lives by exchanging.*" (Adam Smith)

Description of the dissertation topic area

Trade has played an important role in the economic development, where three relatively recent waves have been especially important for international trade and the world in general; Industrial Revolution, post-war period after the both World wars, and the current wave after the 1980s. These landmarks improved transportation links and induced revolution in communication technologies, which in turn reduced distances and enabled the expansion of international trade (WTO, 2014).

Along with the changes in the society came also the changes in theoretical models of trade, where the exchange of goods was the economists' matter of interest for centuries. Theoretical trade models first focused mainly on exploring the effects of countries' different capabilities to produce certain products with the same amount of input. Before Smith's The Wealth of Nations, the Scottish philosopher David Hume benefited the trade theory by offering opposition to mercantilists by arguing that net exporting does not increase wealth as it leads to higher domestic prices, which eventually increases imports. Later, in the second half of the 18th century, Adam Smith developed a theory of absolute advantage in which countries trade, when their absolute labour productivities differ. In Smith's model, which uses labour as the only input, countries compare labour productivities in the production of a particular good and the country with the highest labour productivity becomes an exporter of that good. Each country therefore specialises in the production of the good with the absolute advantage and imports the less efficiently produced good from abroad. In the case when a country has no absolute advantage, trade does not occur (Krugman, Obstfeld & Melitz, 2012).

Half of a century later, David Ricardo presented a theory of relative advantage. In this model, a country exports a particular good if it has a relative advantage in the production of this good; that is if the good is produced with a lower level of the relative opportunity costs. Each country later specialises in the production of the comparative-advantage product. Regarding this theory, international trade occurs also when one of the countries does not have an absolute advantage in any production of goods. Using Ricardo's comparative advantage model as a benchmark, the Heckscher-Ohlin model (the H-O model) predicts that countries will adjust their production and trading on behalf of their factor endowments. This is a general equilibrium model of international trade and was developed by Eli Heckscher and Bertil Ohlin. Contrary to the previous two models, the H-O model assumes two factors of production, labour and capital, and compares the relative abundances of these factors between countries. A country with a higher capital-to-labour ratio (i.e. the capital abundant country) specialises in the production of the capital intensive

product and later exports it. Meanwhile, a labour abundant country specialises in producing and exporting a labour intensive product and imports a capital intensive product. Accordingly, the prices of the abundant factor rise as a consequence of trade. While there were no factor gains in Smith's or Ricardo's model due to the usage of only one factor in the model, the Stolper-Samuelson theorem in the H-O model indicates that the real returns of the factor-abundant owners will increase, and the real returns of the owners of the other factor will decrease as a consequence of trade (Krugman, Obstfeld & Melitz, 2012).

More recent models control also for different types of returns to scale and competition. Krugman (1979) developed a model, which uses a monopolistic competition as a framework and instead of using international differences in technology (as Smith and Ricardo) or differences in factor endowments (as in the H-O model), it uses the economies of scale as a driver of trade. As a result, trade develops also between countries that have similar levels of tastes, technology levels and factor endowments. Panagariya (1981) developed a model, which studies production patterns in a two-sector, a two-commodity model, where one commodity is produced in a sector with increasing returns to scale (IRS) and the other commodity is produced in a sector with decreasing returns to scale (DRS). The model assumes two open economies that differ in size and concludes that a large country will export an IRS commodity, while a small country will export a DRS commodity. In his later study, Krugman (1991) developed an economic geography model with the purpose of studying the reasons for the concentration of manufacturing in some regions, rather than others, by taking into account the economies of scale and the transportation costs. The result of the model is two-sided – on the one hand, with high transportation costs and weak economies of scale, the manufacturing production is concentrated around higher demand. On the other hand, low transportation costs and strong economies of scale increase the manufacturing production in the areas that already have a large concentration of manufacturing to start with.

The abovementioned papers concentrated mainly on studying the transnational exchange of goods between different countries on a level of a country or industry. In this regard, the Melitz (2003) model presents an important milestone in the theoretical models of trade by taking into account heterogeneous firms. In a closed economy, only the firms with a sufficient productivity level stay on the market and produce. When comparing incumbents and new entrants, the latter on average have a lower level of productivity and a higher probability to exit the market. In an open economy only the most productive firms export since they are able to endure the additional exporting costs. Again, the least productive firms exit the market. The exit of least productive firms and the increasing sales of exporting firms – a consequence of supplementary export sales – cause the relative productivity level in the economy to increase and transfer market shares and profits towards most productive firms.

The Melitz (2003) model presents groundwork for many theoretical trade models, which expand the model in several ways. Bustos (2011a) introduces an option to upgrade the

technology level. In the model, firms have an option to upgrade their level of technology by paying an additional fixed cost, which results in reducing their level of marginal costs of production. The model concludes that only the most productive firms upgrade technology and export, the firms with intermediate productivity levels export but do not upgrade their technology, while the least productive firms serve the domestic market without upgrading their technology levels.

In her following paper, Bustos (2011b) enhances the previous model by controlling for skill-upgrading within firms. Firms have an option to upgrade their technology level by investing in skill-intensive technology. Similarly as in the previous model, the adoption of a high-technology level entails higher fixed costs and lower marginal costs of production, while taking into account also the level of labour costs in the low- and high-technology firms. The wages of skilled employees present a higher share in those firms that adopt the skill intensive high-technology. Before trade liberalisation, appointed with high trade costs, firms again form three groups; the least productive firms do not export and continue using low-technology, the intermediate productive firms export but also use low technology, while the most productive firms export and upgrade their level of technology. After trade liberalisation, represented with a reduction in variable trade costs, the least productive firms arrange four different groups; the least productive exit the market, while the increasing productivity levels enable the firms to, first, stay on the domestic market, use low technology and downgrade skills, second, start exporting but downgrade skills and continue using low technology, and third, start exporting and upgrade the technology level and skills. Firms with the medium productivity level continue exporting, switch to high technology and upgrade skills, while the most productive firms continue using high technology and exporting but downgrade skills.

Finally, Amiti and Davis (2011) upgraded the Melitz (2003) model by controlling also for imports in the model, while evaluating the effect of trade liberalisation on wages. The model controls for imports by introducing a higher fixed cost for importing intermediates from a particular foreign market. Among others, the conclusions of the theoretical model point to the exit of the least productive firms, to a wage decrease of firms, serving only the domestic market, and to a wage increase of sufficiently large importers and exporters. Finally, the model also proposes that a firm with higher profits and wages will import a larger share of its inputs or export a larger share of its outputs.

Findings from the abovementioned theoretical models, indicating that importing and exporting firms have superior characteristics in comparison to non-trading firms, were empirically tested in several papers. This introductory part presents only a few empirical studies, whereas additional studies will be presented more in depth in the upcoming chapters. At first, the empirical studies mainly concentrated on analysing the characteristics of exporters. Studies confirm that exporters have a higher level of employment, wages and productivity, compared to non-exporters. One reason for this is the self-selection of firms into exporting as future exporters show superior characteristics

several years before they start exporting (see for example Yang & Mallick, 2010; and Bernard & Jensen, 1999). Bernard and Jensen (1999) find that before the start of exporting, the increase in firm size and wages, which in turn increases the prospects of becoming an exporter, is especially important. Bernard and Jensen (1999) emphasise that exporting brings several benefits to firms and individuals in the form of higher wages, better future employment opportunities, increased growth of shipments, innovation and productivity, increases in employment growth, and enhanced survival probability.

In addition to the self-selection of firms into exporting, studies also confirm learning-by-exporting. Taking into account a subsample of Slovenian manufacturing firms, Kostevc (2009) confirms previous studies on the self-selection of firms into exporting, but also finds that more productive exporters enter more competitive exporting markets, which in turn additionally increases their productivity, in comparison to exporters, serving less competitive markets. By establishing evidence for a higher growth of sales, productivity, and employment of new exporters, compared to non-exporting Chinese firms, Yang and Mallick (2010) also confirm learning-by-exporting of firms.

While the studies on analysing the characteristics of exporters are abundant, the importance of importing has been exposed only recently. Studying the Spanish manufacturing firms, Damijan and Kostevc (2015) confirm that more productive firms self-select into importing. By importing, firms get an access to new, cheaper and/or better-quality products, which decrease firms' variable costs and enable greater investing in innovations. An increase in innovations, as a consequence of importing, later has a positive impact on exporting, resulting again in additional innovations. Importing is therefore a prerequisite for further innovations and exporting. Studying the Belgian firm-level data, Amiti, Itskhoki and Konings (2014) among others confirm that more productive firms import a larger share of their inputs from abroad, which additionally increases their productivity. A positive impact of imports on productivity was confirmed also by Halpern, Koren and Szeidl (2011), studying the Hungarian micro-level data. The study finds ample productivity gains in the manufacturing sector due to importing inputs internationally, where the vast share of this productivity increase can be attributed to an increased volume and value of imported inputs. Even more, imports had an important impact on the Hungarian economic growth.

Another section of the trade literature, important for this dissertation topic, analyses the connectedness between international trade and labour demand. In this area of research, studies usually take into account the impact of outsourcing and offshoring on the labour demand. Analysing the Slovenian manufacturing sector, Zajc Kejžar and Ponikvar (2004) find that investment liberalisation influenced firms from different parts of the total factor productivity distribution differently. More precisely, the most efficient firms face productivity increase, the least efficient incumbent firms face job destruction, while the intermediate efficient firms experience both phenomena. Taking into account the Italian manufacturing firms, Lo Turco and Maggioni (2012) analyse the impact of offshoring on

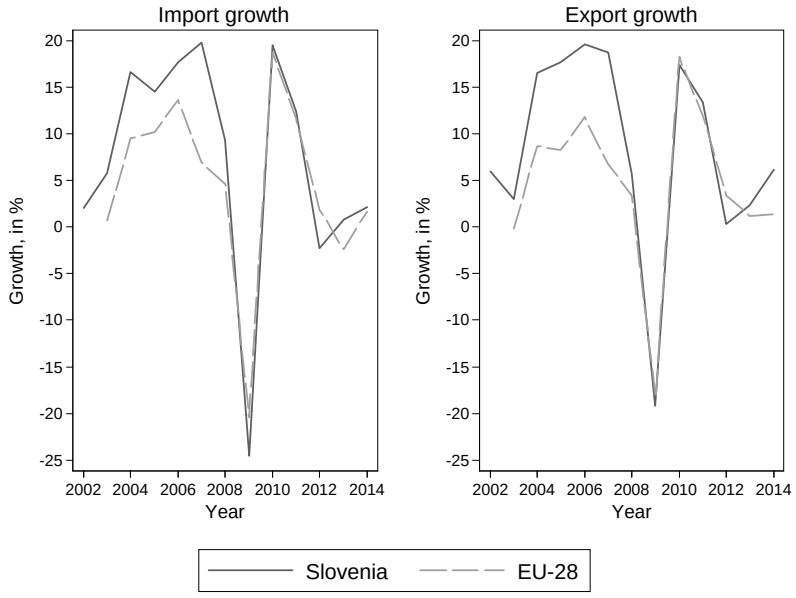
the labour demand. The important contribution of the study is differentiating between offshoring to high- and low-income countries. Results indicate that offshoring to low-income countries has a negative impact on the labour demand.

While the drawback of the abovementioned studies is not differentiating between skilled and unskilled workers, there are many papers, which control for skills as well. In their two papers, Feenstra and Hanson (1996, 1999) study the impact of outsourcing on the relative demand for skilled employees (Feenstra & Hanson, 1996) and wages of skilled employees (Feenstra & Hanson, 1999) in the United States. Results indicate that outsourcing on average increases the relative demand for skilled labour and their relative wages. The fear of job destruction in developed countries has increased in the recent years due to the enhanced globalisation and trade liberalisation in developing countries. Nevertheless, the majority of studies find the threat not being large and commonly influencing only the low-skilled employees (see for example Mion & Zhu, 2013; Hijzen et al., 2005; Egger & Egger, 2003; and Strauss-Kahn, 2003).

Research purpose and contributions of the dissertation

The abovementioned trend of increasing import and export growth is pronounced also in Figure 1, which shows import and export growth for Slovenia, the country of interest in this dissertation, and in the EU. Both, import and export, grew by a higher margin in Slovenia before the crisis, compared to the EU-28 average.

Figure 1. Import and export growth in Slovenia and in EU-28

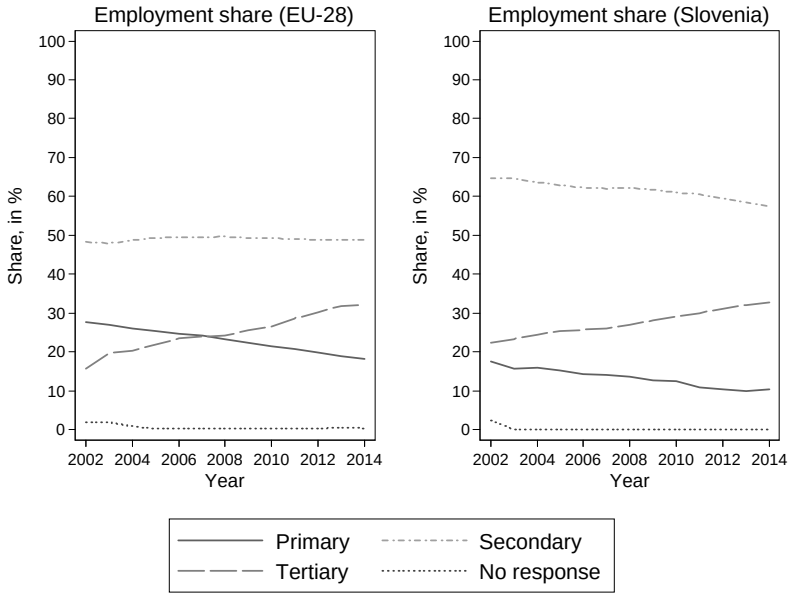


Source: SORS, own calculations

As the literature review exposed the interconnectedness of international trade and the skill structure of firms, the following two figures take into account the trends of the

employment shares and rates, divided by the level of education, for the EU-28 and Slovenia. The highest employment share appertains to the employees with the secondary level of education, followed by the tertiary educated employees and employees with the primary educational level (Figure 2). In Slovenia, the employment shares of employees with the secondary and primary level of education decreased in the observation period, while the employment share of employees with tertiary educational level increased. Similar trends are evident also in the EU data, with the exception that the employment share of employees with the secondary level of education remained roughly the same through the observation period. It is important to mention that the change in Slovenian employment share by educational level is also a consequence of high participation rate of the younger population in tertiary education, which does not necessarily mean the qualitative shift in the labour force structure. Therefore, the causality is in this case at least partially running from the labour supply and not demand.

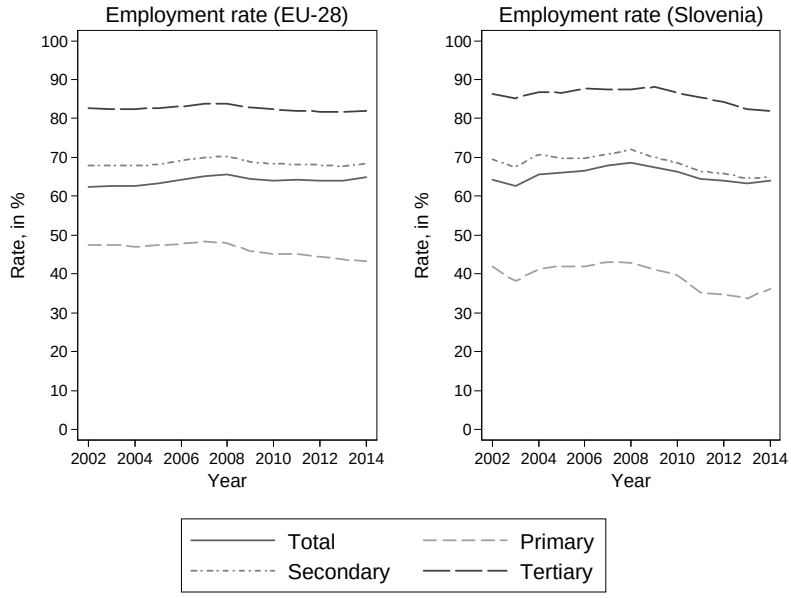
Figure 2. Employment share by educational level in Slovenia and in EU-28



Source: SORS, own calculations

Similar trends are shared also when comparing the employment rates by educational level in Slovenia and in the EU-28, where the above-average employment rates belong to employees with the tertiary and secondary level of education, while the employment rates of employees with the primary level of education are below-average (Figure 3).

Figure 3. Employment rate by educational level in Slovenia and in EU-28



Source: SORS, own calculations

As a small and open economy, Slovenia is highly dependent on the trends in the global environment and international trade. Also, its structure of employees has changed greatly in favour of skilled individuals. After observing these statistical findings, I was motivated to further explore the linkages and causalities between international trade and skills, in order to add to the existing literature. In addition, according to the abovementioned statistics, I believe Slovenia is a suitable country for making in-depth analyses.

The aim of the theoretical paper in the first chapter is to add to the existing theoretical models on heterogeneous firms by controlling also for imports and taking into account an individual's decision for skill upgrading. The main objective of the model is to consider the following two research questions: *(i) How does an individual's decision for skill upgrading later affect the firm's labour demand?*; and *(ii) Do low- and high-technology firms take different decisions in employing skilled individuals, and starting to import and/or export after trade liberalisation?* Contributions of the theoretical model in the first chapter are twofold. First, the model fills the gap in the international trade theory by accounting also for imports and thus broadening the models of Melitz (2003) and Bustos (2011a, 2011b). Second, since an individual's decision for skill upgrading later has an important impact on the firm's labour demand and productivity, the model is split into two parts. The first part of the model analyses the resolutions of individuals with higher and lower levels of ability for skill upgrading. Findings of the first part of the model are later incorporated in the second part, which analyses firms' decisions for technology upgrading and the start of importing and/or exporting.

The main goal of the analysis in the second chapter is to empirically test some of the conclusions, set by the theoretical model in the first chapter. The model in this chapter considers answering the ensuing research questions: *(i) Do firms with a better skill structure also start importing?*; *(ii) Do importing firms further increase their skill level after the start of importing?*; and *(iii) Do firms use imports for supplying intermediate goods and/or increasing their level of technology before the start of exporting?* Since previous studies on the sequencing between international activities of firms usually considered only imports, exports and technology upgrading (see for example Damijan & Kostevc, 2015; and Yang & Mallick, 2010), this study fills the void in the literature by including also the skill structure of firms and different types of imports into the model. In addition, the model also brings insights for policy implications with regard to stimulating the international cooperation of firms and creating stimulus for higher employment of skilled labour.

Finally, the aim of the empirical model in the third chapter is to study the impact of outsourcing and offshoring on the skill structure of firms. The analysis addresses the following research questions: *(i) Does controlling for both phenomena – offshoring and outsourcing – in one model add to the findings of previous empirical studies, which control only for one factor in their model?*; *(ii) Does controlling for a destination country of outsourcing and offshoring bring new insights to the results?*; and *(iii) Does controlling for an occupational level of workers when defining skills bring additional contribution to the results of the paper?* This analysis contributes to the field of knowledge in several ways. Firstly, by taking into account several measures when defining skills. Besides the usual level of education, this study considers also the occupational classification of employees. Since skills can be acquired also through employment and experience, I believe it is important to control for both, the occupational and the educational level when defining skills. Secondly, since previous studies, controlling only for one of the two factors in their models, concluded that both, offshoring and outsourcing, on average have a positive impact on the relative employment of skilled employees (see for example Feenstra & Hanson, 1996; Egger & Egger, 2003; and Mion & Zhu, 2013), this analysis controls for both phenomena in one model in order to avoid the missing variable bias problem. Taking into account both factors in one model is important also due to the fact that both are expected to increase in the future, according to forecasts of UNCTAD (2013).

Research methods and data

Research methods in this dissertation are used in accordance with the proposed aims of a particular chapter. The theoretical model in chapter one extends the theoretical models on heterogeneous firms by Melitz (2003), Bustos (2011a, 2011b), and Amiti and Davis (2011), by including also the analysis of individuals' behaviour into the model. The latter part refers to the work of Stark and others (see for example Stark & Wang, 2001; Stark, Helmenstein & Prskawetz, 1998; Stark & Chau, 1998; and Stark, Helmenstein & Prskawetz, 1997 for reference). The outline of the second chapter is based on the empirical

methods used in Damijan and Kostevc (2015), and Yang and Mallick (2010), who apply propensity score matching. I extend their analyses by studying more thoroughly the sequencing between importing and exporting, by means of controlling for the type of imports, and the skill structure of firms in the model. For robustness checks, various types and variations of the matching techniques are used. Finally, the third chapter uses different methods for the panel data analysis; pooled OLS, fixed effects and random effects. Again, several different variations of the models are used in order to enhance the robustness of results.

The empirical analysis of the second and third chapter combines several different databases, which form a rich firm-level and employee-level panel dataset for Slovenian firms, covering the period from 1996 to 2010. The dataset comprises information on the balance sheet data and income statements of Slovenian firms (i.e. number of employees, capital per employee, value added per employee), their export and import activities (i.e. volume and value of exports and imports, type of exported and imported goods, destination of exports and imports), characteristics of employees (i.e. gender, age, gross wage, educational level, occupational level), and the information on the foreign direct investments (FDI) flows for a particular Slovenian firm. The dataset combines 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. The data 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).

Structure and contents of the dissertation

The core of this doctoral dissertation consists of three chapters, analysing linkages and causalities between the trade status and the skill structure of Slovenian firms, where Chapter 1 introduces a theoretical model, which is later tested empirically in Chapter 2. Finally, Chapter 3 studies the effects of offshoring and outsourcing on the skill structure of firms.

The first chapter introduces a theoretical model, which studies the decisions of individuals for investing in higher education, and the decisions of firms for technology and skill upgrading, and the decision for starting importing and exporting. The first section introduces the motivation and goals of the analysis, and is later followed by the second section with a review of the relevant literature. The third section, which introduces the model, is split in three subsections. The first subsection gives a short description of the model, and is followed by the first part of the theoretical model, which studies the behaviour of individuals. The final subsection analyses the behaviour of firms, where it first presents additional background and the presumptions of the model regarding firm preferences, the entry and exit of firms, technology and factor heterogeneity, and the

decision to begin with international activities. The last section presents the main findings and the conclusion.

The findings of the theoretical model from the first chapter are later analysed empirically in Chapter 2, which untangles the relationship between the skill structure of firms, imports and exports. The first section introduces the topic, presents the motivation and contributions of the analysis, while the subsequent section introduces the relevant literature from the field of research. The methodology and data are thoroughly presented in the following section. In its first subsection, the models, which are later estimated by propensity score matching, and matching techniques that are later applied to the models, are introduced. The second subsection overviews the data used and the main descriptive statistics. The following section firstly provides the tests on the quality of matching, before presenting the results in the next subsections. Results of the basic model are included in subsection 2.4.1 and present the results on the linkages between importing, exporting and the skill structure of firms. The extensions of the model are included in subsection 2.4.2, which take into account additional lags of the outcomes of interest. The final section of Chapter 2 gives a summary and a brief discussion of the results.

Chapter 3 presents the empirical analysis of the effects of outsourcing and offshoring on the skill structure in Slovenian firms. As in the previous two chapters, Chapter 3 also begins with the introduction and the literature review in order to present the main aims and motivation of the analysis, and the relevant background of the topic. The following section presents the methodological framework and specification of the basic model, and its extensions. The description of the data and the descriptive statistics are presented in section 3.4. The results in the subsequent section are split in two parts; the first part summarises the results of the basic model with the variables of interest being outsourcing and offshoring. The second subsection of the results presents the robustness checks, which control for offshoring and outsourcing from high- and low-income countries, and introduce additional measures of skills. The final section presents a summary of the main findings.

Although each of the chapters includes a pertinent introduction and conclusion, the dissertation also includes a general introduction and conclusion. The latter is included in Chapter 4 and presents the main findings and the discussion of the results. The following chapter includes the list of references, while the last chapter consists of appendices. The appendices contain additional realisations of the equations from the main text, a supplementary explanation of particular methodologies used, and complementary tables with complete results and robustness checks. The final appendix presents a thorough abstract of the dissertation in the Slovenian language.

1 HOW TRADING FIRMS UPGRADE SKILLS AND TECHNOLOGY: THEORETICAL MODEL

1.1 Introduction

The liberalisation of international trade increases firm's productivity for two reasons; one is due to easier access to a better selection of advanced technologies and another is due to a better allocation of production factors. The latter channel was among others emphasized in the Melitz (2003) model, while the former was for example stressed in Bustos (2011b). The Melitz (2003) model explores the effects of trade on intra-industry reallocations and aggregate industry productivity by taking into account heterogeneous firms that differ regarding their level of productivity. The model concludes that only the most productive firms engage in exporting activities. The Melitz (2003) model represents groundwork in the recent trade literature and was used as a basis also in the Bustos (2011b) model, which explores the effects of trade liberalisation on skill upgrading in exporting firms, where the model also differentiates between high- and low-technology firms.

This paper aims to fill the void in the international trade theory by broadening the theoretical models of Melitz (2003) and Bustos (2011b), and correspondingly including imports to the model. By doing this, the model also explains recent empirical findings on the importance of importing as one of the drivers of firm's productivity gains. Evaluating trade liberalisation after China's entry to the World Trade Organization, Bloom, Draca and Van Reenen (2011) find that the increased Chinese import competition increased the innovations and adoption of new technologies, which in turn increased the productivity within firms, while between firms it transferred employment toward innovative and technologically advanced firms.

The positive impact of importing on the firm's productivity was confirmed also by Halpern, Koren and Szeidl (2011), studying the Hungarian data, Kasahara and Rodrigue (2008), studying the Chilean data, and Amiti and Konings (2007), studying the Indonesian data. The latter study points out that these productivity increases are a consequence of importing high-quality intermediates, the enhanced diversification of inputs, and higher learning opportunities (Amiti & Konings, 2007). Taking into account importers and exporters, Smeets and Warzynski (2010) confirm that both, exporting and importing, increase the firm's productivity, while firms with the highest level of productivity are engaged in both trading activities. In relation to these findings, empirical papers also certify the positive impact of importing on exporting. Bas and Strauss-Kahn (2014) emphasize three channels through which importing affects exporting positively. First is the indirect productivity channel of increased productivity after importing, which can in turn have a positive effect on overcoming export costs. Second is a direct cost channel due to changing the input structure towards more cost-effective importing intermediates. Finally, through the quality/technology transfer, imported intermediate inputs can enable exporting products to be of such quality and technology levels, as desired in the export markets.

Positive effects of importing on exporting were for example confirmed also by Feng, Li and Swenson (2012), studying the Chinese data.

In addition, since the individual's decisions for acquiring higher skills later have an important impact on the behaviour of profit-maximizing firms, another motivation for writing this paper was to combine specific individual's and firm's decisions. Since the existing trade models are based on broader, firm-level decisions, the impetus of the present paper is to explore more in depth also the behaviour of individuals and their decision for skill upgrading, as these decisions have in turn the effect on skill upgrading within a firm.

The model in this paper bases its framework on the models of Bustos (2011a, 2011b) and Melitz (2003), and on the work of Stark and others (see for example Stark & Wang, 2001; Stark, Helmenstein & Prskawetz, 1998; Stark & Chau, 1998; and Stark, Helmenstein & Prskawetz, 1997 for reference), who developed models on human capital formation. The model first explores the behaviour of individuals, who decide whether to invest in acquiring higher skills or not. In this part, the model differentiates between high ability and low ability individuals, where the individual's ability level defines the cost level for acquiring skills. Individual's ability is discoverable only to the individual. Upon the level of these costs, individuals decide whether to invest in obtaining the skills or not, where this decision depends also upon their future wage level. Results suggest that only high ability individuals find it profitable to invest in acquiring additional skills, while they in turn demand higher wages after entering employment. The findings that higher firm's labour costs signal higher employment of more skilled workers are then incorporated in the second part of the model. This part focuses on exploring the behaviour of heterogeneous firms that decide on when to start investing in higher technology, and when to start engaging in trading activities. In this part of the model, profit-maximizing firms differ upon their level of labour productivity, where the proxy for higher labour productivity are higher labour costs, indicating a higher employment level of skilled employees. Once more, the latter judgement is backed up by the results from the first part of the model. Investing in higher technology and starting to import and export brings higher fixed costs, but decreases the level of firm's marginal costs, and/or increases the employment of skilled workers, and/or increases revenues. Findings from the second part suggest that the technologically advanced firms employ a higher number of skilled workers and that only the most productive firms find it profitable to start trading, investing in higher technology and skill upgrading.

This paper contributes to the literature in two ways. Firstly, since the mentioned empirical papers emphasized the importance of differentiating between importing and exporting, this model accounts for both. Therefore, the model broadens the content of the papers of Bustos (2011a, 2011b) and Melitz (2003), who take into account only exporters. Secondly, while other theoretical trade models only analysed decisions from a firm's point of view, this paper's contribution is to combine behaviour of individuals and firms in one model of trade. The model therefore broadens the existing trade models by analysing the behaviour

of individuals and their decision for skill upgrading. This is later incorporated in the firm-level decisions, by taking into account the firm's labour demand and productivity.

The remainder of the paper is organised in the following manner: the next section presents a brief introduction of the theoretical background, which is further on used as a reference point to the theoretical model, included in the third section. The last section summarises the main findings and includes a conclusion.

1.2 Literature review

Melitz (2003) developed an important theoretical model, which explores the effects of trade on intra-industry reallocations and aggregate industry productivity. The model uses heterogeneous firms that differ regarding the level of productivity, where firms with higher levels of productivity produce the same amount of products at lower marginal costs. After observing their level of productivity, firms decide to exit or enter the market, where new entrants have a lower level of productivity and a higher probability to exit than firms that are already on the market. When exploring the effects of trade, the author only focuses on exports. After firms start exporting, they are faced with higher costs for two reasons; one reason is higher per-unit trade costs, and the other reason is higher fixed costs. The latter can be explained as a consequence of establishing new networks, adapting the product to the new market, setting up new distribution channels, etc. After introducing the possibility to export to the model, firms again observe their level of productivity. Once more, the least productive firms decide to exit the market, the firms with medium-level of productivity decide to serve the domestic market, while the most productive firms serve the domestic market and export (Melitz, 2003).

The Melitz (2003) model presents the groundwork for many subsequent theoretical models on trade. Bustos upgraded the Melitz (2003) model by including technology upgrading (Bustos, 2011a) and skill upgrading (Bustos, 2011b) into the model. In the first model, Bustos (2011a) takes into account profit maximizing firms which decide whether to start exporting and whether to invest in higher technology. By adopting higher technology, firms pay higher fixed production costs, while their marginal costs are reduced. After proving that using high technology and serving the domestic market is always dominated by some other choice, firms form four different groups: the least productive firms exit, the low productive firms use low technology and serve the domestic market, the medium productive firms still use low technology but also export, while only the most productive firms upgrade their technology level and export (Bustos, 2011a).

The gains of different production factors, labour and capital to be precise, were included already in the Heckscher-Ohlin model (the H-O model), which predicts that countries adjust their production and trading on behalf of their factor endowments. The Stolper-Samuelson theorem in the H-O model indicates that the real returns of the factor-abundant owners increase, and the real returns of the owners of the other factor decrease as a

consequence of trade (Krugman, Obstfeld & Melitz, 2012). Relating to the conclusions of the H-O model, the relative demand for skilled workers – a scarce factor in developing countries – should decrease after trade liberalisation. However, the empirical findings show the opposite (see for example Goldberg & Pavcnik, 2007). Bustos (2011b) has filled the gap in trade literature, by exploring the effects of trade liberalisation on skill upgrading in exporting firms. The model accounts for two categories of workers, skilled and unskilled. As in the previous model (Bustos, 2011a), firms form four different groups before trade liberalisation, whereas after liberalisation, they form six groups in total. The least productive firms exit. Among the firms that did not export before trade liberalisation, a fraction of these firms continue serving the domestic market, use low technology and downgrade skills; another fraction of these firms still uses low technology, but they start exporting and downgrade skills, while the most productive of these firms start to export, upgrade their technology and skills. Firms that were already exporting before trade liberalisation and used low technology continue to export, switch to high technology and upgrade skills. Finally, the most productive firms that were exporting and using high technology before trade liberalisation continue exporting and using high technology, but they downgrade skills. The conclusions of the theoretical model were later tested also empirically, by studying the effect of Brazil's tariff reduction on Argentinian firms. The model's predictions that low-technology firms downgrade skills and that firms in the upper-middle range of productivity distribution upgrade skills after trade liberalisation are consistent with the empirical findings. On the other hand, the prediction that the most productive high-technology firms downgrade skills after trade liberalisation is not consistent with the empirical findings (Bustos, 2011b).

Finally, as presented in the introduction, it is important to control for the imports in trade models, as imports usually serve as a prerequisite to exporting activities (see for example empirical studies of Damijan & Kostevc, 2015; and Altomonte & Békés, 2010). To be precise, by studying the connections between importing, exporting and innovation in Spanish firms, Damijan and Kostevc (2015) find that importing enables firms to first start with process and product innovation, and later also with exporting. In addition, exporting stimulates further innovation. Although empirical studies show the importance of importing, the latter is infrequently included in the theoretical models of trade. One of the models that does account for importing is the theoretical model by Amiti and Davis (2011), who base their theoretical model on the Melitz (2003) model and control for imports, by including additional costs of importing in the model.

The theoretical model in this paper combines different aspects of the models, presented in the literature review and adds also a thorough analysis of individuals' behaviour and their decision for skill upgrading. It is necessary to study these decisions, as they later have an important impact on the firm's productivity level, labour demand and labour costs. For this purpose, several papers of Stark and others were taken into account (see for example Stark & Wang, 2001; Stark, Helmenstein & Prskawetz, 1998; Stark & Chau, 1998; and Stark,

Helmenstein & Prskawetz, 1997 for reference). The primary focus is on the paper by Stark and Wang (2001), which developed a model of human capital formation in an environment with and without migration. I bring the model into use as a benchmark and use it for explaining the individual's choice for skill upgrading.

1.3 The Model

This section presents a simple theoretical model, the first part of which studies the decision of individuals to invest in acquiring additional skills. The findings of the first part of the model are later incorporated in the second part, which analyses the decision of heterogeneous firms to start trading and investing in higher technology.

1.3.1 Setup of the Model

The model takes into account the country, endowed with heterogeneous workforce and heterogeneous firms. Individuals differ according to their ability levels, which are exogenously determined. Firms on the other hand differ according to the different productivity levels, which are the end result of different technologies used, and in regards to firms being included in international trade. Concerning the latter, the model differentiates between importers, exporters and importing-exporting firms, whereas concerning the former it differentiates between high-technology and low-technology firms.

1.3.2 Individuals

This part of the theoretical model follows the work of Stark and others (see for example Stark & Wang, 2001; Stark, Helmenstein & Prskawetz, 1998; Stark & Chau, 1998; and Stark, Helmenstein & Prskawetz, 1997 for reference). Each individual in the economy is endowed with a certain amount of efficiency units (θ), which represents the ability of a worker. If the average ability of workers in the economy is $\underline{\theta}$, and the abilities of high ability and low ability workers are θ_S and θ_U, respectively, the following applies: $\theta_U < \underline{\theta} < \theta_S$. The model also assumes that the individual's ability is discoverable only to the individual. For brevity, the model denotes all individuals with above-average abilities by θ_S, and individuals with below-average abilities by θ_U. Derivations of the model therefore assume two ability levels.

After individuals evaluate their level of ability, they decide whether to invest in acquiring higher skills or not. It is assumed that the costs for acquiring higher skill levels are different for individuals with different abilities. To be precise, costs for acquiring human capital for high ability individuals (k_S) are lower than the costs of low ability individuals (k_U); i.e. $k_U > k_S > 1$. All individuals have an opportunity to achieve higher levels of education and become skilled. However, since it is also assumed that the costs for acquiring the highest levels of human capital are too high for low ability individuals, they will be able to obtain the human capital only up to a certain level and will not be able to achieve above-average skill levels. The drawback of this assumption is in measuring the

costs for acquiring higher levels of education only by the level of individual's ability and not taking into account other aspects, as for example individual's financial capability. In reality, due to reasons such as individual's financial constraints or the lack of stamina, not all highly capable individuals decide to acquire higher levels of education.

In order to emphasise the difference between individuals' ability and skills, and the period after individuals acquire skills, the model denotes high ability, high skilled individuals with Θ_S, and low ability, low skilled individuals with Θ_U. While the ability of individuals is not discoverable and observable by others, the model assumes that firms can discover and observe individuals' skills. The ability of individuals is therefore reflected in their skills. In reality, firms can for example detect individuals' skills in the form of their educational level. However, as it was argued before, the skill level of individuals cannot be fully reflected in their educational level. Nevertheless, since individuals' personal characteristics would be hard to measure objectively, since many empirical studies measure skill level with the level of education, and since this measure embraces some important aspects of individuals' skills, as for example their ability, stamina, diligence, etc., I believe it is a sufficient proxy for measuring individuals' skills. Yet, it would be useful to include the fact that individuals' skills cannot be fully discoverable and observable in the future model extensions.

The model assumes that higher opportunity costs of education are later reflected in individuals' higher wages. More precisely, individuals with higher abilities will have incentives for acquiring above-average levels of human capital, if their costs for acquiring high skill levels will be later compensated with higher gross earnings when they are employed. By this, the model controls for the different financial background of individuals. The gross earnings of high ability, high skilled workers (w_S) should therefore be higher than the gross earnings of low ability, low skilled workers (w_U); i.e. $0 < w_U < w_S$. Thus, each individual initially bears the costs of acquiring human capital. However, the costs are later transmitted onto firms in the form of higher expected gross earnings of high ability, high skilled individuals.

The function of gross earnings for unskilled workers is the following:

$$w_U(\Theta_U) = \lambda[\ln(\Theta_U + 1)] - k_U\Theta_U, \qquad (1)$$

where the first term on the right hand side ($\lambda[\ln(\Theta_U + 1)]$) represents personal returns to human capital, and the last term represents costs of acquiring human capital. The parameter λ is assumed to be positive. Furthermore, for convenience, the following is assumed as well: $\lambda > k_U > k_S > 1$. The latter assumption is important in order for individuals to have incentives for acquiring human capital. Otherwise, personal returns to human capital would be too low, compared to costs of acquiring human capital.

Similarly, the function of gross earnings of skilled workers can be written as:

$$w_S(\Theta_S) = \lambda\,[\ln(\Theta_S + 1)] - k_S\Theta_S. \tag{2}$$

The succeeding claim proves that the optimal skill level of workers with low ability and low skills is lower than the optimal skill level of workers with high ability and high skills. It is important to prove that in order to make further inferences on the wage level of skilled workers.

Claim 1: The optimal skill level of individuals with low ability is lower than the optimal skill level of individuals with high ability.

Proof: To get the optimal skill level of high and low ability individuals, first order conditions of gross earnings for each level of skills are derived.

$$\frac{\partial w_U(\Theta_U)}{\partial \Theta_U} = \frac{\lambda}{\Theta_U + 1} - k_U \tag{3}$$

$$\frac{\partial w_S(\Theta_S)}{\partial \Theta_S} = \frac{\lambda}{\Theta_S + 1} - k_S \tag{4}$$

When checking the maxima, the following optimal skill levels of workers are calculated. Optimal skill level of the low ability workers (Θ_U^*) is:

$$\Theta_U^* = \lambda(k_U)^{-1} - 1. \tag{5}$$

Optimal skill level of the high ability workers (Θ_S^*) is:

$$\Theta_S^* = \lambda(k_S)^{-1} - 1. \tag{6}$$

When comparing both optimal levels and taking into account that $k_S < k_U$, it is confirmed that $\Theta_U^* < \Theta_S^*$. ■

Although the previous claim confirms that the high ability workers will have higher optimal skill levels than the low ability workers, it also has to be proven that the high ability workers will have incentives to invest in their educational attainment and make the best of their potential. As mentioned before, high ability workers will have incentives to invest in their educational attainment and become skilled, if their future income would increase because of that investment. By inserting optimal skill levels of high ability and low ability individuals (expressions (5) and (6)) in the functions of gross earnings (expressions (1) and (2)), the following can be derived:

$$w_U(\Theta_U^*) < w_S(\Theta_S^*) \tag{7}$$

$$\lambda[\ln(\lambda / k_U)] - k_U\,[(\lambda / k_U) - 1] < \lambda[\ln(\lambda / k_S)] - k_S\,[(\lambda / k_S) - 1]. \tag{8}$$

Taking into account the assumption $\lambda > k_U > k_S > 1$, it can be confirmed that the gross earnings of workers with low optimal ability ($w_U(\Theta_U^*)$) are lower, compared to the gross earnings of workers with high optimal ability ($w_S(\Theta_S^*)$).

For consistency purposes it was also confirmed that $w_U(\Theta_U^*) > 0$. The proof for this claim can be found in Appendix A.

As only the high ability individuals have incentives to invest in acquiring higher skills, total workforce (L) in the country comprises high ability, high skilled workers (L_S) and low ability, low skilled workers (L_U). Workforce in the country as a whole is therefore the following: $L = L_S + L_U$.

1.3.3 Firms

This part of the model takes into account heterogeneous profit-maximizing firms that differ in their level of labour productivity and decide whether to adopt a skill-intensive technology, and whether to start exporting and importing. The previous part of the model concluded that skilled workers have a higher level of ability and can hence be employed in a more productive way. This finding will be accounted for in the current part of the model, when taking into account the level of firm's labour productivity. The subsequent part of the theoretical model follows the work of Melitz and Redding (2014), Amiti and Davis (2011), Bustos (2011a and 2011b), and Melitz (2003).

1.3.3.1 Preferences

Following Melitz and Redding (2014), and Bustos (2011a, 2011b), this part considers two symmetric countries that engage in bilateral trade after trade liberalisation. Consumer preferences are described by a continuum of horizontally-differentiated varieties and are assumed to take the Constant Elasticity of Substitution (CES) form:

$$Q = \left[\int_0^M q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}}, \tag{9}$$

where ω defines a particular variety of a product, M is the number of existing varieties, and σ is a constant elasticity of substitution. The following holds: $\sigma = 1/(1-\rho)$, where ρ is a parameter which determines the constant elasticity of substitution, so that $\sigma > 1$ applies. These preferences define the following demand function for each variety ω: $q(\omega) = XP^{\sigma-1}p(\omega)^{-\sigma}$. Here, X represents the aggregate spending level of consumers, $p(\omega)$ the price of each variety, and P the price index, equal to:

$$P = \left[\int_0^M p(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}. \tag{10}$$

1.3.3.2 Firm entry and exit

Following Melitz and Redding (2014), and Bustos (2011b), firms pay a sunk fixed entry cost f_X to enter an industry. After that, firms draw the level of their productivity φ from a cumulative distribution $G(\varphi)$ and with regard to this level they decide whether to exit the market or to produce.

1.3.3.3 Technology and factor heterogeneity

Products are produced by using a composite factor of production, L, which is composed of skilled labour (L_S) and unskilled labour (L_U). From the previous subchapter, it follows that skilled workers have a higher level of ability, which is reflected in their higher wage level $w_U < w_S$. Furthermore, following Melitz and Redding (2014), and Bustos (2011b), by paying an additional fixed cost, firms can upgrade to a high-technology level h, which is also more skill-intensive and reduces the firm's marginal costs of production. On the other hand, the low-technology level l is less skill-intensive and demands lower fixed costs for producing goods. As in the case of distribution of skills, the distribution of high-tech and low-tech firms is discrete.

Total costs for low-technology firms are as follows:

$$TC_l = \left[f + \frac{q}{\varphi} \right] w_S^{\beta} w_U^{1-\beta}, \tag{11}$$

where f denotes fixed costs, w_S and w_U are wages of skilled and unskilled workers, respectively, q is the level of firm's output, φ is productivity level, and $\beta \in (0,1)$ denotes skill intensity.

On the other hand, firms can invest in higher skill-intensive technology. Total costs for the latter can be defined by:

$$TC_h = \left[f\eta + \frac{q}{\gamma\varphi} \right] w_S^{\alpha} w_U^{1-\alpha}, \tag{12}$$

where $\eta > 1$, $\gamma > 1$, $\alpha \in (0,1)$, and $\alpha > ß$. The model assumes that due to a smaller relative share of skilled employees in low-technology firms, who use low-technology equipment, the labour productivity in low-technology firms is lower than the labour productivity in high-technology firms. On the other hand, as a result of investing in skill-intensive technology, high-technology firms change their skill structure by employing a higher number of high ability, high skilled employees. Accordingly, the model assumes that skill-intensive technology is brought into use more productively when employing relatively more skilled individuals with high abilities. Relating to the findings from the first part, which studied the incentives for individual's skill upgrading, the model also assumes that firms with higher labour productivity have higher labour costs, as a consequence of a

higher employment of skilled workers, who earn higher wages; $w_S > w_U$. Higher labour costs can therefore be considered as a proxy for higher employment of skilled workers. These assumptions are consistent with the findings of empirical studies, which confirm that bigger firms use more technology-advanced equipment, pay higher wages and employ more productive workers (Idson & Oi, 1999). Similar characteristics have also been confirmed in trading firms, which are larger in size and more productive (Altomonte & Békés, 2010). These conclusions are reflected in the assumption that $\alpha > ß$ (expressions (11) and (12)), when defining the total costs of low- and high-technology firms.

The parameters α and ß, and consequently also firms' wages, are determined exogenously. Since defining market-clearing wage and labour market equilibrium would further increase the complexity of the model, this extension to the model would be out of the scope of the current paper. Nevertheless, it would be useful to expand the model by including these concepts in the future model extensions.

1.3.3.4 International activities of firms

The model is built as a 2-stage model, where costs of trade decrease significantly only in the second stage, as a consequence of trade liberalisation. In the first stage, firms decide whether to invest in skill-intensive high-technology, whereas in the second stage, firms decide whether to engage in trading activities. Similarly as in Melitz and Redding (2014), and Bustos (2011b), firms decide to start exporting after realising their level of productivity, φ, and taking into account the higher costs of exporting. On the one hand, additional fixed costs of exporting, f_E, arise from establishing new sales channels, advertising, adapting to new laws and rules, etc., while on the other, firms also have to pay additional iceberg variable trade costs τ, meaning that τ number of units have to be shipped abroad in order for one unit to arrive, where $\tau > 1$ (Melitz & Redding, 2014). For very similar reasons as in the case of exports, importing also entails higher fixed costs, denoted by f_I (Amiti & Davis, 2011). Additional costs of exporting and importing make an assortment of the most productive firms that can afford to endure higher costs.

In the current setup of the model, the costs of importing and exporting are defined exogenously and are not compared by their height. In the future model extensions, it would be interesting to compare also the height of the costs, in order to make a connection between importing and exporting, and the sequencing pattern between the two. Importing can for instance lead to reduction of fixed exporting costs as an importing firm already knows the foreign market, has established its networks, etc. As a result, starting to import can increase the probability of a firm to start exporting.

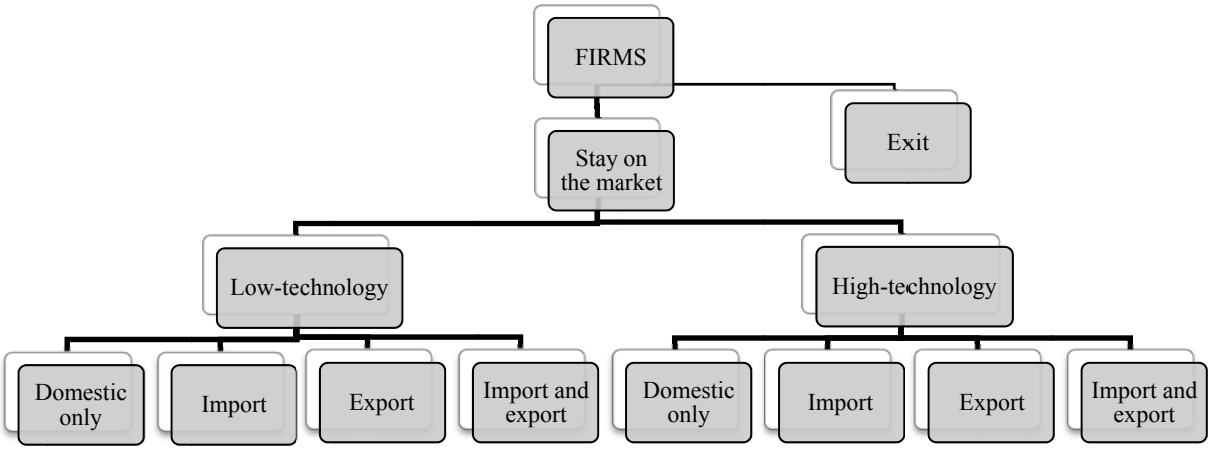
1.3.3.5 Firm behaviour

Some additional assumptions concerning costs and the change in productivity levels are made below. As introduced earlier, this model is of a two-stage type, where in the first stage, firms decide whether to invest in high-technology or not and in the second stage,

after trade liberalisation, firms decide whether to engage in international activities or not. When firms start importing, they have access to cheaper technology and/or access to cheaper intermediates. It is therefore anticipated that importing increases the productivity of firms for two different reasons. First, importing intermediates allows other factors of production to be used more productively. Second, importing more affordable technology equipment in turn increases the firm's productivity. Accordingly, the level of labour productivity in firms increases after importing. The model also assumes the fixed costs of acquiring high-technology are higher than the fixed costs of importing; i.e. $f_I < f\eta$. The reason behind this assumption is that when comparing the technology level of low-technology importers and high-technology firms, which invest in technology within their own R&D departments, it is assumed that the increase in the productivity level will not be as big in low-technology firms that start importing, compared to the productivity increase in firms that start investing in high-technology. Although low-technology firms still have a more affordable option for increasing their level of productivity through importing, the benefits are not as high, compared to investing into developing custom-made high-technology equipment within firms. Finally, due to exporting, firms sell their products to a higher number of customers and therefore reach higher revenues.

The following paragraphs describe a two-stage model, where in each of the steps, firms decide between several options and choose the most profitable one. It is assumed that in the first stage (before trade liberalisation), importing and exporting is beyond the reach due to high costs, so firms can only choose whether to invest in higher technology or not. In the second step, after trade liberalisation, firms have an option to start importing, exporting or both. The following diagram summarises the steps of the model.

Figure 4. The flow-chart of events in the two-stage model



In the listed steps, firms compare several different profit options, which are described next. Following Melitz and Redding (2014), and Bustos (2011b), the market structure is of monopolistic competition type, where each firm chooses its price in order to maximise its

profits. The profit maximising price is a constant mark-up over marginal costs. In the first stage, low-technology firms (11) charge the price

$$p_l = \frac{\sigma}{\sigma - 1} \frac{w_S^{\beta} w_U^{1-\beta}}{\varphi}, \tag{13}$$

while high-technology firms (12) charge the price

$$p_h = \frac{\sigma}{\sigma - 1} \frac{w_S^{\alpha} w_U^{1-\alpha}}{\gamma\varphi}. \tag{14}$$

Firms compare the following two options:

a) No trade, use low technology (11):

$$\pi_l(\varphi) = \frac{r_l(\varphi)}{\sigma} - f w_S^{\beta} w_U^{1-\beta}, \tag{15}$$

where $\pi_l(\varphi)$ are the total profits of firms with low-technology levels, φ is the level of labour productivity, and $r_l(\varphi)$ are revenues, with $r_l(\varphi) = XP^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{w_S^{\beta} w_U^{1-\beta}}{\varphi}\right)^{1-\sigma}$.

b) No trade, use high technology (12):

$$\pi_h(\varphi) = \frac{r_h(\varphi)}{\sigma} - f\eta w_S^{\alpha} w_U^{1-\alpha}, \tag{16}$$

where $\pi_h(\varphi)$ are the total profits of firms with high-technology levels, and $r_h(\varphi)$ are the revenues, with $r_h(\varphi) = XP^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{w_S^{\alpha} w_U^{1-\alpha}}{\gamma\varphi}\right)^{1-\sigma}$.

According to Melitz and Redding (2014), firms first assess their level of productivity and upon that decide whether to stay and produce or whether to exit the market. If they stay, they maximise the level of their profits with regard to the level of their productivity. This generates a survival bound productivity φ^*, returning zero profits: $\pi(\varphi^*) = 0$.

When comparing zero-profit bounds of low- and high-technology firms in the first stage of the model; i.e.

$$\pi_l(\varphi) = \pi_h(\varphi) \Leftrightarrow \frac{r_l(\varphi)}{\sigma} - fW_l = \frac{r_h(\varphi)}{\sigma} - f\eta W_h, \tag{17}$$

it follows that due to the higher fixed costs of adopting new technology, only the most productive firms will be able to afford investing in high-technology. For convenience, W_l is denoted as total labour costs in low-technology firms ($W_l = w_S^{\beta} w_U^{1-\beta}$), and W_h as total labour costs in high-technology firms ($W_h = w_S^{\alpha} w_U^{1-\alpha}$). Least productive firms will therefore use low-technology. Furthermore, the exit bound productivity, φ^*, is defined by:

$$\pi_l(\varphi^*) = 0 \Leftrightarrow \varphi^* = A f^{\frac{1}{\sigma-1}} W_l^{\frac{\sigma}{\sigma-1}}, \tag{18}$$

where $A = \left(\frac{\sigma}{X}\right)^{\frac{1}{\sigma-1}} \frac{1}{P\rho}$.

To get the level of productivity, above which a firm finds it profitable to invest in high-technology, φ_h, the subsequent two expressions are compared: $\pi_l(\varphi_h) = \pi_h(\varphi_h)$, yielding the following:

$$\varphi_h = A\left[f(\eta W_h - W_l)\right]^{\frac{1}{\sigma-1}} \left(\frac{W_h}{\gamma} - W\right). \tag{19}$$

Now, it must apply that $\varphi^* < \varphi_h$, which is true as long as $(W_l)^{\frac{\sigma}{\sigma-1}} < (\eta W_h - W_l)^{\frac{1}{\sigma-1}} \left(\frac{W_h}{\gamma} - W_l\right)$. The latter expression stands when the wages in high-technology firms (W_h) are significantly higher than the wages in low-technology firms (W_l). This is consistent with the findings from the first part of the paper, which concludes that higher wages signal a higher employment of skilled workers. I believe this assumption is valid as it confirms previous empirical findings that firms, which use more technology-advanced equipment, also pay higher wages, and employ more productive workers (see for example Idson & Oi, 1999). Therefore, only the most productive firms use skill-intensive technology and upgrade skills. In addition, taking into account the last term in the upper expression $\left(\frac{W_h}{\gamma} - W_l\right)$, the relative increase in wages due to investing in higher technology has to be higher than the relative decrease in marginal costs; i.e. $\frac{W_h}{W_l} > \gamma$, which additionally emphasises the importance of higher employment of skilled workers in high-technology firms.

After trade liberalisation in the second stage, low-technology firms compare the following four options:

a) No trade, use low technology (11):

$$\pi_l(\varphi) = \frac{r_l(\varphi)}{\sigma} - f w_S^{\beta} w_U^{1-\beta}, \tag{20}$$

where $\pi_l(\varphi)$ are the total profits of firms with low-technology levels, φ is the level of labour productivity, and $r_l(\varphi)$ are the revenues, with $r_l(\varphi) = XP^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{w_S^{\beta} w_U^{1-\beta}}{\varphi}\right)^{1-\sigma}$.

b) Start importing, use low technology (11):

When low-technology firms start importing, their costs and productivity level increase and add up to: $TC_l^I = \left[f + f_I + \frac{q}{\gamma_l^I \varphi}\right] w_S^{\beta^I} w_U^{1-\beta^I}$, where $\beta < \beta^I < \alpha$, and $1 < \gamma_l^I < \gamma$. Introducing the factors β^I and γ_l^I enables controlling for the decrease in marginal costs and the changes of the skill structure in favour of the skilled employees after low-technology firms start importing. However, as explained above, the increase in the productivity level is not as big as it would be if the firms invested in developing the custom-made technology within their own R&D departments. Firms charge the price: $p_l^I = \frac{\sigma}{\sigma-1}\frac{w_S^{\beta^I} w_U^{1-\beta^I}}{\gamma_l^I \varphi}$. Taking these facts into account, profit is as follows:

$$\pi_l^I(\varphi) = \frac{r_l^I(\varphi)}{\sigma} - (f + f_I) w_S^{\beta^I} w_U^{1-\beta^I}, \tag{21}$$

where $\pi_l^I(\varphi)$ are the total profits of low-technology firms that start importing, and $r_l^I(\varphi)$ are the revenues, with $r_l^I(\varphi) = XP^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{w_S^{\beta^I} w_U^{1-\beta^I}}{\gamma_l^I \varphi}\right)^{1-\sigma}$.

c) Start exporting, use low technology (11):

When low-technology firms start exporting, their costs add up to: $TC_l^E = \left[f + f_E + \frac{\tau q}{\varphi}\right] w_S^{\beta} w_U^{1-\beta}$. Consequently, firms charge the price: $p_l^E = \frac{\sigma}{\sigma-1}\frac{\tau w_S^{\beta} w_U^{1-\beta}}{\varphi}$. Taking these facts into account, the profit is:

$$\pi_l^E(\varphi) = \frac{r_l^E(\varphi)}{\sigma} - (f + f_E) w_S^{\beta} w_U^{1-\beta}, \tag{22}$$

where $\pi_l^E(\varphi)$ are the total profits of low-technology firms that start exporting, and $r_l^E(\varphi)$ are the revenues, with $r_l^E(\varphi) = XP^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{\tau w_S^{\beta} w_U^{1-\beta}}{\varphi}\right)^{1-\sigma}$.

d) Start importing and exporting, use low technology (11):

When low-technology firms start importing and exporting, their costs add up to: $TC_l^{IE} = \left[f + f_I + f_E + \frac{\tau q}{\gamma_l^I \varphi}\right] w_S^{\beta^I} w_U^{1-\beta^I}$. Consequently, firms charge the price: $p_l^{IE} = \frac{\sigma}{\sigma-1}\frac{\tau w_S^{\beta^I} w_U^{1-\beta^I}}{\gamma_l^I \varphi}$. Taking these facts into account, the profit is:

$$\pi_l^{IE}(\varphi) = \frac{r_l^{IE}(\varphi)}{\sigma} - (f + f_I + f_E) w_S^{\beta^I} w_U^{1-\beta^I}, \tag{23}$$

where $\pi_l^{IE}(\varphi)$ are the total profits of low-technology firms that start importing and exporting, and $r_l^{IE}(\varphi)$ are the revenues, with $r_l^{IE}(\varphi) = XP^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{\tau w_S^{\beta^I} w_U^{1-\beta^I}}{\gamma_l^I \varphi}\right)^{1-\sigma}$.

When comparing the zero-profit bounds in this stage of the model, the assumption of identical countries is considered (Bustos, 2011a), from which it follows that the price index (P) and the expenditure level (X) are the same at home and abroad. First, the zero-profit bounds of low-technology firms that do not engage in international activities are compared to the bounds of those which start importing in the second stage of the model:

$$\pi_l(\varphi) = \pi_l^I(\varphi) \Leftrightarrow \frac{r_l(\varphi)}{\sigma} - fW_l = \frac{r_l^I(\varphi)}{\sigma} - (f + f_I) W_l^I. \tag{24}$$

For convenience, I again used the abbreviation for the total labour costs in low-technology firms (W_l) and denoted the total labour costs of importing low-technology firms by $W_l^I = w_S^{\beta^I} w_U^{1-\beta^I}$. It follows that only the most productive low-technology firms will be able to afford paying higher fixed costs of importing, while the least productive low-technology firms will continue serving the domestic market. To get the level of productivity, above which a low-technology firm finds it profitable to start importing, φ_l^I, one compares the subsequent two expressions: $\pi_l(\varphi_l^I) = \pi_l^I(\varphi_l^I)$, and gets the following:

$$\varphi_l^I = A\left[f(W_l^I - W_l) + f_I W_l^I\right]^{\frac{1}{\sigma-1}}\left(\frac{W_l^I}{\gamma_l^I} - W_l\right). \quad (25)$$

The expression $\varphi^* < \varphi_l^I$ applies, as long as $f^{\frac{1}{\sigma-1}}(W_l)^{\frac{\sigma}{\sigma-1}} < \left[f(W_l^I - W_l) + f_I W_l^I\right]^{\frac{1}{\sigma-1}}\left(\frac{W_l^I}{\gamma_l^I} - W_l\right)$.

This is true when the wages in importing low-technology firms (W_l^I) are significantly higher than the wages in low-technology firms (W_l), which again signals a higher employment level of skilled workers, as follows from the first part of the model. This assumption is also valid, since the empirical data confirms that importing firms are on average larger and pay higher wages (see for example Altomonte & Békés, 2010). In addition, taking into account the last term in the upper expression $\left(\frac{W_l^I}{\gamma_l^I} - W_l\right)$, the relative increase in wages due to importing has to be higher than the relative decrease in marginal costs after the start of importing; i.e. $\frac{W_l^I}{W_l} > \gamma_l^I$. This statement corresponds to the initial assumption that the decrease in marginal costs due to imports is lower than it would be, should the firms invest in developing custom-made technology within their own R&D departments.

Furthermore, when comparing the zero-profit bounds of low-technology firms that do not engage in international activities and of those which start exporting in the second stage of the model:

$$\pi_l(\varphi) = \pi_l^E(\varphi) \Leftrightarrow \frac{r_l(\varphi)}{\sigma} - fW_l = \frac{r_l^E(\varphi)}{\sigma} - (f + f_E)W_l, \quad (26)$$

it follows that exporting low-technology firms do not invest in upgrading their skill structure nor do they invest in acquiring lower marginal costs. Therefore, since the productivity level of low-productive firms stays the same after they start exporting, low-technology firms will export only if the costs of exporting are lower than the increase in revenues after the start of exporting. However, following Melitz and Redding (2014), it is assumed that the fixed costs of exporting are too high for low-technology firms and therefore present a selection, so that only the most productive firms start exporting. As a result, firms that do not invest in acquiring a higher level of productivity – either through importing or through investing in higher technology – cannot start exporting since their productivity level is too low.

In addition, the zero-profit bounds of low-technology firms which do not engage in international activities and of those that start importing and exporting in the second stage of the model, are compared with the following expressions:

$$\pi_l(\varphi) = \pi_l^{IE}(\varphi) \Leftrightarrow \frac{r_l(\varphi)}{\sigma} - fW_l = \frac{r_l^{IE}(\varphi)}{\sigma} - (f + f_I + f_E)W_l^I \,. \tag{27}$$

In relation to the upper comparison, low-technology firms will find engaging in importing and exporting activities profitable only if the increase in revenues and productivity level is bigger than the increase in costs of exporting and importing. To get the level of productivity, above which a low-technology firm finds it profitable to start importing and exporting, φ_l^{IE}, the subsequent two expressions are compared: $\pi_l(\varphi_l^{IE}) = \pi_l^{IE}(\varphi_l^{IE})$, yielding the following:

$$\varphi_l^{IE} = A\left[f(W_l^I - W_l) + (f_I + f_E)W_l^I)\right]^{\frac{1}{\sigma-1}}\left(\frac{\tau}{\gamma_l^I}W_l^I - W_l\right). \tag{28}$$

This allows us to check when the productivity level of low-technology firms that import (φ_l^I) is lower than the productivity level of low-technology firms that export and import (φ_l^{IE}):

$$\varphi_l^I < \varphi_l^{IE} \Leftrightarrow \left[f(W_l^I - W_l) + f_I W_l^I\right]^{\frac{1}{\sigma-1}}\left(\frac{1}{\gamma_l^I}W_l^I - W_l\right) < \left[f(W_l^I - W_l) + (f_I + f_E)W_l^I\right]^{\frac{1}{\sigma-1}}\left(\frac{\tau}{\gamma_l^I}W_l^I - W_l\right). \tag{29}$$

Since $f_E > 0$ and $\tau > 1$, it follows that $\varphi_l^I < \varphi_l^{IE}$, when the wages in importing low-technology firms (W_l^I) are significantly higher than the wages in low-technology firms (W_l), which was already assumed. Therefore, only the most productive low-technology firms that will be able to compensate for higher exporting costs will start exporting and importing.

To sum up, after trade liberalisation in the second stage of the model, only the most productive low-technology firms choose to upgrade skills and to start exporting and importing, less productive low-technology firms only import, and the least productive low-technology firms continue serving the domestic market. On the other hand, low-technology firms will not decide to engage in exporting activities without increasing their level of productivity by importing, as their productivity level would be too low to bear exporting costs.

The model now focuses on evaluating the following four options of high-technology firms after trade liberalisation in the second stage:

a) No trade, use high technology (12):

$$\pi_h(\varphi) = \frac{r_h(\varphi)}{\sigma} - f\eta w_S^{\alpha} w_U^{1-\alpha}\,, \tag{30}$$

where $\pi_h(\varphi)$ are the total profits of firms with high-technology levels, and $r_h(\varphi)$ are the revenues, with $r_h(\varphi) = XP^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{w_S^{\alpha} w_U^{1-\alpha}}{\gamma\varphi}\right)^{1-\sigma}$.

b) Start importing, use high technology (12):

When high-technology firms start importing, their costs and productivity level increase and add up to: $TC_h^I = \left[f\eta + f_I + \frac{q}{\gamma_h^I \varphi}\right] w_S^{\alpha^I} w_U^{1-\alpha^I}$, where $\beta < \beta^I < \alpha < \alpha^I < 1$, and $\gamma_l^I < \gamma < \gamma_h^I$. Introducing factors α^I and γ_h^I enables controlling for the increase in productivity level and the changes in skill structure in favour of the skilled employees after high-technology firms start importing. In addition, firms charge the price: $p_h^I = \frac{\sigma}{\sigma-1}\frac{w_S^{\alpha^I} w_U^{1-\alpha^I}}{\gamma_h^I \varphi}$. Taking these facts into account, the profit is:

$$\pi_h^I(\varphi) = \frac{r_h^I(\varphi)}{\sigma} - (f\eta + f_I) w_S^{\alpha^I} w_U^{1-\alpha^I}, \tag{31}$$

where $\pi_h^I(\varphi)$ are the total profits of high-technology firms that start importing, and $r_h^I(\varphi)$ are the revenues, with $r_h^I(\varphi) = XP^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{w_S^{\alpha^I} w_U^{1-\alpha^I}}{\gamma_h^I \varphi}\right)^{1-\sigma}$.

c) Start exporting, use high technology (12):

When high-technology firms start exporting, their costs add up to: $TC_h^E = \left[f\eta + f_E + \frac{\tau q}{\gamma\varphi}\right] w_S^{\alpha} w_U^{1-\alpha}$. Consequently, firms charge the price: $p_h^E = \frac{\sigma}{\sigma-1}\frac{\tau w_S^{\alpha} w_U^{1-\alpha}}{\gamma\varphi}$. Taking these facts into account, profit is as follows:

$$\pi_h^E(\varphi) = \frac{r_h^E(\varphi)}{\sigma} - (f\eta + f_E) w_S^{\alpha} w_U^{1-\alpha}, \tag{32}$$

where $\pi_h^E(\varphi)$ are the total profits of high-technology firms that start exporting, and $r_h^E(\varphi)$ are the revenues, with $r_h^E(\varphi) = XP^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{\tau w_S^{\alpha} w_U^{1-\alpha}}{\gamma\varphi}\right)^{1-\sigma}$.

d) Start importing and exporting, use high technology (12):

When high-technology firms start importing and exporting, their costs add up to: $TC_h^{IE} = \left[f\eta + f_I + f_E + \frac{\tau q}{\gamma_h^I \varphi} \right] w_S^{\alpha^I} w_U^{1-\alpha^I}$. Consequently, firms charge the price: $p_h^{IE} = \frac{\sigma}{\sigma - 1} \frac{\tau w_S^{\alpha^I} w_U^{1-\alpha^I}}{\gamma_h^I \varphi}$. Taking these facts into account, the profit is:

$$\pi_h^{IE}(\varphi) = \frac{r_h^{IE}(\varphi)}{\sigma} - (f\eta + f_I + f_E) w_S^{\alpha^I} w_U^{1-\alpha^I}, \tag{33}$$

where $\pi_h^{IE}(\varphi)$ are the total profits of high-technology firms that start importing and exporting, and $r_h^{IE}(\varphi)$ are the revenues, with $r_h^{IE}(\varphi) = XP^{\sigma-1} \left(\frac{\sigma}{\sigma - 1} \frac{\tau w_S^{\alpha^I} w_U^{1-\alpha^I}}{\gamma_h^I \varphi} \right)^{1-\sigma}$.

The following two expressions are considered when comparing the zero-profit bounds of high-technology firms that do not engage in international activities and of those which start importing in the second stage of the model:

$$\pi_h(\varphi) = \pi_h^I(\varphi) \Leftrightarrow \frac{r_h(\varphi)}{\sigma} - f\eta W_h = \frac{r_h^I(\varphi)}{\sigma} - (f\eta + f_I) W_h^I. \tag{34}$$

For convenience, the abbreviation for the total labour costs in high-technology firms (W_h) is applied, while total labour costs of importing high-technology firms are denoted by $W_h^I = w_S^{\alpha^I} w_U^{1-\alpha^I}$. To calculate the level of productivity in importing high-technology firms, φ_h^I, the subsequent two expressions are compared: $\pi_h(\varphi_h^I) = \pi_h^I(\varphi_h^I)$, yielding the following:

$$\varphi_h^I = A \left[f\eta (W_h^I - W_h) + f_I W_h^I \right]^{\frac{1}{\sigma-1}} \frac{\gamma W_h^I - \gamma_h^I W_h}{\gamma_h^I \gamma}. \tag{35}$$

In order for this expression to be positive, $\varphi_h^I > 0$, it is important for the following expression to hold: $\frac{\gamma W_h^I}{\gamma_h^I W_h} > 1$. Since $W_h^I > W_h$, it follows that the marginal cost reduction of high-technology firms that do not engage in international activities (γ) and of those which start importing in the second stage of the model (γ_h^I), should not differ substantially. This coincides with the assumption from the previous part of the paper, stating that importing brings lower marginal cost reduction, compared to the marginal cost reduction due to investment into high-technology.

In addition, the level of productivity of high-technology domestic firms, φ_h, and the level of productivity of high-technology importing firms, φ_h^I, is compared as well. The expression $\varphi_h < \varphi_h^I$ applies, as long as $\left[f(\eta W_h - W_l)\right]^{\frac{1}{\sigma-1}}\left(\frac{W_h}{\gamma} - W_l\right) < \left[f\eta(W_h^I - W_h) + f_I W_h^I\right]^{\frac{1}{\sigma-1}}\left(\frac{\gamma W_h^I - \gamma_h^I W_h}{\gamma_h^I \gamma}\right)$. The latter expression is valid when the wages in high-technology firms (W_h) are significantly higher than the wages in low-technology firms (W_l). Also, the wage level in high-technology firms should increase substantially as a consequence of importing (W_h^I). Again, following the conclusions made when studying the skill upgrading at the level of individuals, both presumptions signal a higher employment level of skilled workers and were already assumed in the previous part of the paper.

Next, the following two expressions are considered when comparing the zero-profit bounds of high-technology firms that do not engage in international activities and of those which start exporting in the second stage of the model:

$$\pi_h(\varphi) = \pi_h^E(\varphi) \Leftrightarrow \frac{r_h(\varphi)}{\sigma} - f\eta W_h = \frac{r_h^E(\varphi)}{\sigma} - (f\eta + f_E)W_h . \tag{36}$$

To get the level of productivity, above which a high-technology firm finds it profitable to start exporting, φ_h^E, the subsequent two expressions are compared: $\pi_h(\varphi_h^E) = \pi_h^E(\varphi_h^E)$, yielding the following:

$$\varphi_h^E = A\left[f_E W_h\right]^{\frac{1}{\sigma-1}} \frac{\tau W_h}{\gamma}\left(1 - \frac{1}{\tau}\right). \tag{37}$$

Since it was already assumed that $\tau > 1$, the productivity level of high-technology exporting firms will be positive; $\varphi_h^E > 0$. In addition, the level of productivity of high-technology domestic firms, φ_h, and the level of productivity of high-technology exporting firms, φ_h^E, is compared as well. The expression $\varphi_h < \varphi_h^E$ applies, as long as $\left[f(\eta W_h - W_l)\right]^{\frac{1}{\sigma-1}}\left(\frac{W_h}{\gamma} - W_l\right) < \left[f_E W_h\right]^{\frac{1}{\sigma-1}} \frac{\tau W_h}{\gamma}\left(1 - \frac{1}{\tau}\right)$. The latter expression confirms that only the most productive high-technology firms, which will be able to compensate for higher exporting costs, start exporting.

By confirming that the most productive high-technology firms engage in trading activities after trade liberalisation in the second stage due to their initial higher level of productivity, it is necessary to compare the zero-profit bounds of high-technology firms that start importing and of those which start exporting in the second stage of the model:

$$\pi_h^I(\varphi) = \pi_h^E(\varphi) \Leftrightarrow \frac{r_h^I(\varphi)}{\sigma} - (f\eta + f_I)W_h^I = \frac{r_h^E(\varphi)}{\sigma} - (f\eta + f_E)W_h . \quad (38)$$

High-technology firms choose between the start of importing and exporting on behalf of their productivity level; high-technology firms decide to import if their productivity level is not yet high enough to start exporting, whereas more productive high-technology firms start exporting in order to increase their revenues. This makes it possible to compare the productivity levels of high-technology firms that start importing (φ_h^I) and high-technology firms that start exporting (φ_h^E) and see that high-technology firms start importing, when the level of bound productivity is higher; i.e. $\varphi_h^E < \varphi_h^I \Leftrightarrow \left[f_E W_h\right]^{\frac{1}{\sigma-1}} \tau W_h \left(1 - \frac{1}{\tau}\right) < \left[f\eta(W_h^I - W_h) + f_I W_h^I\right]^{\frac{1}{\sigma-1}} \left(\frac{\gamma}{\gamma_h^I} W_h^I - W_h\right)$. The latter expression applies if the wage level in high-technology firms (W_h) is significantly lower than the wage level in high-technology importing firms (W_h^I): $W_h < W_h^I$, which is again a sign of a higher employment level of skilled workers. Moreover, the decision between the start of importing and exporting will depend on external factors; i.e. the cost level of importing and exporting. If the costs of importing are significantly higher than the costs of exporting, only the most productive high-technology firms will be able to afford importing. In contrast, when the opposite holds, only the most productive high-technology firms will be able to afford exporting.

The next step compares the zero-profit bounds of importing high-technology firms and of high-technology firms that start importing and exporting in the second stage of the model:

$$\pi_h^I(\varphi) = \pi_h^{IE}(\varphi) \Leftrightarrow \frac{r_h^I(\varphi)}{\sigma} - (f\eta + f_I)W_h^I = \frac{r_h^{IE}(\varphi)}{\sigma} - (f\eta + f_I + f_E)W_h^I . \quad (39)$$

It follows that high-technology firms will find exporting and importing profitable only if the increase in revenues will be bigger than the increase in costs of exporting. To get the level of productivity, above which a high-technology firm finds the start of importing and exporting profitable, φ_h^{IE}, the subsequent two expressions are compared: $\pi_h^I(\varphi_h^{IE}) = \pi_h^{IE}(\varphi_h^{IE})$, obtaining the following:

$$\varphi_h^{IE} = A\left[f_E W_h^I\right]^{\frac{1}{\sigma-1}} \frac{\tau W_h^I}{\gamma_h^I}\left(1 - \frac{1}{\tau}\right). \quad (40)$$

This shows when the productivity level of high-technology firms that import (φ_h^I) is lower than the productivity level of high-technology firms that export and import (φ_h^{IE}):

$\varphi_h^I < \varphi_h^{IE} \Leftrightarrow \left[f\eta(W_h^I - W_h) + f_I W_h^I\right]^{\frac{1}{\sigma-1}}\left(W_h^I - \frac{\gamma_h^I}{\gamma}W_h\right) < \left[f_E W_h^I\right]^{\frac{1}{\sigma-1}}\tau W_h^I\left(1-\frac{1}{\tau}\right)$. Again, the latter expression applies if the wage level in high-technology firms (W_h) is significantly lower than the wage level in high-technology importing firms (W_h^I): $W_h < W_h^I$. Findings from the part of the model, studying the skill upgrading at the level of individuals, again indicate higher wages being a signal of a higher employment level of skilled workers. In addition, if the costs of importing are significantly higher, compared to the costs of exporting, only the most productive firms will be able to afford the start of importing.

Finally, since the decision of high-technology firms on when to start exporting and importing depends also on external factors; i.e. the cost level of exporting and importing, the analysis from the previous paragraph has to be repeated for high-technology firms that decide between starting to export, and starting to export and import. Therefore, the zero-profit bounds of exporting high-technology firms and of high-technology firms that start importing and exporting in the second stage of the model are compared with the following expressions:

$$\pi_h^E(\varphi) = \pi_h^{IE}(\varphi) \Leftrightarrow \frac{r_h^E(\varphi)}{\sigma} - (f\eta + f_E)W_h = \frac{r_h^{IE}(\varphi)}{\sigma} - (f\eta + f_I + f_E)W_h^I . \qquad (41)$$

From this it follows that high-technology firms find exporting and importing profitable only if the increase in the level of productivity is bigger than the increase in costs of importing. To get the level of productivity, above which a high-technology firm finds it profitable to start importing and exporting, φ_h^{IE}, the subsequent two expressions are compared: $\pi_h^E(\varphi_h^{IE}) = \pi_h^{IE}(\varphi_h^{IE})$, yielding the following:

$$\varphi_h^{IE} = A\left[(f\eta + f_E)(W_h^I - W_h) + f_I W_h^I\right]^{\frac{1}{\sigma-1}} \frac{\tau}{\gamma\gamma_h^I}(\gamma W_h^I - \gamma_h^I W_h) . \qquad (42)$$

One can now check when the productivity level of high-technology firms that export (φ_h^E) is lower than the level of high-technology firms that export and import (φ_h^{IE}): $\varphi_h^E < \varphi_h^{IE} \Leftrightarrow \left[f_E W_h\right]^{\frac{1}{\sigma-1}}\tau W_h\left(1-\frac{1}{\tau}\right) < \left[(f\eta + f_E)(W_h^I - W_h) + f_I W_h^I\right]^{\frac{1}{\sigma-1}}\tau\left(\frac{\gamma}{\gamma_h^I}W_h^I - W_h\right)$. The latter expression applies if the wage level in high-technology firms (W_h) is significantly lower than the wage level in high-technology importing firms (W_h^I), which again signals a higher employment level of skilled workers after importing. Concerning external factors, if the costs of importing are significantly high, only the most productive high-technology firms will be able to engage in both, exporting and importing.

To sum up, after trade liberalisation in the second stage of the model, only the least productive high-technology firms serve only the domestic market, where the decision on whether to start importing, exporting or both depends on the level of wages before and after importing, on the firm's productivity level and on external factors; i.e. the level of export and import costs. Interestingly, when high-technology firms decide whether to start exporting or not, the final decision is not based on the wage level of high-technology non-trading firms and high-technology exporting firms. Making inferences from the first part of the paper which studied the skill upgrading at the level of individuals, this would be a sign of a higher employment level of skilled employees. Therefore, skill upgrading occurs only in importing firms or firms that engage in both; importing and exporting.

1.4 Conclusion

The theoretical models of trade have been evolving through history in a desire of a thorough interpretation of international flows. Recent theoretical trade models account for firm heterogeneity, and also for technology and skill upgrading. Guided by these theories, I developed a theoretical model, which explores the individual's decisions for investing in skill upgrading and the firm's decisions to start technology upgrading and trading.

The model in this paper is divided in two parts. First part explores the behaviour of individuals and their decisions on whether to invest in acquiring higher skill levels. Individuals have a choice to acquire higher skills, where the decision depends on their ability level. The findings suggest that since the education costs of low ability workers for acquiring higher skills are excessive, only high ability workers achieve higher skill levels. In addition, as a result of high education costs, high ability, high skilled workers demand higher wages after entering employment. Higher wages therefore signal higher employment of skilled workers. This finding is brought into use in the second part of the model, which takes into account the firm's decisions on whether to invest in higher technology and whether to engage in international activities. The model suggests that before trade liberalisation, only the most productive firms invest in acquiring higher technology levels. Higher labour costs of these firms signal a higher employment of skilled workers. After trade liberalisation, costs of importing and exporting diminish and firms have an option to start engaging in international activities. This part again takes into account findings from the first part of the model, that the higher labour costs of firms signal higher employment of skilled workers. Taking into account low-technology firms first, the most productive low-technology firms choose to skill upgrade and to start exporting and importing, less productive low-technology firms also upgrade skills but start only importing, and the least productive low-technology firms continue serving only the domestic market. Low-technology firms therefore use importing as means of increasing their productivity level before the start of exporting. This finding was confirmed also in empirical studies (see for example Damijan & Kostevc, 2015; and Altomonte & Békés, 2010). Furthermore, low-technology firms do not engage exclusively in exporting, as their productivity level is too low to cover exporting costs. With regards to high-technology

firms, only the least productive high-technology firms do not start importing and/or exporting after trade liberalisation, where the decision on whether to import, export, or both, depends on the firm's productivity level, the skill upgrading before and after importing, and on external factors; the level of export and import costs. Skill upgrading in high-technology firms after trade liberalisation takes place only in firms that start importing, or that start engaging in both, importing and exporting.

The model highlights several facts, which would be noteworthy of further empirical testing. One could empirically analyse the following findings of the theoretical model: (i) firms with better skill structure also start importing; (ii) importing firms have a better skill structure than non-importing firms; and (iii) by having an access to technology and/or to intermediates, imports serve for increasing the technology level and/or cost reductions before the start of exporting.

The key contributions of this model are a differentiation between importers and exporters, and a thorough analysis of the behaviour of individuals and firms, where the connection between the two has been made by linking fragments of models on the individual's and the firm's behaviour. The possible limitations of the model present additional assumptions, which had to be made when developing the model; e.g. the increase in the wage level of skilled workers after investing in high technology $\left(\frac{W_h}{W_l} > \gamma\right)$, and after the start of importing $\left(\frac{W_l^I}{W_l} > \gamma_l^I\right)$, compared to the decrease in the marginal costs in these firms. Furthermore, the model also assumes that the productivity level increase after importing is lower compared to the productivity level increase after investing in high-technology. These additional assumptions to some extent limit the value of the model, as it would be hard to test them empirically. Moreover, following Bustos (2011b), and Stark and others, the model assumes a discrete distribution of skilled, while it would be more realistic to assume a continuous distribution of skilled and to take into account also the semi-skilled workers. Even though this model extension would greatly increase the complexity of the model and considering that the empirical studies also use discrete variables for defining workers' skills, it would be useful to take this limitation into account in the future model extensions. In addition, although the model considers three dynamic phase shifts; i.e. the individual's decision to acquire skills, the firm's decision to opt for high technology, and the firm's decision to start importing and/or exporting, it is limited in discussing only two firm's decisions simultaneously (e.g. high-technology vs. low-technology, no trade vs. importing, etc.). Since nowadays firms face the changing environment which demands complex decision-making on a daily basis, this structure of the model would be limited to transform in everyday environment. Although losing a more static structure of the model would greatly increase its complexity, this limitation would be useful to be taken into account in further studies. Nevertheless, despite the aforementioned shortcomings, I believe the model's conclusions bring contributions to the field of knowledge, since the conclusions

are also consistent with previous empirical findings and open several possibilities for further empirical analyses.

2 UNTANGLING THE RELATIONSHIP BETWEEN SKILL STRUCTURE, IMPORTS AND EXPORTS

2.1 Introduction

Exploring the sources of higher productivity in firms has been of great interest in various fields of research which show that firms' higher productivity can be attributed to tougher market competition, technological spillovers, human capital and international trade (Syverson, 2011), to name only a few. Firms, engaged in trade, tend to be more productive due to cost reductions and technological transfers, which can be achieved by offshoring, outsourcing and supply chain management (Onodera, 2008). Another reason for observed superior performance of trading firms is the self-selection of more productive firms into trading activities (Aw et al., 2011; Aw et al., 2008; Greenaway & Kneller, 2004; Melitz, 2003; Vogel & Wagner, 2008; Wagner, 2007). An alternative source of higher productivity in firms is the employment of skilled employees, who use given resources more efficiently and can adopt and start using new technologies more quickly (Corvers, 1997). These determinants of firm performance – involvement in trading activities and the engagement of skilled employees – have also a positive impact on one another. More precisely, empirical studies prove that imports have an important impact on the demand for skilled workers (Burstein et al., 2013; Parro, 2013; and Raveh & Reshef, 2013). Furthermore, imports also have a positive impact on the start of exporting activities (Damijan & Kostevc, 2015; and Wagner, 2012b).

The aim of the analysis is to test some of the implications made in the theoretical part of the previous chapter. An additional aim is to add to the empirical studies which exposed the impact of trade status on the firms' skill structure, and the interaction between the firms' skill structure, importing and exporting. The following hypotheses, which were, among others, discussed in the theoretical model, were chosen to be empirically analysed in this study: (i) firms with better skill structure start importing; (ii) importing firms increase their skill share after the start of importing; and (iii) having access to technology or to intermediates through importing increases the probability of exporting. The motivation for choosing these particular hypotheses was to contribute to the findings of empirical studies, which took into account the sequencing between importing and exporting (for instance Damijan & Kostevc, 2015), and employment and exporting (for instance Yang & Mallick, 2010). In addition, when choosing which conclusions of the theoretical model to test empirically, some data limitations were considered as well.

The empirical analysis therefore examines the differences in the levels of the skill structures of importers and non-importers, and import starters and non-importers. In addition, the analysis also examines the impact of having access to cheaper intermediates via imports (measured by imports of intermediate goods), and the impact of having access to technologies via imports (measured by imports of capital goods) on the start of exporting activities. To the best of my knowledge, no such analysis of the casual links and

sequencing between the skill structure of firms, imports, and exports has been done yet. The purpose of this study is to fill this void in the literature and to provide some policy implications.

Another motivation for studying the linkages between imports, exports and the skill structure of firms is in the increasing importance of international trade and skilled workforce in the last decade in most of the developed world. According to Eurostat, the share of employees with attained tertiary education has been steadily increasing in the EU, whereas the increase of the share in Slovenia was above the EU average. In the last decade, the share of employees with attained tertiary education has increased by 8.2 percentage points in the EU-28 and by 11.8 percentage points in Slovenia. Additionally, the employment rates of persons with attained tertiary education have always been the highest, reaching 82.1 % in the EU-28 in 2014 (82.0 % in Slovenia), while the total employment rate in the EU-28 was 64.9 % (63.9 % in Slovenia). On the other hand, the increase of imports and exports – measured as the value of EUR – has been even higher. Although international trade declined during the crisis, the overall increase of imports reached 49.2 % in the EU-28 (79.7 % in Slovenia) in the last decade, while the increase of exports was even higher, reaching 53.0 % in the EU-28 (106.7 % in Slovenia) (Eurostat).

In order to study the above hypotheses that are based on the implications of the formal model outlined in the previous chapter, a linked employer-employee panel dataset for Slovenian manufacturing firms is used, covering the period from 1996 to 2010. With the aim of considering evident differences between importing and non-importing firms, the propensity score matching approach is applied. The dataset is constructed from several data sources with information on the financial figures of firms, the values of imports and exports, and the characteristics of employees.

Results confirm some previous findings and deliver new insights to understanding the linkages between imports, exports and skill upgrading. Results confirm previous findings that importing activities have a positive impact on the demand for skills (see for example Crino, 2012; and Meschi et al., 2008). In addition, firms with a higher skill share self-select into importing and continue to have a higher skill share, compared to non-importing firms. When analysing the effect of starting to import intermediate or capital goods on the start of exporting, I find that importing intermediate goods has an immediate positive impact on the start of exporting in the year after the start importing. On the other hand, importing of capital goods has a positive impact on the start of exporting not earlier than in the second year after the start of importing capital goods. These results point to a different role of the capital and intermediate goods in the production process. Since intermediate goods usually have a relatively short expiration date and require additional manufacturing processing or are used for resale, the impact of importing these goods might be instantaneous but short-term. In contrast, since capital goods generally present firms' fixed assets and are employed in the production process, the impact of importing these goods might appear gradually but last longer time.

Besides contributing to the field, the paper also adds insights into policy implications. Based on the result of this empirical study, it is important that policy-makers focus on establishing an environment that stimulates international cooperation. Next, creating incentives for a higher employment of skilled employees also seems to be important for the start of importing, which consequently has a positive impact on the start of exporting. In turn, importing plays an important role in boosting employment of skilled individuals.

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 empirical model, describes the data and presents the descriptive statistics. The basic results, extensions of the model and a short discussion are included in section four. The last section summarises and concludes.

2.2 Literature review

Existing studies show that greater trade openness is one of the main reasons for increases in the demand and supply of more educated labour, which has been evident throughout the developed world (Foster et al., 2012; Meschi et al., 2008; Attanasio et al., 2003; Tokarick, 2002; Muendler, 2004; Feenstra & Hanson, 1999). However, until recently, the majority of labour economists agreed that technological improvements were the leading reason for a steady increase in the supply and demand for skilled labour, while a positive impact of trade has been widely downplayed. Nevertheless, recent studies, which include longer analysis periods, expand their research also on emerging markets and use up-to-date estimation methods, confirm the role of trade in shifting the demand towards more educated labour. The crucial finding is that trade is an important driver of technological change and consequently has a great impact on upgrading the skill structure of firms and their innovation activities (Bloom et al., 2011; Crino, 2012; Meschi et al., 2008). Moreover, several empirical studies confirm that trading firms employ more educated labour (Brambilla et al., 2010) and pay higher wages (Helpman et al., 2011; and Schank et al., 2007). This is due to the fact that exporting firms are on average larger and more productive than their non-exporting counterparts and due to the screening of potential employees more intensively. Accordingly, the workforce of exporting firms has an above-average ability and wages (Helpman et al., 2011).

Initially, empirical studies focused mainly on exploring exporting status and other determinants, whereas current studies emphasise the importance of including also importing status in the analysis (Damijan & Kostevc, 2015; and Muuls & Pisu, 2007). Productivity gains due to greater access to imports were for example proven by Amiti and Konings (2007), who make a distinction between productivity gains, which are followed by lower tariffs on final goods and the ones that are followed by lower tariffs on intermediate goods. While lower output tariffs increase productivity by increasing import competition, lower input tariffs increase productivity due to access to cheaper imported inputs (Amiti & Konings, 2007). Similarly, trade liberalisation in India granted access to a greater number of imported inputs for firms, which resulted to an increased number of

products introduced by domestic firms (Goldberg et al., 2010). Bas and Strauss-Kahn (2011) explicate the importance of imported inputs by confirming a strong impact of imported inputs on firms' productivity and export performance in France, where the impact on productivity is more pronounced for imports from developed countries, compared to imports from developing countries. Also, a higher number of imported inputs and/or a more diverse spectrum of imported inputs increase the probability to survive in export markets as this enables firms to cover the fixed costs of exports (Bas & Strauss-Kahn, 2011). A positive impact of imports on firms' future exporting activities was confirmed also by Wagner (2012a).

Furthermore, the composition of imports has been recognised as being important as well. In particular, a reduction of trade costs increases trade in capital goods, which in turn leads to an increase in the skill premium – i.e. the wage of skilled labour, relative to the wage of unskilled labour – and welfare gains for skilled labour. The mechanism at work here is the capital-skill complementarity, which creates the skill-biased trade (Burstein et al., 2013; and Parro, 2013). Raveh and Reshef (2013) also confirm that the composition of imports influences the demand for skilled labour and the skill premium. Authors conclude that R&D-intensive capital equipment is complementary to skilled labour, while less innovative capital is complementary to non-skilled labour. Consequently, the imports of R&D-intensive capital equipment raise the skill premium, whereas the imports of less innovative capital lower the skill premium (Raveh & Reshef, 2013).

While the majority of papers focus their research on finding the types of correlations between the determinants of firms' productivity, more recent papers also focus on exploring the directions of causalities between these determinants. Once more, studies mainly focus their attention on exporting firms (see for example Damijan et al., 2010; and Yang & Mallick, 2010), while the evidence on importing firms is scarce. In their recent paper, Damijan and Kostevc (2015) include also importers in their research and confirm the link between imports, exports and innovation, using the Spanish microdata. Their conclusion is that firms predominantly learn from importing, which in turn has a positive effect on innovation and finally on exports. The latter then paves the way for further innovation. The results are prominent especially for smaller firms, where imports enable these firms to introduce new production processes and to improve the characteristics of their produced goods. Damijan and Kostevc (2015), however, did not control for the skill structure of firms in their research.

Empirical studies that explore the relationship between imports and the skill structure of firms usually find a positive impact of imports on the skill structure of firms. Meschi et al. (2008) demonstrate that sectors with the highest increase of imported inputs, relative to total inputs, also have the highest relative increase of skilled workers' labour costs. Authors explain this increase as a consequence of transferring the skill-intensive technologies with imports, which contributes to a skill-biased increase of labour demand in favour of the skilled workers. Moreover, their results are backed up by the fact that only

imports from industrialised countries indicate the transfer of new and skill-intensive technologies (Meschi et al., 2008). Focusing on the effects of service offshoring on employment, where service offshoring is defined as the share of service inputs in the total non-energy inputs, Crino (2012) also confirms the skill-biased effects of offshoring. To be precise, offshoring increases the demand for high- and medium-skilled labour, while hinders the demand of low-skilled labour.

The issue of trade and skill structure of firms was also covered by recent papers on the effect of trade liberalisation in developing countries. Focusing especially on China, these studies show that reducing the obstacles of importing from developing countries has on average a positive impact on the skill structure of firms in developed countries, while it adversely affects the employment of less-educated labour (Pierce & Schott, 2012; Bloom et al., 2011; and Mion et al., 2010). By studying the effects of trade liberalisation within a developing country, Fieler et al. (2014) confirm increases in the skill premium, skill intensity and quality upgrading among exporters. As a spillover effect, this in turn induces quality upgrading among other domestic firms, while the least productive firms change for the worse and become less skill intensive.

Bloom et al. (2011) give several explanations for the positive influence of trade liberalisation on firms' skill structure. Firstly, trade liberalisation increases the opportunities for employing labour and capital, which in turn reduces the costs of innovation and the production of new goods. In the wake of the alternative explanation, the liberalisation of international trade increases competition, which in turn fosters innovation. Moreover, lowering trade barriers also enlarges the market size, which in sequence reallocates the fixed costs of innovation to a higher number of agents and enables firms to share the knowledge more easily. Finally, as a consequence of trade liberalisation and hence the decreasing of trade costs in emerging markets, firms in developed countries shift their product mix towards more technologically advanced products and consequently benefit when using intermediates from the emerging markets (Bloom et al., 2011).

Motivated by the above-mentioned study of Damijan and Kostevc (2015), which studied the sequencing patterns between importing, exporting and innovation, and defined the importance of importing for the start of other activities, I decided to explore the sequencing between importing and exporting more in depth, by including also the type of imports into the analysis. As already presented in the introductory part, intermediate and capital goods have different roles in firms' production processes. Therefore, it is important to test whether the start of importing these goods has a significant impact on the start of exporting and whether there are differences in the impact on the start of exporting when controlling for the types of imported goods. The mechanism behind this, i.e. the learning-by-importing, was introduced in the theoretical model in the previous chapter. The model concludes that through continuous process of importing, firms get an access to technology and/or an access to intermediates, which in turn increases firms' productivity before the start of exporting. Furthermore, since one of the conclusions of the theoretical model also

points to a higher employment of skilled labour in more productive firms and since the presented statistical data point to an increasing share of tertiary educated employees in the country of interest in this study, Slovenia, I also introduce the skill structure of firms in the analysis. Distinguishing between the imports of intermediate and capital goods, and introducing the skill structure of firms in the analysis are therefore the main contributions to the existing literature.

2.3 Methodology and data

As stated before, the theoretical model from the previous chapter provides a framework for the empirical model in the present chapter. The model tests several hypotheses, derived from the theoretical model: (i) correlation between importing and a better skill structure of firms is positive; (ii) firms with a better skill structure start importing; (iii) skill structure changes in favour of the skilled after the start of importing; (iv) importing capital goods (which acts as a proxy for access to technology via imports) has a positive impact on the start of exporting; and (v) importing intermediate goods (which is a proxy for access to cheaper intermediates via imports) has a positive impact on the start of exporting. The last two points refer to the finding of the theoretical model, which concludes that firms use importing in order to increase their level of productivity before the start of exporting. Importing increases the firms' productivity by making a production process more cost effective. Firms can achieve this in two ways. The first is by importing higher quantities of more affordable intermediates, or importing intermediates of higher quality from abroad. The second is by importing capital goods that are more affordable or of higher quality, which can in turn increase the technological advancement and cost-effectiveness of firms' production processes. The latter might in turn also demand more sophisticated intermediate inputs, meaning the last two points might occur hand in hand.

The following subsections first present the methodology and then continue by describing the data and presenting the main descriptive statistics.

2.3.1 Methodology

With the aim of analysing the presented hypotheses, I apply propensity score matching, which was also used when studying sequencing patterns between importing, exporting and innovation (Damijan & Kostevc, 2015), and exporting and firm performance (Yang & Mallick, 2010). The abovementioned papers serve as a benchmark to this study. Propensity score matching is used in order to explore different behavioural patterns of firms that share similar characteristics. Moreover, the statistical literature suggests also other advantages of propensity score analysis; e.g. the propensity score does not rely on the correct specification of the functional form of the relationship, it makes a more unambiguous comparison between treated and control units and is more objective, as modelling and the outcome analysis are done separately (Zanutto 2006; Hill et al., 2004; Becker & Ichino, 2002; and Rubin, 1997). The estimation of the average treatment effects is based on

propensity scores. I follow the definition of Rosenbaum and Rubin (1983), who define it as the conditional probability of receiving a treatment, given the pre-treatment characteristics. The methodology for estimating individual hypotheses is described in greater detail below.

2.3.1.1 Hypothesis 1: Correlation between importing and a better skill structure of firms is positive

In order to estimate the first hypothesis, I explore the differences in the skill structures of importers and non-importers. In accordance, the treatment group consists of importing firms and the control group consists of non-importing firms. Since the aim of the first hypothesis is to analyse the correlation between importing and skill structure of firms, and since this hypothesis does not differentiate between importing starters nor does it measure the sequencing and causality, variables in the expressions for estimating the propensity score and the average treatment effect on the treated are not lagged.

It is important to discuss also the possible endogeneity issue, linked with this hypothesis. Higher share of skilled workers in importing firms might not necessarily reflect that firms are highly-technological, as the reason for their better skill structure might be due to the large volumes of importing, which does not demand firms to have their own production. As a result, large volumes of importing might change the skill structure of firms in favour of the skilled. Hypotheses 2 and 3 aim to overcome this issue by focusing on importing starters, where the second hypothesis analyses whether a better skill structure is a prerequisite for the start of importing, and the third hypothesis analyses whether skill structure changes in favour of the skilled after the start of importing.

Hypothesis 1 is summarised in (43):

$$Skill\_share_t = f(IMP_t = 1) \tag{43}$$

IMP_t in (43) relates to importing, and $Skill\_share_t$ relates to firms' skill share in the period *t*. Following existing literature, workers are defined as skilled if they attain at least some form of college degree (Bloom et al., 2011; Tokarick, 2002; and Baldwin & Cain, 2000), which is typically 14 years of educational attainment in Slovenia.

The following model has been used for estimating the propensity score ($p(X_1)$) (probit estimation), where the propensity score equals the probability of being an importer, based on certain pre-treatment characteristics of firms, X_1:

$$p(X_1) = f(Size_{it}, Lvae_{it}, Lke_{it}, Rimsh_{it}, Foreign_{it}, FDI_{it}, Time_t, Ind_t) \tag{44}$$

The explanatory variables in the model (44) are the following: logarithm of the number of employees in a firm ($Size_{it}$), logarithm of the value added per employee ($Lvae_{it}$), logarithm of capital per employee (Lke_{it}), regional import share, as a measure of regional

externality ($Rimsh_{it}$), dummy variable, controlling for the foreign ownership of a firm ($Foreign_{it}$), and a dummy variable, controlling for firms' foreign direct investments abroad (FDI_{it}). Variable $Time_t$ controls for year specific effects and Ind_t denotes industry dummy variables (2-digit NACE rev. 1 industries). The average treatment effect on the treated (ATT) is later computed in the following way:

$$ATT_1 = E[Skill\_share_{it} \mid p(X_1), IMP_t = 1] - E[Skill\_share_{it} \mid p(X_1), IMP_t = 0] \quad (45)$$

In equation 45, ATT_1 reports the difference in the skill share between importing firms ($IMP_t = 1$; treatment group) and non-importing firms ($IMP_t = 0$; control group), where the outcome of interest, $Skill\_share_{it}$, refers to the skill structure of firm *i* in year *t*, and $p(X_1)$ refers to the propensity score from the equation (44).

2.3.1.2 Hypothesis 2: Firms with a better skill structure start importing

The second hypothesis explores whether firms with a better skill structure self-select into importing. Testing the hypothesis follows the procedure, presented in Yang and Mallick (2010). The treatment group consists of firms that start importing in a particular year, and the control group consists of non-importing firms. Hypothesis 2 is summarised in (46):

$$Prob(IMPstart_t = 1) = f(Skill\_share_{t-s}) \quad (46)$$

The variable $IMPstart_t$ denotes importing starters, which start importing in the period *t* and which have not been importing in the previous years. The variable $Skill\_share_{t-s}$ denotes the firm's skill share. In order to empirically analyse the hypothesis, the variable of interest; i.e. the skill share, is lagged for one period ($s = 1$) in the base results, whereas in the extensions of the model, it is lagged for two periods ($s = 2$). As a result, when calculating the propensity scores, the control variables are lagged for one or two periods, respectively, and are parallel to the ones in the model (44). The following model has been used for estimating the propensity score ($p(X_2)$) (probit estimation):

$$p(X_2) = f(Size_{it-s}, Lvae_{it-s}, Lke_{it-s}, Rimsh_{it-s}, Foreign_{it-s}, FDI_{it-s}, Time_t, Ind_t) \quad (47)$$

For testing the second hypothesis, the ATT is computed in the following way:

$$\begin{aligned} ATT_2 = {} & E[Skill\_share_{it-s} \mid p(X_2), IMPstart_t = 1] - \\ & - E[Skill\_share_{it-s} \mid p(X_2), IMP_t = 0] \end{aligned} \quad (48)$$

In equation (48), ATT_2 reports the difference in the skill share between importing starters ($IMPstart_t = 1$; treatment group) and non-importing firms ($IMP_t = 0$; control group), where the outcome of interest, $Skill\_share_{it-s}$, refers to the skill share of firm *i* in the year *s*

before the start of importing, *t* refers to the entrance year of importing, and $p(X_2)$ refers to the propensity score from the equation (47).

2.3.1.3 Hypothesis 3: Skill structure changes in favour of the skilled labour after the start of importing

The next hypothesis examines whether skill structure of importing starters changes in favour of the skilled after the start of importing, using differences-in-differences matching estimator, which enables estimating the effect on the change in the outcome variable before and after the treatment. This step restricts the treatment variable compared to the previous model (equations 47 and 48) by taking into account only the firms that start importing in a particular year and have not been importing in the previous years, but continue importing at least one year after the start of importing. In the extended model, which concentrates on the impact in the second year after the start of importing, the treatment variable takes into account importing starters that continue importing at least two years after the start of importing. The control group again consists of non-importing firms. When calculating propensity scores, control variables are lagged for one period and parallel to the ones in the model (47).

Two different methods for calculating the ATT were used when testing the third hypothesis:

$$\begin{aligned} ATT_3 = {} & E\left[Skill\_share_{it+s} \mid p(X_2), IMPstart_t = 1, IMP_{t+s} = 1\right] - \\ & - E\left[Skill\_share_{it+s} \mid p(X_2), IMP_t = 0, IMP_{t+s} = 0\right] \end{aligned} \tag{49}$$

$$\begin{aligned} ATT_4 = {} & E\left[Skill\_share_{it+s} - Skill\_share_{it} \mid p(X_2), IMPstart_t = 1, IMP_{t+s} = 1\right] - \\ & - E\left[Skill\_share_{it+s} - Skill\_share_{it} \mid p(X_2), IMP_t = 0, IMP_{t+s} = 0\right] \end{aligned} \tag{50}$$

The basic model concentrates on the impact one year after the start of importing ($s = 1$), while the extensions of the model concentrate on the impact in the second year after the start of importing ($s = 2$). This step takes into account two different outcomes of interest and hence calculates two different average effects of treatment on the treated; ATT_3 and ATT_4. The outcome of interest in the former is the skill share in year *s* after the start of importing ($Skill\_share_{it+s}$), while the outcome of interest in the latter is the change in the skill share in year *s* after the start of importing ($Skill\_share_{it+s} - Skill\_share_{it}$). The treatment group in the basic model consists of importing starters that have not been importing in the previous years and continue importing at least one year after the start of importing ($IMPstart_t = 1, IMP_{t+1} = 1$), while in the extensions of the model, it consists of importing starters that have not been importing in the previous years and continue importing at least two years after the start of importing ($IMPstart_t = 1, IMP_{t+1} = 1, IMP_{t+2} = 1$). The control group consists of non-importing firms

($IMP_t = 0, IMP_{t+s} = 0$). Again, the *t* in equations (49) and (50) refers to the entrance year of importing.

2.3.1.4 Hypotheses 4 and 5: Importing capital or intermediate goods has a positive impact on the start of exporting

Finally, the last two hypotheses take into account the effect of starting to import on the start of exporting, where two different imported types of goods, intermediate and capital, were taken into account. The procedure for estimating the propensity scores in this step again coincides with the equation (47), where the control variables are lagged for one period. The classification of Broad Economic Categories (BEC) was used for defining intermediate and capital goods. Hypotheses 4 and 5 are summarised in (51) and (52), respectively:

$$Prob(EXPstart_{t+s} = 1) = f(IMPstart\_c_t) \tag{51}$$

$$Prob(EXPstart_{t+s} = 1) = f(IMPstart\_i_t) \tag{52}$$

$EXPstart_{t+s}$ presents the start of exporting in period *t*+*s*, $IMPstart\_c_t$ presents the start of importing capital goods, and $IMPstart\_i_t$ the start of importing intermediate goods in period *t*.

The two average treatment effects on the treated, ATT_5 and ATT_6, are calculated in the following way:

$$\begin{aligned} ATT_5 = {} & E\left[EXPstart_{it+s} \mid p(X_2), IMPstart\_c_t = 1, IMP\_c_{t+s} = 1\right] - \\ & - E\left[EXPstart_{it+s} \mid p(X_2), IMP_t = 0, IMP_{t+s} = 0\right] \end{aligned} \tag{53}$$

$$\begin{aligned} ATT_6 = {} & E\left[EXPstart_{it+s} \mid p(X_2), IMPstart\_i_t = 1, IMP\_i_{t+s} = 1\right] - \\ & - E\left[EXPstart_{it+s} \mid p(X_2), IMP_t = 0, IMP_{t+s} = 0\right] \end{aligned} \tag{54}$$

The outcome of interest in ATT_5 is the start of exporting in year *s* after the start of importing capital goods ($EXPstart_{it+s}$), where *t* in equation (53) refers to the year when a firm started importing capital goods. The treatment group in the basic model consists of firms that start importing capital goods and continue importing these goods one year after the start of importing ($IMPstart\_c_t = 1, IMP\_c_{t+1} = 1$), while the treatment group in the extensions of the model consists of firms that start importing capital goods and continue importing these goods in the first and the second year after the start of importing ($IMPstart\_c_t = 1, IMP\_c_{t+1} = 1, IMP\_c_{t+2} = 1$). The treatment group takes into account firms that start importing capital goods in a particular year and have not been importing these goods in the previous years. The treatment however does not restrict imports of other

types of goods in the years before the start of importing capital goods. Focusing only on pure importing starters of capital goods; i.e. firms that have not been importing any types of goods before the start of importing capital goods, would greatly reduce the sample of firms in the treatment group (for 85.4 %). The control group consists of non-importing firms ($IMP_t = 0, IMP_{t+s} = 0$).

It would also be interesting to control whether firms import similar products that they produce and later sell or export, and therefore control for the pass-on trade (Damijan, Konings & Polanec, 2013). However, since the data does not currently enable this analysis, it would be noteworthy to include this test in the future analysis.

Meanwhile, the outcome of interest in ATT_6 is the start of exporting in year *s* after the start of importing intermediate goods ($EXPstart_{it+s}$), where *t* in equation (54) refers to the year when a firm started importing intermediate goods. The treatment group in the basic model consists of firms that start importing intermediate goods and continue importing these goods one year after the start of importing ($IMPstart\_i_t = 1, IMP\_i_{t+1} = 1$), while the treatment group in the extensions of the model consists of firms that start importing intermediate goods and continue importing these goods in the first and the second year after the start of importing ($IMPstart\_i_t = 1, IMP\_i_{t+1} = 1, IMP\_i_{t+2} = 1$). The treatment group takes into account firms that start importing intermediate goods in a particular year and have not been importing these goods in the previous years. As in the case of capital goods, the treatment does not restrict imports of other types of goods in the years prior to the start of importing intermediate goods. Focusing only on pure importing starters of intermediate goods; i.e. firms that have not been importing any types of goods before the start of importing intermediate goods, would greatly reduce the sample of firms in the treatment group (for 65.1 %). The control group consists of non-importing firms ($IMP_t = 0, IMP_{t+s} = 0$).

In order to estimate the ATT based on the particular propensity score, several different matching methods were used in order to increase the significance of results. These comprise one nearest neighbour matching with the replacement, taking into account two different calipers, 0.05 and 0.1. A tighter caliper significantly reduces bias and improves the performance of propensity score matching. On the other hand, a narrow caliper can also lead to the reduction of closer matches (Lunt, 2014). The calipers have been chosen in accordance with the analysis made by Austin (2011), who recommends the width of the caliper to equal 0.2 of the standard deviation of the logit of the propensity score. Next, I also use five nearest neighbours matching with the replacement and apply the same two calipers. For additional robustness checks, radius matching is used, where I again apply calipers 0.05 and 0.1. Finally, I also use kernel matching, where the significance of results was further tested by using two different bandwidths, 0.06 and 0.01. As in the several papers that used propensity score matching, bootstrapped standard errors were used (see

for example Heckman, Ichimura & Todd, 1997; Dehejia & Wahba, 1999, 2002; and Ichino & Becker, 2002 for reference).

2.3.2 Data and descriptive statistics

The reason for choosing Slovenia as the country of interest is due to its characteristics of a small and open economy. In the observation period, Slovenia increased its share of imports of goods and services as a percentage of GDP from 47.4 % in 1996 to 68.7 % in 2010. Among the EU countries, Luxembourg was in the forefront with 147.1 %, Spain was the last with 26.8 %, and the overall EU average was 37.0 % in 2010. The OECD average (25.8 %) and the world average (28.0 %) were even lower in the same year (World Bank, 2015).

To estimate the relationships between importing, exporting, and the skill structure of firms, a linked employer-employee panel dataset for Slovenian manufacturing firms that were active during the period from 1996 to 2010 was used. The dataset combines several databases: personal income-tax data, transaction-level data on imports and exports of goods, Statistical Registry of Employees, firm-level accounting data, and data on foreign direct investments of Slovenian firms. These datasets were 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).

The dataset contains information on balance sheet data and the income statements of Slovenian manufacturing firms, their import and export activities, and the attributes of employees. The richness of the dataset enables the empirical analysis of controlling for several characteristics of firms, i.e. number of employees, capital per employee, value added per employee, ownership, foreign direct investments, types of imports, and takes into account the attributes of employees, i.e. years of schooling, educational level, and wages. Table 1 presents some descriptive statistics of the data. For brevity, the descriptive statistics for initial years are presented with a four-year gap, whereas the recent years have no gaps.

Importing and exporting firms share similar characteristics – they are on average bigger, employ a higher number of skilled employees, and pay higher wages (Table 1). Wages in importing and exporting firms are higher in total and for skilled employees. However, while the share of skilled employees is above average in importing firms, it is usually below average in exporting firms. The only exception when the skill share was above the average in the observed period in exporting firms was the year 2009. Possible reason for this phenomenon could be the size of exporters, since exporters employ above average number of workers. Reducing the number of workers in the recent years in exporting firms led to the increase in the skill share of these firms. These descriptive statistics coincide with previous empirical studies (see for example Altomonte et al., 2013; Crino, 2012;

Altomonte & Békés, 2010; and Meschi et al., 2008). In the recent years, the number of employees has decreased in all treated firms due to the global crisis.

Table 1. Characteristics of Slovenian manufacturing firms, broken-down by importing and exporting activities (mean values)

Manufacturing firms - total							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Employment	45.5	43.1	38.4	37.5	34.8	30.4	28.9
Employment of skilled	4.3	4.6	4.8	4.9	4.6	4.5	4.5
Skill share	14.0	14.0	14.7	14.8	14.8	15.5	16.4
Gross wage	5,073	7,665	10,269	11,005	11,624	11,476	11,886
Gross wage of skilled	9,961	14,371	17,567	18,415	19,406	19,071	18,985
Importing manufacturing firms							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Employment	73.8	71.9	84.7	79.0	74.8	69.4	66.3
Employment of skilled	7.0	7.7	10.9	10.6	10.4	10.7	10.7
Skill share	14.2	14.9	15.8	15.6	16.3	17.3	18.8
Gross wage	5,587	8,503	11,703	12,543	13,515	13,533	14,191
Gross wage of skilled	10,900	15,536	19,982	20,668	21,917	21,939	22,106
Exporting manufacturing firms							
Year	**1998**	**2002**	**2006**	**2007**	**2008**	**2009**	**2010**
Employment	107.5	98.7	78.2	71.2	71.9	64.2	63.8
Employment of skilled	10.2	10.7	9.3	9.0	9.6	9.5	9.8
Skill share	11.6	12.2	14.4	14.7	14.6	15.7	16.2
Gross wage	5,724	8,548	11,409	12,205	12,966	12,810	13,262
Gross wage of skilled	12,165	17,481	21,028	21,585	23,409	22,865	22,800

Note. Explanations of the variables are as follows: *Employment*: the average number of employees; *Employment of skilled*: the average number of skilled employees; *Skill share*: the average of the skill share in firms (in per cent); *Gross wage*: average gross wage in €; *Gross wage of skilled*: average gross wage of skilled employees in €.

Source: SORS, author's calculations

2.4 Results and discussion

In order to assure unbiased results, several tests on the quality of matching were made. First, the Propensity Score histograms, which present the overlap between treated and untreated firms, show that roughly a half of the observations in the treated groups were matched with a similar propensity score in the untreated groups. In addition, the efficiency of the matching for each exogenous variable has been checked. The t-test is used for testing the hypothesis that the mean value of a variable is the same in the treatment and in the control group. With the exception of the t-test for the first hypothesis, all other tests show that the Balancing property is satisfied. Next, the bias after the matching procedure is measured to check whether the differences between the treatment and the control group

decrease considerably after matching. The test shows that the matching procedure on average significantly reduced the differences between the treatment and the control groups. Although the t-test for the first hypothesis did not confirm that the Balancing property is satisfied, the other tests did, following to the conclusion that the matching procedure generated an appropriate control group to match the observations in the treatment group. The tests are enclosed in the Appendix. The succeeding two subsections present base results and some additional robustness checks.

2.4.1 Base results

The following tables present the results on the linkages between imports, exports and the skill structure of firms. To enhance the robustness of the results, each treatment was evaluated with different matching methods. The extensions of the model and additional robustness checks are presented in the next subsection.

Table 2. Results of testing Hypothesis 1: Correlation between importing and a better skill structure of firms is positive

Outcome of interest: skill share				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.05	0.269***	0.034	35,910	33,289
Nearest neighbour (5), caliper: 0.05	0.253***	0.030	35,910	33,289
Radius, caliper: 0.05	0.333***	0.025	35,910	33,289
Kernel, bandwidth: 0.06	0.320***	0.025	35,910	33,289

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing firms); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

The results of the analysis of the differences in the skill structure between importers and non-importers (Table 2) indicate that importers have a higher share of skilled employees than non-importers. Depending on the chosen method, the share of skilled employees in importing firms is on average higher for 25.3 to 33.3 %, compared to non-importing firms. These findings are confirmed by all matching methods.

Table 3. Results of testing Hypothesis 2: Firms with a better skill structure start importing

Outcome of interest: skill share one year before the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.05	0.206***	0.053	888	28,549
Nearest neighbour (5), caliper: 0.05	0.145***	0.046	888	28,549
Radius, caliper: 0.05	0.105***	0.036	888	28,549
Kernel, bandwidth: 0.06	0.104***	0.035	888	28,549

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

The results of the analysis of the self-selection of firms with a better skill structure into importing (Table 3) indicate that future importers have a higher skill share than non-importers one year before starting to import. The share is higher for 10.4 to 20.6 %, depending on the chosen method. The findings are confirmed by all matching methods.

Table 4. Results of testing Hypothesis 3: Skill structure changes in favour of the skilled labour after the start of importing

Outcome of interest: skill share one year after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.05	0.419***	0.093	805	23,640
Nearest neighbour (5), caliper: 0.05	0.351***	0.070	805	23,640
Radius, caliper: 0.05	0.337***	0.059	805	23,640
Kernel, bandwidth: 0.06	0.334***	0.059	805	23,640
Outcome of interest: change in the skill share one year after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.05	0.073*	0.038	843	27,765
Nearest neighbour (5), caliper: 0.05	0.030	0.032	843	27,765
Radius, caliper: 0.05	0.025	0.024	843	27,765
Kernel, bandwidth: 0.06	0.024	0.024	843	27,765

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters that import also one year after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: SORS, author's calculations

The results of analysing the third hypothesis (Table 4) indicate that new importers have a higher skill share one year after the start of importing, compared to non-importing firms. Depending on the chosen method, the share is higher for 33.4 to 41.9 %. This result supports previous results on the self-selection of firms with a better skill structure into importing. On the other hand, the majority of results does not show a significant increase in the skill share of workers one year after the start of importing and thus does not support the hypothesis that firms improve their skill structure one year after the start of importing.

The final step analyses the impact of starting to import capital goods (Table 5) and the impact of starting to import intermediate goods (Table 6) on the start of exporting.

Table 5. Results of testing Hypothesis 4: Importing capital goods has a positive impact on the start of exporting

Outcome of interest: start of exporting one year after the start of importing capital goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.05	1.000E-04	0.006	818	24,038
Nearest neighbour (5), caliper: 0.05	0.002	0.005	818	24,038
Radius, caliper: 0.05	0.003	0.004	818	24,038
Kernel, bandwidth: 0.06	0.003	0.004	818	24,038

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters of capital goods that import also one year after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: SORS, author's calculations

Table 6. Results of testing Hypothesis 5: Importing intermediate goods has a positive impact on the start of exporting

Outcome of interest: start of exporting one year after the start of importing intermediate goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.05	0.013***	0.005	905	24,038
Nearest neighbour (5), caliper: 0.05	0.009*	0.005	905	24,038
Radius, caliper: 0.05	0.010***	0.004	905	24,038
Kernel, bandwidth: 0.06	0.010**	0.004	905	24,038

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters of intermediate goods that import also one year after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: SORS, author's calculations

The results suggest that the start of importing intermediate goods has a positive impact on the start of exporting in the next period (Table 6), while the start of importing capital goods does not seem to have an immediate impact on the start of exporting in the next period (Table 5). One could also interpret these results in a way that, due to the different characteristics and usage of intermediate and capital goods in the production process,

importing intermediate goods has a prompt effect on the start of exporting, while importing capital goods might have a delayed effect on the start of exporting. To test this claim, the following subsection takes also the second period into account and makes additional robustness checks.

2.4.2 Extensions of the model

Following Yang and Mallick (2010), and Damijan and Kostevc (2015), who lag the outcomes of interest by one and two periods, this subsection lags the outcome of interest for two periods when analysing the second hypothesis, and taking into account the second year after the start of importing when analysing the last three hypotheses. Additional robustness checks that include alterations of matching methods (e.g. changing the calipers and the bandwidths) and additional Balancing property tests are included in the Appendix.

First, the extensions of the model take into account additional checks of the self-selection of firms into importing, by comparing the skill shares of non-importing firms and importing starters two years before the start of importing. When testing Hypothesis 2 in the basic model and in extensions of the model, the same treatment has been used. In addition, in order to compare the results of the basic and extended model, the sample of the treated firms has been defined in a way to focus on the same cohort of firms. The results suggest that firms do not have a significantly different skill structure two years before the start of importing. Comparing these results to the results of the basic model indicates that firms decide to additionally increase their skill share one year before the start of importing.

Table 7. Model extensions of testing Hypothesis 2: Firms with a better skill structure start importing

Outcome of interest: skill share two years before the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.05	-0.067	0.088	888	24,376
Nearest neighbour (5), caliper: 0.05	-0.018	0.070	888	24,376
Radius, caliper: 0.05	0.023	0.054	888	24,376
Kernel, bandwidth: 0.06	0.022	0.054	888	24,376

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

Next, the skill share and its change two years after the start of importing are analysed. In line with the base results and the results of the self-selection of firms with a higher share of skilled workers into importing, results from Table 8 show that the skill share of importing starters is higher also two years after the start of importing. Depending on the chosen method, the skill share in importing starters is higher for 41.1 to 52.7 % two years after the start of importing, compared to non-importing firms. In addition, results show that the increase in the skill share in importing firms two years after the start of importing, compared to non-importing firms, is higher for 10 to 15.7 %, depending on the chosen method. Since the cohort of the treated firms was not the same in the basic and extended model, the results of the two cannot be compared. More precisely, the treatment group in the extended model was restrained, compared to the basic model, by taking into account only importing starters that continue importing two years after the start of importing. Significantly positive change in the skill share two years after the start of importing, compared to the insignificant change one year after the start of importing, could be the consequence of the survival of the fittest, where only the most productive importing starters continue importing two years after the start of importing. On the other hand, the reason for the significantly positive change in the skill share in the second year after the start of importing could be the sign of firms changing their skill structure only in the second year after the start of importing. It would be interesting to analyse these points in the future research.

These results partially confirm the conclusions of the theoretical model, which point to a positive impact of importing on the employment of skilled labour. The theoretical model explained that the labour productivity and consequently also the employment of skilled labour increase after firms start importing. The increased productivity is the result of two reasons; first is through importing intermediate goods, which allows other production factors to be used more productively, and the other is through importing technology that is more affordable and/or of better quality.

Table 8. Model extensions of testing Hypothesis 3: Skill structure changes in favour of the skilled labour after the start of importing

Outcome of interest: skill share two years after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.05	0.527***	0.108	516	19,630
Nearest neighbour (5), caliper: 0.05	0.418***	0.083	516	19,630
Radius, caliper: 0.05	0.414***	0.070	516	19,630
Kernel, bandwidth: 0.06	0.411***	0.070	516	19,630
Outcome of interest: change in the skill share two years after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.05	0.157**	0.061	560	27,677
Nearest neighbour (5), caliper: 0.05	0.103**	0.048	560	27,677
Radius, caliper: 0.05	0.100**	0.039	560	27,677
Kernel, bandwidth: 0.06	0.100**	0.039	560	27,677

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters that import also two years after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: SORS, author's calculations

Finally, analysing the impact of starting to export in the second year after the start of importing capital or intermediate goods confirms the supposition from the previous subchapter. More precisely, the previous part presumed that due to the characteristics and the usage of intermediate and capital goods in the production process, importing intermediate goods has a prompt effect on the start of exporting, while importing capital goods might have a delayed effect on the start of exporting. Even more, the results in Table 10 unveil that the majority of firms start exporting in the succeeding year after the start of importing intermediate goods. This is evident since the results in the second year after the start of importing intermediate goods are insignificant or even significantly negative. On the other hand, results in Table 9 show that firms start exporting two years after the start of importing capital goods.

As explained in the previous subchapter, these results point to a different role of intermediate and capital goods in the production process. More precisely, while

intermediate goods usually require additional manufacturing processing or are used for resale, investments in capital goods take longer to show effect. For instance, an investment in a new assembly line requires time for installation, testing, etc., before the start of the final implementation of the new line. In contrast, firms make every effort to minimise the costs of stockholding and therefore aim not to store their intermediate inputs for longer periods but try to use them in a manufacturing process or resale them as soon as possible.

Table 9. Model extensions of testing Hypothesis 4: Importing capital goods has a positive impact on the start of exporting

Outcome of interest: start of exporting two years after the start of importing capital goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.05	0.006	0.007	723	19,984
Nearest neighbour (5), caliper: 0.05	0.011**	0.005	723	19,984
Radius, caliper: 0.05	0.010**	0.004	723	19,984
Kernel, bandwidth: 0.06	0.010**	0.004	723	19,984

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters of capital goods that import also two years after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: SORS, author's calculations

Table 10. Model extensions of testing Hypothesis 5: Importing intermediate goods has a positive impact on the start of exporting

Outcome of interest: start of exporting two years after the start of importing intermediate goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.05	-0.008	0.005	795	19,984
Nearest neighbour (5), caliper: 0.05	-0.005*	0.003	795	19,984
Radius, caliper: 0.05	-0.004*	0.002	795	19,984
Kernel, bandwidth: 0.06	-0.004*	0.002	795	19,984

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters of intermediate goods that import also two years after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source: SORS, author's calculations

2.5 Conclusions

The aim of this study was to empirically test some of the deductions made in the theoretical model from the previous chapter. More precisely, the aim of the paper was to test the following: (i) whether firms with a better skill structure self-select into importing; (ii) whether firms further improve their skill structure after the start of importing; and (iii) whether the start of importing intermediate or capital goods later has a positive impact on the start of exporting. These relations between importing, exporting and the skill structure of firms in a small and open economy were studied using the employer-employee panel dataset. The dataset took into account Slovenian manufacturing firms in the period from 1996 to 2010. With the aim of considering evident differences between the importing and the non-importing firms, the propensity score matching approach was applied.

The empirical analysis confirmed that firms with a better skill structure self-select into importing. In addition, the importing firms sustain a higher skill share than the non-importing firms in the first and second year after the start of importing. While the skill structure of firms does not seem to improve significantly one year after the start of importing, it increases in the second year after the start of importing. The estimated results coincide with some of the previous studies which have, to the best of my knowledge, not yet studied thoroughly the relationship between importing and the skill structure of firms. The results confirm the previous empirical findings on the positive impact of importing activities on the demand for skills (see for example Crino, 2012; and Meschi et al., 2008), and add new insights on the self-selection of firms with a better skill structure into importing. More precisely, this study applies a thorough analysis of all phases of

importing; i.e. before the start of importing, importing starters and importers in general. Furthermore, with the aim of capturing the level of changes in the skill structure of firms, the differences-in-differences matching estimator was applied.

In addition, the results also add new insights regarding the impact of starting to import intermediate or capital goods on the start of exporting. Starting to import intermediate goods has a positive impact on the start of exporting already in the first year after the start of importing these goods. Even more, the impact on the start of exporting in the second year after the start of importing intermediate goods is insignificant or even negative, indicating that the start of importing intermediate goods has an immediate impact on the start of exporting. In contrast, importing capital goods shows a positive impact on the start of exporting only in the second year after the start of importing these goods. These results indicate the different function of the capital and intermediate goods in the production process. While intermediate goods usually refer to raw materials and thus require further processing or are used for resale, capital goods usually refer to firms' fixed assets and are used to increase firms' productive capacities. Consequently, as shown by this paper, the impact of importing capital goods may have a delayed impact on the start of exporting, while importing intermediate goods has an immediate effect on the start of exporting.

Besides researchers in this field, governments, firms, workers, jobseekers and students will also benefit from this study. Since firms with a better skill structure self-select into importing, it is important for the governments to focus on establishing an environment that encourages international cooperation and stimulation of skill upgrading in firms, in order to further increase the productivity and competitiveness of domestic firms. Moreover, firms should have greater incentives for hiring skilled workers, while students, workers and individuals in the job market should in turn have higher incentives for attaining college degrees and acquiring additional on-the-job training.

3 THE EFFECTS OF OUTSOURCING AND OFFSHORING ON SKILL STRUCTURE: EVIDENCE FROM MATCHED FIRM-EMPLOYEE DATA

3.1 Introduction

Globalisation has changed the world dramatically in the most recent decades. According to International Monetary Fund (IMF), trade liberalisation 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 organisation of their value added activities, where offshoring and outsourcing are among their main methods of strategic positioning. Forecasts on increasing internationalisation specify that firms will carry out even more of their activities outside of their enterprises in the future; for instance by increasing foreign direct investment (FDI) flows, or by 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 the 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 the French manufacturing industries, Egger and Egger (2003), studying the impact of trade liberalisation 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 an 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 as 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 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. In this study, outsourcing is defined as the ratio between firm's value of intermediate imports and its value of total material costs, while offshoring is measured as the presence of the FDI flows in a firm.

The 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 workers 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 their models at a time. The majority of these models confirmed a positive impact of offshoring and outsourcing on the labour demand, without controlling for the other factor. Not controlling for both factors in one model might therefore lead to the missing variable bias. In addition, both factors are expected to increase in the future. Taking these facts into account, I believe it is important to account for both aspects in one model.

The 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 a new interpretation of results and controls for the 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 access to technologically more advanced intermediate inputs, which in turn demand the 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 the home country (as for example research, sales, marketing, finance, etc.).

The final aim is to include a new dimension when defining skills, which takes into account also the occupational classification of workers and not only the level of their formal education. It is important to take this into account since workers gain their skills not only by formal education but also through various forms of vocational trainings and during their work career. One would expect that taking into consideration also the occupational classification when defining skills should further increase the explanatory power of the model.

The empirical analysis addresses the following hypotheses: (i) the effect of offshoring and outsourcing remains positive also after controlling for both factors in one model; (ii) outsourcing from high-income countries and offshoring to low-income countries have a positive effect on the skill share of firms; and (iii) the effect of offshoring and outsourcing varies between different occupational levels of workers.

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. The empirical analysis is split into 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. An additional extension of the model introduces a new dimension when defining skills, which takes into account not only the formal educational level of workers but also their occupational classification. By including this, the model does not only control for the educational level of workers, but also for their occupational level and different characteristics of working responsibilities. By controlling for the occupational structure, the model can also test, whether firms differentiate between employing workers with different educational levels within the same occupational class. This conclusion would bring additional policy implications to previous findings.

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 level of countries, offshoring to low- and high-income countries shows a similar and positive impact on the relative employment of skilled labour in manufacturing firms. In service firms, results point to a weaker impact of offshoring to high-income countries, compared to offshoring to low-income countries. Furthermore, when controlling also for the 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 for 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 workers with different educational levels within the same occupational group, which is especially true for Managers in service firms and Professionals in manufacturing firms. This conclusion is in line with findings of the previous chapters, confirming 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 provides conclusions.

3.2 Literature review

Literature review starts with a brief discussion on the theoretical models which explore the 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 offshoring costs on 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 the 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 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 an industrialised 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 unionised framework, outsourcing increases both, relative wages and the relative employment of high-skilled labour in the home 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. The results of their earlier paper point to an increase in 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 sectoral 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. The 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 the 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. The author concludes that outsourcing activities are concentrated in high-skilled manufacturing industries, while service industries show the highest increase in 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 the 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 belief, their results indicate 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 two 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, the 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 the 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 the 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, the competition in the Belgian market has increased through the 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.

The findings of presented studies in this section show that 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 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 the best of my 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 the occupational classification of workers, as skills can be acquired through employment and experience, and not only through formal education. 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 the opportunities to achieve higher formal education, but took an important position in firms 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 the employment effects of offshoring and outsourcing differ by task characteristics. Nevertheless, in order to fully control for the informal education of workers, it would be interesting to control also for other variables, as for example the period of employment, and also personal characteristics of workers, as for example gender, length of pursuing the studies, social status of the family, etc. These aspects could be included to the analysis in the future extensions of the model.

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 and avoid the missing variable bias problem. The reasoning behind this is due to the findings of empirical studies, which show that offshoring and outsourcing both have a positive impact on the labour demand, where the models accounted for only one of the factors in their model. Therefore, both factors – offshoring and outsourcing – are included in this 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, the paper's main aim is to test whether: (i) including both phenomena – offshoring and outsourcing – in one model alters the results of the 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 workers; (ii) controlling for the 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) controlling for the occupational structure of workers brings additional contributions to the results of the paper.

3.3 Methodology

This section presents the methodology and sets up a framework and specification of the model, which will serve for empirically testing of 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. The 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 the 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 this 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, in this analysis, outsourcing 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*:

$$Outsourcing_{it} = \frac{Intermediate\ imports_{it}}{Total\ material\ costs_{it}}, \tag{55}$$

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 a process of relocating a part of or all the activities to another firm, located overseas, or as foreign direct investments. For estimating the effect of offshoring, I take into account the dataset from the Bank of Slovenia, which comprises information on the FDI flows for every Slovenian firm. This dataset gathers information on the volume of the FDI and the destination country of the investment. Offshoring is denoted by introducing a dummy variable, indicating the existence of firm's FDI flows.

Definitions of the outsourcing and offshoring therefore take into account only foreign flows. The weaknesses of the abovementioned definitions are mainly the consequence of data limitations. More precisely, since firms can buy intermediate goods also from domestic firms, it would be important to include also this information to the analysis, should it be available. To control for this, this study used a proxy in the form of domestic cost level, calculated as the difference between the total level of material costs and imports. In addition, since not all FDI flows affect firms' skill share, definition of offshoring should also include information on the type and volume of the FDI flows in order to make a more comprehensive measure on its effect on the skill share. Unfortunately, this data is available only for the recent years. In future studies, it would also be interesting to analyse the share of inputs from countries, where firms have outward FDI, and compare this with the share of inputs from countries, where firms do not have outward FDI.

3.3.1 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:

$$Y_{it} = A_{it} f(K_{it}, H_{it}, C_{it}), \tag{56}$$

where the dependent variable, Y_{it}, is the output, A_{it} is productivity, K_{it} is 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. Due to the abovementioned data limitations of offshoring's and outsourcing's definitions, it was not possible to find an appropriate measure for both factors that would consider all flows and is therefore not entirely consistent with the presented model. It would be interesting to take this into account in the future studies, when data limitations are resolved.

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 (56) by the total number of firms' employees, separate the international activities of firms into offshoring (Off_{it}) and outsourcing (Out_{it}), separate domestic inputs into unskilled labour (L_{it}) and domestic costs (DC_{it}), take logarithms and rearrange the equation so that the variable of interest on the left is the skilled labour:

$$-\beta(\beta-1)\ln H_{it} = \ln P_{it} + \ln A_{it} + \alpha \ln K_{it} + (1-\alpha-\beta)\ln(Out_{it} + Off_{it} + L_{it} + DC_{it}) \quad (57)$$

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 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. A detailed derivation of the model is enclosed in the Appendix.

After rearranging, the empirical model hence becomes:

$$\begin{aligned} Skill\_share_{it} = {} & \beta_0 + \beta_1 Out_{it} + \beta_2 Off_{it} + \beta_3 X_{it} + \beta_4 A_{it} + \beta_5 K_{it} + \\ & + \beta_6 W_{it} + \beta_7 DC_{it} + Time_t + Ind_t + \varepsilon_{it}, \end{aligned} \quad (58)$$

where the dependent variable $Skill\_share_{it}$ is the logarithm of the ratio between skilled employees and the total number of employees in 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 DC_{it} is a logarithm of the domestic cost level in firm i and year t. Domestic cost level (DC_{it}) is calculated as the difference between the total level of material costs and imports. To increase the sensitivity of results, two different measures of productivity (A_{it}) are used; value added per employee and total factor productivity. 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 the explanatory value of the model. More precisely, changes in firm size might be a consequence of the changes in these variables. Instead, the model has been estimated with and without firm size as one of the explanatory variables.

It would be convenient to include also other control variables that have an important effect on the skill structure of firms, as for example information on the R&D expenditures and the number of patents. However, since this data is not available or is imperfect, there exists a missing variable bias which would be important to take into account in the future studies.

3.3.2 Extensions of the model

The 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. The authors emphasise 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:

$$\begin{aligned} Skill\_share_{it} = {} & \beta_0 + \beta_1 Out_{it} + \beta_2 Out\_high_{it} + \beta_3 Off_{it} + \beta_4 Off\_high_{it} + \\ & + \beta_5 High_{it} + \beta_6 X_{it} + \beta_7 A_{it} + \beta_8 K_{it} + \beta_9 W_{it} + \beta_{10} DC_{it} + \\ & + Time_t + Ind_t + \varepsilon_{it}, \end{aligned} \tag{59}$$

where Out_high_{it} is an interaction term between outsourcing and a dummy variable, controlling for high-income countries, Off_high_{it} is an interaction term between offshoring and a dummy variable, 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 (59) follows the basic model (58). 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 β_1

and β_2 reflect the impact of outsourcing from high-income countries, while the impact of offshoring to low-income countries is reflected in the coefficient β_3.

Subsequently, the extensions of the model also include a new dimension when defining skills. In the previous analyses, workers were usually defined as skilled after achieving a particular educational 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 the occupational level when defining the 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 onto 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 to the abovementioned fields (ILO, 2014).

3.4 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 1997 to 2010. The dataset comprises information on the balance sheet 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 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 11), and taking into account the 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 a higher total 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 the 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 a 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 11. 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 as follows: *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 12). Both types of firms are bigger in size, compared to an average firm in Table 11. The

average age of employees in offshoring and outsourcing firms is also slightly higher than in the average firm. Finally, the 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. The descriptive statistics for these firms show that they are on average bigger and pay higher wages than the average offshoring and outsourcing firms. The table is enclosed in the Appendix.

Table 12. 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

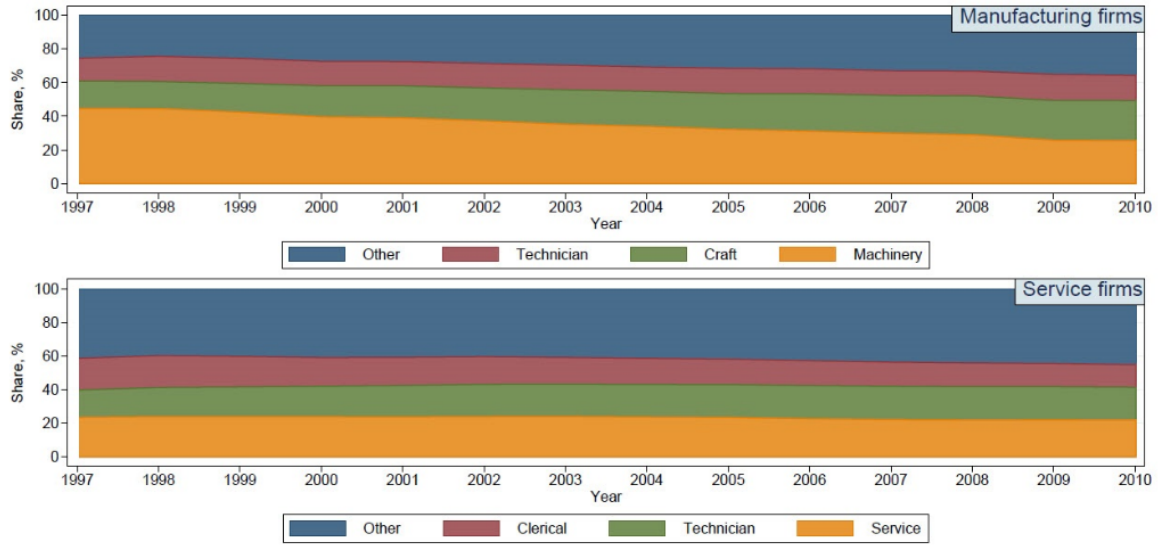
Note. Explanations of the variables are as follows: *Outsourcing firms*: firms that import intermediate products; *Offshoring firms*: firms that engage in outward FDI; *Employment*: mean number of employees; *Employment of tertiary educated*: mean number of tertiary educated employees; *Skill share*: 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, the occupational structure of manufacturing and service firms is compared by using ISCO-88 classification (Figure 5). 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 remained 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 5. Occupational structure of manufacturing and service firms in Slovenia



Source: SORS, author's calculations

Table 13 below presents the 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. 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. This allocation of shares is consistent with the ISCO-88 classes of skill levels, presented in the methodological part. 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. Technicians also have above average wages, in parallel to the total average numbers. 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.

Table 13. 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 as follows: *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 of a particular occupational group in €; *Gross wage of tertiary educated*: mean annual gross wage of tertiary educated in a particular occupational group in €.

Source: SORS, author's calculations

The descriptive statistics of other occupational groups (included in the Appendix) reveal that other groups present only a minor share in the group of tertiary educated workers. The

highest share in the total employment is on average presented by 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.

3.5 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 an alternative definition of skilled employees is introduced, taking into account information on the occupational level of employees.

3.5.1 Basic model

The 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 the models (Cameron & Trivedi, 2009). In accordance, the method proposed by Schaffer and Stillman (2010) is applied, while the Sargan-Hansen 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.

Table 14. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the 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

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 seems to have no impact on the skill structure in service firms (Table 14).

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, the 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 investments with intermediate inputs, when estimating the production function. The 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.

3.5.2 Extensions of the model

In order to obtain new information, two extensions of the basic model have been made. The first extension differentiates between outsourcing from high- and low-income countries and offshoring to high- and low-income countries. The second extension includes information on the 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.

3.5.2.1 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 the estimation whether a particular type of source country of offshoring and outsourcing has a more significant impact on the skill structure of domestic firms.

Table 15. 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. The ependent 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the 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

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. The insignificant interaction term between offshoring and high-

income countries implies 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 seem 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 workers than offshoring to low-income countries. Outsourcing does not seem to have an impact on the skill share of firms in neither type of firms.

In order to test if the coefficients of the variables *Offshoring* and *Offshoring_high* in service firms are significantly different, the Wald test was applied, confirming that offshoring to high-income countries has a weaker impact on the relative employment of skilled workers (the p-value of the F-test was 0.089). It was presumed in the introductory part of the paper that offshoring to low-income countries would shift the manually-intensive parts of production abroad, keeping the high value added departments in the home country. Contrary to this claim, one could deduce from the results for service firms that offshoring to high-income countries might shift departments with higher value added to high-income countries, which would affect the skill structure of domestic firms negatively. This could be due to a firm's takeover or an urge for cost reduction; e.g. being in the area with higher purchasing power or closer to suppliers.

3.5.2.2 Alternative definition of skills

To this point, workers were defined as skilled when reaching a tertiary level of education. However, since workers gain important skills also by working in firms and not only by obtaining formal education, information on the occupational level of workers is added to the definition of skills, as explained in the methodology part. In order to further increase the contribution of the analysis, a 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, are the fixed effects, so the following conclusions relate to the results of this method.

Table 16. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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. On the other hand, the results for service firms again indicate that offshoring to low-income countries does not seem to have a statistically significant impact on the skill share of firms, while the negative and statistically significant interaction term indicates that offshoring to high-income countries has a weaker impact on the relative employment of skilled workers than offshoring to low-income countries. Once more, the Wald test was applied in order to test if the coefficients of the variables

Offshoring and *Offshoring_high* in service firms are significantly different. The test confirmed that offshoring to high-income countries has a weaker impact on the relative employment of skilled workers (the p-value of the F-test was 0.048).

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 are 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 17), 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 seem 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 17. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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 dimensions for defining 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 18 do not show statistically significant effects for the most preferred method. When dividing the analysis into the three major occupational groups (Table 19), the results again confirm that in manufacturing firms, offshoring to low-income countries does not seem 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. The coefficient on the interaction term between offshoring and high-income countries is statistically insignificant, implying 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, the educational and the occupational level, the results for Managers confirm the conclusions of the previous chapters that firms indeed have greater incentives for hiring more educated workers. In addition, when taking into account only the tertiary educated Professionals in manufacturing firms, the coefficient is 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 both groups occupied the largest share in the group of 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 18. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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 19. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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

3.6 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, into one model, and differentiates between outsourcing from high- and low-income countries, and offshoring to high- and low-income countries. Furthermore, different dimensions when defining skills are taken into account 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 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 about 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 the 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 workers only by the occupational level or when defining skilled workers by both, the occupational and the educational level. Results point to a stronger impact of offshoring to high-income countries on the relative employment of Professionals compared to offshoring to low-income countries in manufacturing firms. In addition, when taking into account only the 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 workers. When defining skilled workers 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 workers by using both definitions, results indicate a positive and similar impact of offshoring to high- and low-income countries on the relative employment of

tertiary educated Managers. The impact of educational level 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 partly confirms the deduction made in the previous chapters on firms having greater incentives for hiring skilled workers.

CONCLUSIONS

This doctoral dissertation analysed the linkages and causalities between importing, exporting and the skill structure of firms. The current chapter summarises key findings of the first three chapters, and presents contributions and opportunities for further research.

Summary of the main findings

The first chapter presented a theoretical model, which analysed the individual's decisions for investing in skill upgrading and the firm's decisions to start technology upgrading and trading. In order to thoroughly analyse the individual's and the firm's behaviour, the model was split into two parts. The first part analysed the individual's decisions for skill upgrading by comparing the incentives of high ability and low ability individuals for investing in acquiring a higher level of education. Since low ability individuals have to pay disproportionally higher costs for acquiring higher skills, only the high ability individuals can afford to invest in attaining a higher level of education. However, after investing in obtaining higher skills, high ability and high skilled individuals demand higher wages once entering the employment, in order to compensate for higher educational costs. A higher wage of a worker therefore signals the employment of a high ability and high skilled individual.

This finding was employed in the second part of the model, which studied the behaviour of firms. Before trade liberalisation, firms decide whether to invest in higher technology or not. The benefits of the latter are lower marginal production costs, while the drawbacks are higher fixed costs. Due to higher fixed costs, only the most productive firms invest in higher technology. After trade liberalisation, firms decide whether to start engaging in international activities, which again results in higher costs, but also increases revenues and/or the employment of skilled workers. The most productive among low-technology firms upgrade their skill levels and start exporting and importing, less productive upgrade skills and start only importing, while the least productive low-technology firms continue serving the domestic market. Findings of the low-technology firms therefore reveal the importance of the start of importing for increasing the level of productivity before the start of exporting. This was confirmed also in empirical studies (see for example Damijan & Kostevc, 2015; and Altomonte & Békés, 2010). On the other hand, only the least productive among the high-technology firms do not start engaging in international activities, while the decision of the most productive high-technology firms to start importing and/or exporting depends on the firm's productivity level, the skill upgrading before and after importing, and on external factors; i.e. the level of export and import costs.

The model in the second chapter empirically tested some of the outcomes of the theoretical model from the previous chapter. When analysing linkages and causalities between the skill structure of firms and the import status, the main ambition of the model was to test: (i) if importers employ a higher share of skilled employees, compared to non-importers; (ii) if

firms with a relatively higher skill share self-select into importing; (iii) and if firms upgrade their skill structure after the start of importing. In addition, when studying the impact of importing on the start of exporting, the analysis examined the influence of buying intermediates abroad and the influence of having access to technologies via imports on the start of exporting. The linked employer-employee panel dataset for Slovenian manufacturing firms was applied for the period from 1996 to 2010. The dataset combined several databases, covering the information on the balance sheet data and income statements of firms (i.e. number of employees, capital per employee, value added per employee, ownership, foreign direct investments), their import and export activities (i.e. value of imports and exports, and the type of imports), and attributes of employees (i.e. years of schooling, educational level, and wages.). In order to control for measurable differences between importing and non-importing firms, the propensity score matching approach was applied, where various matching techniques were used in order to increase the significance of the results. The results show that firms with a relatively better skill structure self-select into importing. In addition, although the skill structure of firms does not increase significantly in the first year after the start of importing, it improves in the second year. Also, in comparison to non-importing firms, importing starters sustain a higher share of skilled employees in the first and second year after the start of importing. Furthermore, the start of importing intermediate goods has a positive impact on the start of exporting in the first year after the start of importing, while the impact in the second year is insignificant or even negative. These results indicate an almost instant impact of importing intermediate goods on the start of exporting. On the other hand, the start of importing capital goods has a positive and statistically significant impact on the start of exporting only in the second year after the start of importing. These results point to a different role of intermediate and capital goods in the production process. More precisely, since intermediate goods usually present raw materials with a shorter lifespan and therefore require further manufacturing treatment or are used for resale, the impact of intermediate goods on the production process and consequently also on exports might be immediate but short-lived. On the other hand, the capital goods usually present firm's fixed assets and are used over a longer period.

The third chapter analysed the impact of offshoring and outsourcing on the relative employment of skilled employees in Slovenian manufacturing and service firms. The analysis used a similar matched firm-level and employee-level dataset as it was used in the previous chapter, covering the period from 1997 to 2010, and including some additional information (i.e. destination of exports and imports, destination of the FDI and occupational level of employees). The latter information was used as a supplementary measure for defining skills. The empirical analysis was divided into two parts, with the first part including a basic model, which studied the impact of offshoring and outsourcing on the relative employment of skilled workers. The model extensions controlled also for outsourcing from high- and low-income countries and offshoring to high- and low-income countries, and considered the level of occupation when defining skills. The three major

groups of the ISCO-88 classification defined skilled workers in the extended model – Managers, Professionals and Technicians. The methods for panel data analysis were used when estimating the effects of outsourcing and offshoring (i.e. pooled OLS, random effects, and fixed effects). The findings of the models point to a stronger and positive effect of offshoring on the relative employment of skilled workers. When controlling for the high- and low-income countries, the results vary depending on which definition of the skilled employees is used. Offshoring to high- and low-income countries indicates to have a comparable 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 relative employment of skilled workers. Results also indicate a weaker impact of offshoring to high-income countries on the skill share of firms in service firms, compared to the effect of offshoring to low-income countries. When introducing the occupational level as a measure for defining skills, the results for manufacturing firms do not vary significantly between different definitions of skilled workers. Offshoring to high-income countries shows a stronger impact than offshoring to low-income countries on the relative employment of Professionals and the relative employment of tertiary educated Professionals in manufacturing firms. In contrast, results for service firms vary depending on the definition of skills used. When defining skilled workers only by using the occupational level as a measure, offshoring to high-income countries shows a weaker impact on the relative employment of Technicians, in comparison to the impact of offshoring to low-income countries. When defining skilled workers by the occupational and educational level, a positive and similar impact of offshoring to high- and low-income countries on the relative employment of tertiary educated Managers is confirmed. The impact of education is therefore different among different occupational groups. This indicates that firms differentiate between employing different workers within the same occupational group, which is in line with conclusions of the previous two chapters, confirming that firms indeed have greater incentives for hiring skilled workers. Finally, several robustness checks were used in order to increase the significance of the results (for example controlling for the firm size, and using different definitions for defining the value added). Robustness checks on average confirm previous results.

Limitations of the doctoral dissertation

The potential limitations of the theoretical model in the first chapter are several assumptions, which in some way constrain the value of the model, as it would be hard to test these assumptions empirically. The model for instance assumes that the increase in the relative wage level of skilled workers after investing in high technology and after the start of importing has to be higher than the decrease in the level of marginal costs in these firms. An additional limitation of the theoretical model is also its more or less static outline. More precisely, even though the model acknowledges three dynamic phase shifts – i.e. the individual's decision to obtain a higher educational level, the firm's decision to invest in

high technology, and the firm's decision to start engaging in international activities – it handles only two of the firm's decisions simultaneously, e.g. investing in high-technology vs. not investing in high-technology, starting to import vs. continue serving the domestic market, etc., and therefore cannot thoroughly reflect the complexity of the current environment.

Although the data used in this doctoral dissertation is very rich, there are some limitations in the empirical analyses due to data usage. Since previous analyses found an important linkage between the age of the firm and the employment growth of the firm, it would be interesting to include the information on firm's age as one of the explanatory variables. Several studies expose that younger firms have higher employment growth than older firms (see for example Banerjee & Jesenko, 2015; Adelino, Robinson & Ma, 2014; and Fort et al., 2013). On the other hand, younger firms are more sensitive to investment opportunities and to the business cycles which contributed to the large employment decline in younger and smaller firms in the recent downturn (Fort et al., 2013). This information is currently not available in the dataset.

In order to further empirically test the conclusions of the theoretical model in the first chapter, additional information on the innovation activities of firms would be necessary. Although the dataset comprises information on the Community Innovation Survey (CIS), this data proved to be inadequate for several reasons; i.e. the survey is conducted only every two years, and the number of observations oscillates significantly between the periods. In addition, to further increase the explanatory power of the analysis, the extended model could also control for the high- and low-income countries.

With the aim of deepening the results of the empirical model in the third chapter, it would be useful to include additional information on the offshoring of firms. For instance the performance indicators of foreign partners that are in control of domestic firms, their employment structure, the value added, the value of the investment, etc. Some of the information is already included in the dataset, but only for recent years. Therefore, by extending the observation period and adding the data for the most recent years, this new information might bring additional contributions to the results. Nevertheless, in spite of limitations, presented in this section, this doctoral dissertation has several contributions, which are gathered in the following section.

Scientific contributions and future research suggestions

The theoretical model in the first chapter has two main contributions. First, it extends the contents of the theoretical models of Bustos (2011a, 2011b) and Melitz (2003) on heterogeneous firms, by including also importers in the model. Second, the model broadens the content of the current theoretical trade models, which to the best of my knowledge focused only on firms' behaviour, by analysing also the behaviour of individuals and their decision for skill upgrading. These findings are later used in the part

of the model, which studies the firm's behaviour. The model opens several possibilities for future research, where the following have been tested in the empirical model in the second chapter: (i) importers have a better skill structure prior to importing; (ii) the structure of workers changes in favour of the skilled workers after the start of importing; and (iii) by having access to technology and/or to intermediates, importing has a positive impact on the start of exporting. In addition, future studies might also take into account the limitations of the model, presented in the previous section. It would be especially noteworthy to consider adjusting the more or less static structure of the model, which does not reflect the complex decision-making of firms in today's environment.

The empirical analysis in the second chapter contributes to the field of knowledge by adding new understandings of the self-selection of importing firms and linkages between importing and the skill structure of firms. Specifically, all stages of importing are taken into account in the analyses; i.e. before the start of importing, first years of importing, and long-term importers. Moreover, types of imports were taken into account to further deepen the explanatory power of the analysis, when analysing the impact of the start of importing on the start of exporting. Here, the analysis distinguished between importing intermediate and capital goods. Finally, conclusions of the study might also benefit governments, firms, jobseekers and students. With the aim of further increasing the productivity and competitiveness of domestic firms, the governments should focus on stimulating international cooperation and skill upgrading in domestic firms. In turn, while firms should have higher incentives for hiring skilled workers, students, jobseekers and workers should have a higher stamina for increasing their educational level and obtaining additional on-the-job training. As introduced in the previous section, it was not possible to control for innovations due to the shortcomings of the CIS dataset. However, in the case of better data quality, it would be advantageous to control also for innovations in order to test additional findings of the theoretical model and to increase the explanatory power of the analysis. Although this was not one of the conclusions of the theoretical model, it would also be interesting to analyse the causality between exporting and the skill structure of firms, and whether there also exists a reverse causality between exporting and importing.

Finally, the first contribution of the empirical analysis in the third chapter includes both measures of strategic positioning of firms, i.e. offshoring and outsourcing, all in one model. To the best of my knowledge, previous studies controlled for only one of the factors simultaneously in their models. Since previous empirical studies confirmed that both of the measures influence the labour demand and since both are expected to increase in the future, it was important to include both in one model in order to avoid the missing variable bias. In addition, the study also differentiated between outsourcing from and offshoring to high- and low-income countries, which renders new interpretations of the results possible and takes into account the differences of partner's performance. Since previous empirical studies exposed the importance of differentiating between manufacturing and service firms, the analysis was made separately for both types of firms.

Furthermore, in order to increase the explanatory power of the model and control for the fact that individuals acquire skills also during a learning process while being employed and not only when gaining the official level of education, the analysis defined skills by taking into account both measures; i.e. the educational and the occupational level. As presented in the previous section, it would be important to control for more detailed information on offshoring, especially since offshoring proved to have an important impact on the skill structure of firms.

REFERENCES

Adelino, M., Ma, S., & Robinson, D. T. (2014). Firm Age, Investment Opportunities, and Job Creation. *NBER Working Paper Series*, Paper No. 19845.

Altomonte, C., Aquilante, T., Békés, G., & Ottaviano, G. I. P. (2013). Internationalization and innovation of firms: evidence and policy. *Economic Policy*, *28*(76), 663–700.

Altomonte, C., & Békés, G. (2010). Trade Complexity and Productivity. *CeFiG Working Papers*, Paper No. 12.

Alvarez, R., Ortega, C. B. & Navarro, L. (2012). Product Mix Changes and Performance in Chilean Plants. *Working Papers University of Chile, Department of Economics*, Paper No. 383.

Amiti, M., Itskhoki, O., & Konings, J. (2014). Importers, Exporters, and Exchange Rate Disconnect. *American Economic Review*, *104*(7), 1942–1978.

Amiti, M., & Davis, D. R. (2011). Trade, Firms, and Wages: Theory and Evidence. *Review of Economic Studies*, *79*(1), 1–36.

Amiti, M., & Konings, J. (2007). Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia. *American Economic Review*, *97*(5), 1611–1638.

Amiti, M., & Wei, S.-J. (2005a). Fear of service outsourcing: is it justified? *Economic Policy*, *20*(42), 307–347.

Amiti, M., & Wei, S.-J. (2005b). Service Offshoring, Productivity, and Employment: Evidence from the United State. *IMF Working Paper*, Paper No. WP/05/238.

Attanasio, O., Goldberg, P., & Pavcnik, N. (2003). Trade reforms and wage inequality in Colombia. *NBER Working Papers*, Paper No. 9830.

Austin, P. C. (2011). Optimal caliper widths for propensity-score matching when estimating differences in means and differences in proportions in observational studies. *Pharmaceutical Statistics*, *10*(2): 150–161.

Aw, B. Y., Roberts, M. J., & Xu, D. Y. (2011). R&D Investment, Exporting, and Productivity Dynamics. *American Economic Review*, *101*(4), 1312–1344.

Aw, B. Y., Roberts, M. J., & Xu, D. Y. (2008). R&D Investments, Exporting, and the Evolution. *American Economic Review: Papers & Proceedings*, *98*(2), 451–456.

Baldwin, R. E., & Cain, G. G. (2000). Shifts in Relative U.S. Wages: The Role of Trade, Technology, and Factor Endowments. *The Review of Economics and Statistics*, *82*(4), 580–595.

Banerjee, B., & Jesenko, M. (2015). The role of firm size and age in employment growth: Evidence for Slovenia, 1996-2013. *Bank of Slovenia working papers*, Paper No. 2/2015.

Bas, M., & Strauss-Kahn, V. (2014). Does importing more inputs raise exports? Firm-level evidence from France. *Review of World Economics*, *150*(2), 241–275.

Becker, S. O., & Ichino, A. (2002). Estimation of average treatment effects based on propensity scores. *The Stata Journal*, *2*(4), 358–377.

Bernard, A. B., & Jensen, J. B. (1999). Exceptional exporter performance: cause, effect, or both? *Journal of International Economics*, *47*(1), 1–25.

Biscourp, P., & Kramarz, F. (2007). Employment, skill structure and international trade: Firm-level evidence for France. *Journal of International Economics*, *72*(1), 22–51.

Bloom, N., Draca, M., & Van Reenen, J. (2011). Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity. *NBER Working Paper Series*, Paper No. 16717.

Brambilla, I., Lederman, D., & Porto, G. (2010). Exports, Export Destinations, and Skills. *NBER Working Papers*, Paper No. 15995.

Burstein, A., Cravino, J., & Vogel, J. (2013). Importing Skill-Biased Technology. *American Economic Journal: Macroeconomics*, *5*(2), 32–71.

Bustos, P. (2011a). Trade Liberalization, Exports, and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinian Firms. *American Economic Review*, *101*(1), 304–340.

Bustos, P. (2011b). The Impact of Trade Liberalization on Skill Upgrading: Evidence from Argentina. *Barcelona GSE Working Paper Series*, Paper No. 559.

Cameron, A. C., & Trivedi, P. K. (2009). *Microeconometrics Using Stata*. College Station, Texas: StataCorp LP.

Corvers, F. (1997). The impact of human capital on labour productivity in manufacturing sectors of the European Union. *Applied Economics*, *29*(8), 975–987.

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

Damijan, J., & Kostevc, Č. (2015). Learning from trade through innovation: Causal link between imports, exports and innovation in Spanish microdata. *Oxford Bulletin of Economics and Statistics*, *77*(3), 408–436.

Damijan, J., Konings, J., & Polanec, S. (2014). Import Churning and Export Performance of Multi-product Firms. *The World Economy*, *37*(11), 1483–1506.

Damijan, J., Konings, J., & Polanec, S. (2013). Pass-on Trade: Why do Firms Simultaneously engage in Two-Way Trade in the Same Varieties? *Review of World Economics*, *149*(1), 85–111.

Damijan, J., Kostevc, Č., & Polanec, S. (2010). From Innovation to Exporting or Vice Versa? *The World Economy*, *33*(3), 374–398.

De Backer, K., & Yamano, N. (2012). International comparative evidence on global value chains. *OECD Science, Technology and Industry Working Paper*, Paper No. 2012/3.

Dehejia, R., & Wahba, S. (1999). Causal Effects in Nonexperimental Studies: Reevaluating the Evaluation of Training Programs. *Journal of the American Statistical Association*, *94*, 1053–1062.

Dehejia, R., & Wahba, S. (2002). Propensity Score-Matching Methods for Nonexperimental Causal Studies. *Review of Economics and Statistics*, *84*, 151–161.

Egger, H., & Egger, P. (2003). Outsourcing and skill-specific employment in a small economy: Austria after the fall of the Iron Curtain. *Oxford Economic Papers*, *55*(4), 625–643.

Elias, P., & Birch, M. (1994). Establishment of Community-Wide Occupational Statistics. ISCO 88 (COM), A Guide for Users. *Institute for Employment Research, University of Warwick*.

Eurostat, statistical database. Retrieved June 12, 2015, from: http://ec.europa.eu/eurostat/data/database

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

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

Feng, L., Li, Z., & Swenson, D. L. (2012). The Connection between Imported Intermediate Inputs and Exports: Evidence from Chinese Firms. *NBER Working Papers*, Paper No. 18260.

Fieler, A. C., Eslava, M., & Xu, D. Y. (2014). Trade, Skills and Quality Upgrading: A Theory with Evidence from Colombia. *NBER Working Papers*, Paper No. w19992.

Fort, T. C., Haltiwanger, J., Jarmin, R. S., & Miranda, J. (2013). How Firms Respond to Business Cycles: The Role of Firm Age and Firm Size. *NBER Working Paper Series*, Paper No. 19134.

Foster, N., Stehrer, R., & de Vries, G. (2012). Offshoring and the skill structure of labour demand. *wiiw Working Papers*, Paper No. w19992.

Fryges, H., Vogel, A., & Wagner, J. (2014). The Impact of R&D Activities on Exports of German Business Services Enterprises: First Evidence from a Continuous Treatment Approach. *The World Economy*. doi: 10.1111/twec.12177.

Goldberg, P. K., Khandelwal, A. K., Pavcnik, N., & Topalova, P. (2010). Imported Intermediate Inputs and Domestic Product Growth: Evidence from India. *The Quarterly Journal of Economics*, *125*(4), 1727–1767.

Goldberg, P. K., & Pavcnik, N. (2007). Distributional Effects of Globalization in Developing Countries. *Journal of Economic Literature*, *45*(1), 39–82.

Greenaway, D., & Kneller, R. A. (2004). Exporting and Productivity in the United Kingdom. *Oxford Review of Economic Policy*, *20*(3), 358–371.

Greenhalgh, C., & Rogers, M. (2010). *Innovation, intellectual property, and economic growth*. New Jersey: Princeton University Press.

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

Halpern, L., Koren, M., & Szeidl, A. (2011). Imported Inputs and Productivity. *CeFiG Working Papers*, Paper No. 8.

Heckman, J., Ichimura, H., & Todd, P. (1997). Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme. *Review of Economic Studies*, *64*(4), 605–654.

Helpman, E., Itskhoki, O., & Redding, S. (2011). Trade and Labor Market Outcomes. *NBER Working Papers*, Paper No. 16662.

Hijzen, A., & Swaim, P. (2010). Offshoring, labour market institutions and the elasticity of labour demand. *European Economic Review*, *54*(8), 1016–1034.

Hijzen, A., Görg, H., & Hine, R. C. (2005). International outsourcing and the skill structure of labour demand in the United Kingdom. *The Economic Journal*, *115*(506), 860–878.

Hill, J. L., Reiter, J. P., & Zanutto, E. L. (2004). *A comparison of experimental and observational data analyses*. In Gelman, A. and X. L. Meng (Eds.), Applied Bayesian and causal inference from an incomplete data perspective (49–60). New York: Wiley.

Horgos, D. (2006). International Outsourcing – Some Measurement Problems: An Empirical Analysis of Outsourcing Activities in Germany. *IAW-Report*, *34*(1), 77–102.

Hummels, D., Jørgensen, R., Munch, J., & Xiang, C. (2014). The Wage Effects of Offshoring: Evidence from Danish Matched Worker-Firm Data. *American Economic Review*, *104*(6), 1597–1629.

Ichino, A., & Becker, S. (2002). Estimation of Average Treatment Effects Based on Propensity Scores. *The Stata Journal*, *2*(4), 358–377.

Idson, T. L., & Oi, W. Y. (1999). Workers Are More Productive In Large Firms. *The American Economic Review*, *89*(2), 104–108.

ILO (2014). International Standard Classification of Occupations. Retrieved August 21, 2014, from: http://www.ilo.org/public/english/bureau/stat/isco/isco88/publ4.htm

ILO (2012). International Standard Classification of Occupations. Structure, groups definitions and correspondence tables. Retrieved January 8, 2015, from: http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_172572.pdf

IMF (2013). Trade interconnectedness: the world with global value chains. Retrieved August 19, 2014, from: http://www.imf.org/external/np/pp/eng/2013/082613.pdf

Kasahara, H., & Rodrigu, J. (2008). Does the Use of Imported Intermediates Increase Productivity? Plant-Level Evidence. *Journal of development economics*, *87*(1), 106–118.

Kiriyama, N. (2012). Trade and Innovation: Synthesis Report. *OECD Trade Policy Papers*, Paper No. 135, OECD Publishing.

Konings, J., & Murphy, A. P. (2006). Do Multinational Enterprise Relocate Employment to Low-Wage Regions? Evidence from European Multinationals. *Review of World Economics*, *142*(2), 267–286.

Kostevc, Č. (2009). Foreign Market Competition as a Determinant of Exporter Performance: Evidence from Slovenian Manufacturing Firms. *The World Economy*, *32*(6), 888–913.

Krugman, P. R., Obstfeld, M., & Melitz, M. J. (2012). *International Economics : Theory & Policy* (9th ed.). Boston [etc.] : Pearson, cop.

Krugman, P. R. (1991). Increasing Returns and Economic Geography. *Journal of Political Economy*, *99*(3), 483–499.

Krugman, P. R. (1979). Increasing Returns, Monopolistic Competition, and International Trade. *Journal of International Economics*, *9*(4), 469–479.

Levinsohn, J., & Petrin, A. (2003). Estimating Production Functions Using Inputs to Control for Unobservables. *The Review of Economic Studies*, *70*(2), 317–341.

Lo Turco, A., & Maggioni, D. (2012). Offshoring to High and Low Income Countries and the Labor Demand. Evidence from Italian Firms. *Review of International Economics*, *20*(3), 636–653.

Lunt, M. (2014). Selecting an Appropriate Caliper Can Be Essential for Achieving Good Balance With Propensity Score Matching. *American Journal of Epidemiology*, *179*(2), 226–235.

Melitz, M. J., & Redding, S. J. (2014). *Heterogeneous Firms and Trade*. In Gopinath, G., Helpman, E., & Rogoff, K. (Eds.), *Handbook of International Economics* (4th ed., 1–54). Elsevier.

Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, *71*(6), 1695–1725.

Meschi, E., Taymaz, E., & Vivarelli, M. (2008). Trade Openness and the Demand for Skills: Evidence from Turkish Microdata. *IZA Discussion Papers*, Paper No. 3887.

Michel, B., & Rycx, F. (2009). Does Offshoring of Materials and Business Services Affect Employment? Evidence from a Small Open Economy. *IZA Discussion Paper Series*, Paper No. 4164.

Mincer, J. (1974). *Schooling, experience and earnings*. New York and London: National Bureau of Economic Research.

Mion, G., & Zhu, L. (2013). Import competition from and offshoring to China: A curse or blessing for firms? *Journal of International Economics*, *89*(1), 202–215.

Mion, G., Vandenbussche, H., & Zhu, L. (2010). Trade with China and skill upgrading: Evidence from Belgian firm level data. *NBB Working Paper*, Paper No. 194.

Mitra, D., & Ranjan, P. (2009). Offshoring and Unemployment: The Role of Search Frictions and Labor Mobility. *IZA Discussion Paper Series*, Paper No. 4136.

Muendler, M. A. (2004). Trade, Technology and Productivity: A Study of Brazilian Manufacturers, 1986-1998. *CESifo Working Paper Series*, Paper No. 1148.

Muuls, M., & Pisu, M. (2007). Imports and Exports at the Level of the Firm: Evidence from Belgium. *CEP Discussion Papers*, Paper No. 801.

Olley, G. S., & Pakes, A. (1996). The Dynamics of Productivity in the Telecommunications Equipment Industry. *Econometrica*, *64*(6), 1263–1297.

Onodera, O. (2008). Trade and innovation project. *OECD Trade Policy Working Paper*, Paper No. 72.

Panagariya, A. (1981). Variable Returns to Scale in Production and Patterns of Specialization. *The American Economic Review*, *71*(1), 221–230.

Papke, L. E., & Wooldridge, J. M. (2008). Panel data methods for fractional response variables with an application to test pass rates. *Journal of Econometrics*, *145*(1-2), 121–133.

Parro, F. (2013). Capital-Skill Complementarity and the Skill Premium in a Quantitative Model of Trade. *American Economic Journal: Macroeconomics*, *5*(2), 72–117.

Petrin, A., Poi, B. P., & Levinsohn, P. (2004). Production function estimation in Stata using inputs to control for unobservables. *The Stata Journal*, *4*(2), 113–123.

Pierce, J. R., & Schott, P. K. (2012). The Surprisingly Swift Decline of U.S. Manufacturing Employment. *NBER Working Papers*, Paper No. 18655.

Raveh, O., & Reshef, A. (2013). Capital Imports Composition, Complementarities, and the Skill Premium in Developing Countries. Retrieved November 13, 2013, from: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2258009

Rosenbaum, P. R., & Rubin, D. B. (1983). The Central Role of the Propensity Score in Observational Studies for Causal Effects. *Biometrika*, *70*(1), 41–55.

Rubin, D. B. (1997). Estimating causal effects from large data sets using propensity scores. *Annals of Internal Medicine*, *127*, 757–763.

Schaffer, M.E., & Stillman, S. (2010). xtoverid: Stata module to calculate tests of overidentifying restrictions after xtreg, xtivreg, xtivreg2 and xthtaylor. Retrieved August 6, 2014, from http://ideas.repec.org/c/boc/bocode/s456779.html

Schank, T., Schnabel, C., & Wagner, J. (2007). Do exporters really pay higher wages? First evidence from German linked employer-employee data. *Journal of International Economics*, *72*(1), 52–74.

Smeets, V., & Warzynski, F. (2010). Learning by Exporting, Importing or Both? Estimating productivity with multi-product firms, pricing heterogeneity and the role of international trade. *Aarhus University, Department of Economics Working Papers*, Paper No. 10-13.

Smith, A. (1904). *An Inquiry into the Nature and Causes of the Wealth of Nations*. Edwin Cannan, E. (Ed.), Library of Economics and Liberty. Retrieved August 8, 2015, from: http://www.econlib.org/library/Smith/smWN1.html

Stark, O., & Wang, Y. (2001). Inducing Human Capital Formation: Migration as a Substitute for Subsidies. *University of Bonn, Center for Development Research, Discussion Papers on Development Policy*, Paper No. 11.

Stark, O., & Chau, N. H. (1998). Human Capital Formation, Asymmetric Inofrmation, and the Dynamics of International Migration. *Reihe Ökonomie / Economics Series*, Paper No. 52.

Stark, O., Helmenstein, C., & Prskawetz, A. (1998). Human Capital Depletion, Human Capital Formation, and Migration: A Blessing in a "Curse"? *Reihe Ökonomie / Economics Series*, Paper No. 55.

Stark, O., Helmenstein, C., & Prskawetz, A. (1997). A Brain Gain with a Brain Drain. *Reihe Ökonomie / Economics Series*, Paper No. 45.

Strauss-Kahn, V. (2003). The role of globalization in the within-industry shift away from unskilled workers in France. *NBER Working Paper Series*, Paper No. 9176.

Syverson, C. (2011). What Determines Productivity? *Journal of Economic Literature*, *49*(2), 326–365.

Tokarick, S. (2002). Quantifying the Impact of Trade on Wages: The Role of Nontraded Goods. *IMF Working Paper*, Paper No. 02/191.

UNCTAD, World investment report 2013. Retrieved August, 19, 2014, from: http://unctad.org/en/PublicationsLibrary/wir2013_en.pdf

Vogel, A., & Wagner, J. (2008). Higher Productivity in Importing German Manufacturing Firms: Self-selection, Learning from Importing, or Both? *IZA Discussion Paper Series*, Paper No. 3854.

Wagner, J. (2012a). Exports, R&D and productivity: a test of the Bustos-model with German enterprise data. *Economics Bulletin*, *32*(3), 1942–1948.

Wagner, J. (2012b). Effects of Productivity and Import on Firm-Level Export. *Ratio Working Papers*, Paper No. 225.

Wagner, J. (2011). Offshoring and firms performance: self-selection, effects on performance, or both? *Review of World Economics*, *147*(2), 217–247.

Wagner, J. (2007). Exports and Productivity: A Survey of the Evidence from Firm-level Data. *The World Economy*, *30*(1), 60–82.

WB (2015) Retrieved February 9, 2015, from: http://data.worldbank.org/about/country-and-lending-groups.

World Bank, statistical database. Retrieved April 22, 2015, from: http://data.worldbank.org/indicator/NE.IMP.GNFS.ZS

WTO (2014). *World Trade Report 2014*. Retrieved October 21, 2014, from: http://www.wto.org/english/res_e/booksp_e/world_trade_report14_e.pdf

Yang, Y., & Mallick, S. (2010). Export Premium, Self-selection and Learning-by-Exporting: Evidence from Chinese Matched Firms. *The World Economy*, *33*(10), 1218–1240.

Zajc Kejžar, K., & Ponikvar, N. (2014). Job Destruction and Productivity Gains in Heterogeneous Incumbent Firms: Comparing the Effects of Imports and Inward Foreign Direct Investment. *Emerging Markets Finance and Trade*, *50*(6), 154–173.

Zanutto, E. L. (2006). A Comparison of Propensity Score and Linear Regression Analysis of Complex Survey Data. *Journal of Data Science*, *4*, 67–910.

Zoghi, C. (2010). *Measuring Labor Composition: A Comparison of Alternate Methodologies*. In Abraham, K. G., Spletzer, J. R., & Harper, M. (Eds.), Labor in the New Economy (457–485). University of Chicago Press.

APPENDICES

LIST OF APPENDICES

Appendix A: Derivation of the Claim on the gross earnings of the rational individuals with the low ability being positive (Chapter 1)

Claim 2: The gross earnings of rational individuals with the low ability are positive (i.e. $w_U(\Theta_U^*) > 0$).

Proof: Consider rational workers who maximize their gross earnings and therefore achieve the optimal level of ability:

$$w_U(\Theta_U^*) = \lambda[\ln(\lambda / k_U)] - k_U\,[(\lambda / k_U) - 1]. \tag{A1}$$

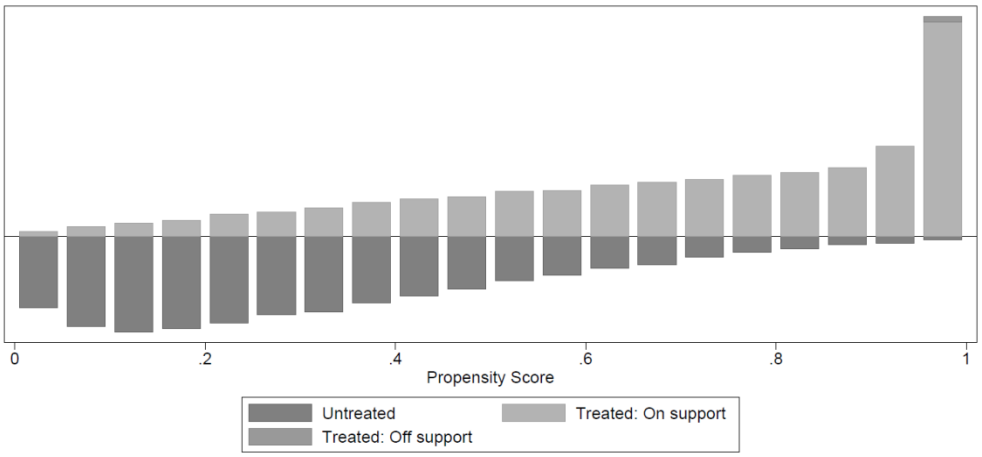
After a simple calculation, one gets the following:

$$w_U(\Theta_U^*) = \lambda[\ln(\lambda) - \ln(k_U) - 1] + k_U. \tag{A2}$$

Knowing the following inequality holds: $\lambda > k_U > k_S > 1$, it follows that $w_U(\Theta_U^*) > 0$. ■

Appendix B: Propensity Score histograms and Balancing property tests

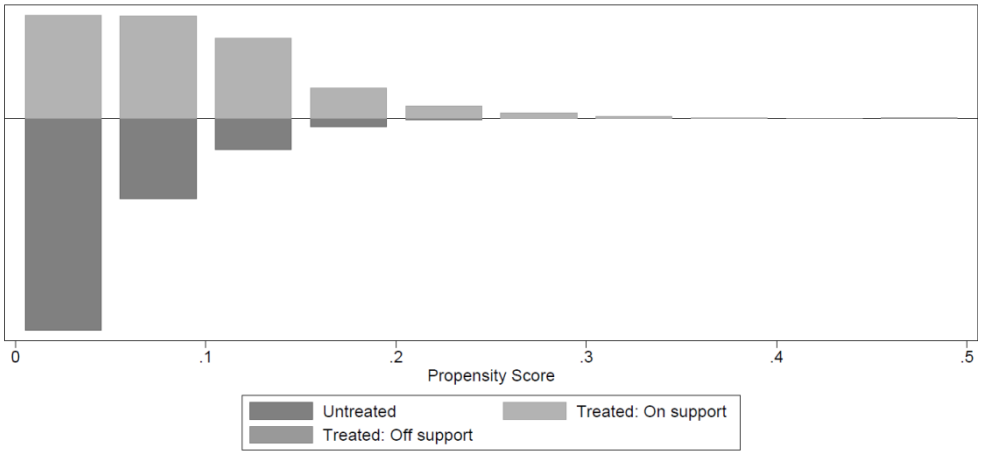
Figure B1. The Propensity Score histogram on the differences in the skill structure between importers and non-importers



Note. *Untreated:* relates to firms in the control group (i.e. non-importing firms), *Treated:* relates to firms in the treatment group (i.e. importing firms).

Source: SORS, author's calculations

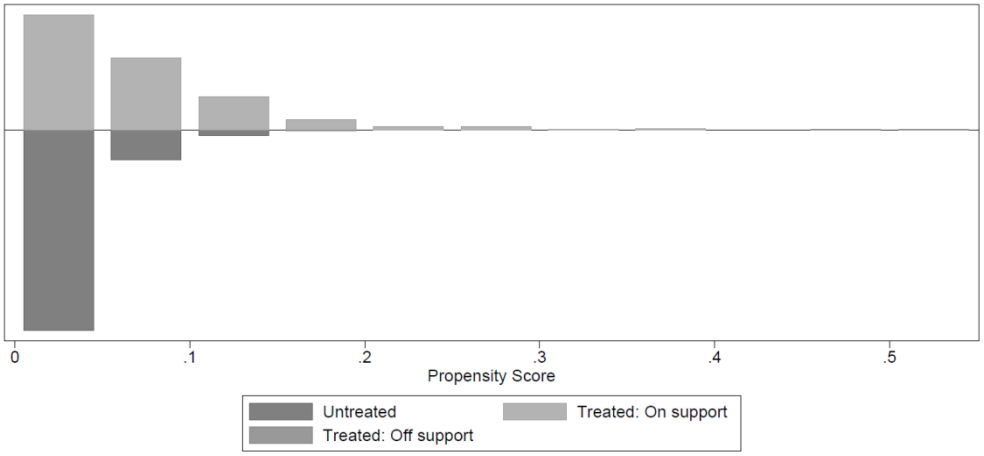
Figure B2. The Propensity Score histogram on the self-selection of firms into importing



Note. *Untreated:* relates to firms in the control group (i.e. non-importing firms), *Treated:* relates to firms in the treatment group (i.e. importing starters).

Source: SORS, author's calculations

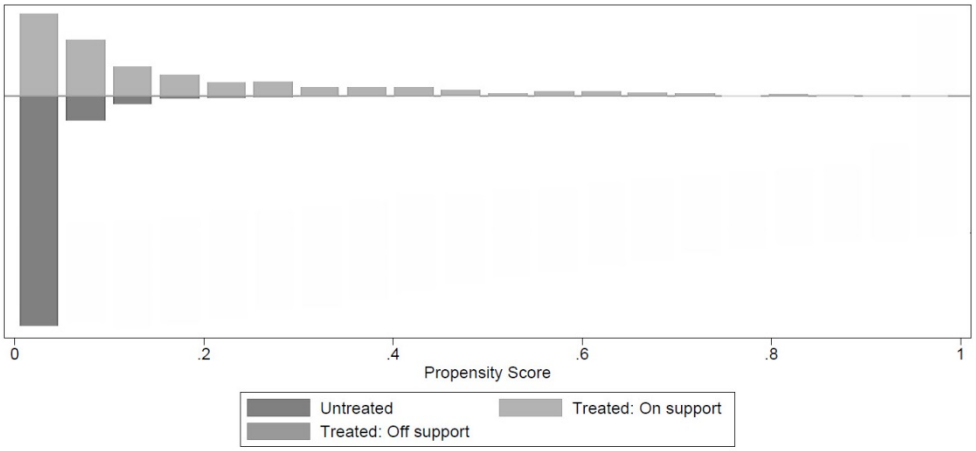
Figure B3. The Propensity Score histogram on learning-by-importing



Note. *Untreated:* relates to firms in the control group (i.e. non-importing firms), *Treated:* relates to firms in the treatment group (i.e. importing starters that import also one year after the start of importing).

Source: SORS, author's calculations

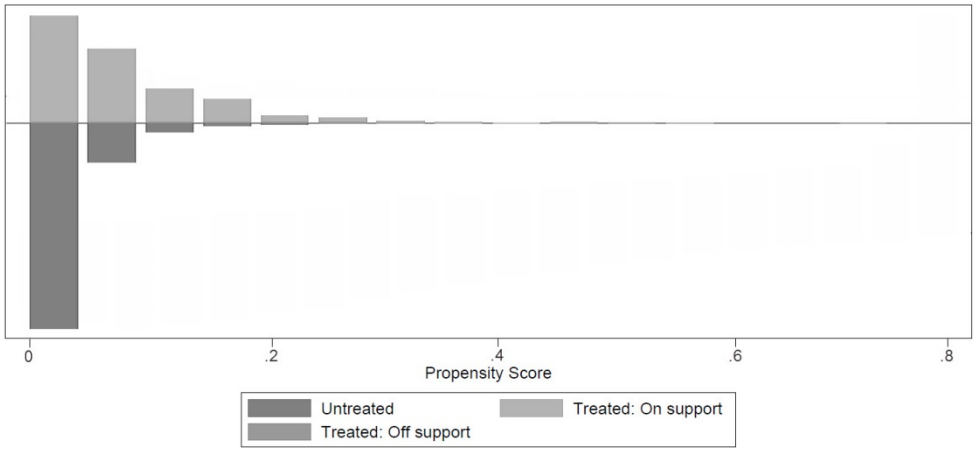
Figure B4. The Propensity Score histogram on the effect of the start of importing capital goods on the start of exporting



Note. *Untreated:* relates to firms in the control group (i.e. non-importing firms), *Treated:* relates to firms in the treatment group (i.e. importing starters of capital goods).

Source: SORS, author's calculations

Figure B5. The Propensity Score histogram on the effect of the start of importing intermediate goods on the start of exporting



Note. *Untreated:* relates to firms in the control group (i.e. non-importing firms), *Treated:* relates to firms in the treatment group (i.e. importing starters of intermediate goods).

Source: SORS, author's calculations

Table B1. Balancing property test in the analysis on the differences in skill structure between importers and non-importers

	Unmatched/ Matched	Bias reduction		t-test	
		% of bias	% of bias reduction	t	p-value
Size	Unmatched	117.1		152.91	0.000
	Matched	5.4	95.4	6.14	0.000
Lvae	Unmatched	28.0		36.89	0.000
	Matched	3.4	87.8	4.56	0.000
Lke	Unmatched	42.5		56.16	0.000
	Matched	6.0	85.9	8.27	0.000
Rimsh	Unmatched	6.2		8.19	0.000
	Matched	4.7	24.4	6.19	0.000
Foreign	Unmatched	32.1		41.82	0.000
	Matched	-13.6	57.5	-13.98	0.000
FDI	Unmatched	45.3		58.52	0.000
	Matched	3.7	91.7	3.75	0.000

Note. The explanation of variables: *Size*: logarithm of the number of employees; *Lvae*: logarithm of the value added per employee; *Lke*: logarithm of the capital per employee; *Rimsh*: regional import share; *Foreign*: dummy variable for foreign ownership; *FDI*: dummy variable for foreign direct investments. Matching method: one nearest neighbour matching with replacement, common caliper: 0.05. Firms in the control group: non-importing firms, firms in the treatment group: importing firms. For brevity, the estimates for industry and year dummies are excluded.

Source: SORS, author's calculations

Table B2. Balancing property test in the analysis on the self-selection of firms into importing

	Unmatched/ Matched	Bias reduction		t-test	
		% of bias	% of bias reduction	t	p-value
Size_1	Unmatched	22.0		9.10	0.000
	Matched	0.4	98.0	0.12	0.905
Lvae_1	Unmatched	-9.8		-3.94	0.000
	Matched	-1.1	89.1	-0.31	0.757
Lke_1	Unmatched	2.7		1.03	0.305
	Matched	-1.8	34.0	-0.52	0.601
Rimsh_1	Unmatched	4.8		1.98	0.048
	Matched	-1.1	76.6	-0.30	0.767
Foreign_1	Unmatched	15.1		7.05	0.000
	Matched	-2.1	86.1	-0.51	0.609
FDI_1	Unmatched	1.9		0.81	0.420
	Matched	-4.7	-145.8	-1.09	0.274

Note. The explanation of variables: *Size_1*: logarithm of the number of employees; *Lvae_1*: logarithm of the value added per employee; *Lke_1*: logarithm of the capital per employee; *Rimsh_1*: regional import share; *Foreign_1*: dummy variable for foreign ownership; *FDI_1*: dummy variable for foreign direct investments. All variables are lagged for one period. Matching method: one nearest neighbour matching with replacement, common caliper: 0.05. Firms in the control group: non-importing firms, firms in the treatment group: importing starters. For brevity, the estimates for industry and year dummies are excluded.

Source: SORS, author's calculations

Table B3. Balancing property test in the analysis of the skill-structure change after the start of importing

	Unmatched/ Matched	Bias reduction		t-test	
		% of bias	% of bias reduction	t	pValue
Size_1	Unmatched	31.4		9.78	0.000
	Matched	1.5	95.2	0.30	0.767
Lvae_1	Unmatched	-12.3		-3.81	0.000
	Matched	-1.6	86.9	-0.33	0.745
Lke_1	Unmatched	1.1		0.31	0.760
	Matched	1.0	7.4	0.22	0.828
Rimsh_1	Unmatched	9.9		3.04	0.002
	Matched	-3.1	68.5	-0.59	0.558
Foreign_1	Unmatched	21.5		7.99	0.000
	Matched	-3.7	82.7	-0.63	0.527
FDI_1	Unmatched	4.6		1.58	0.115
	Matched	-1.6	65.0	-0.28	0.781

Note. The explanation of variables: *Size_1*: logarithm of the number of employees; *Lvae_1*: logarithm of the value added per employee; *Lke_1*: logarithm of the capital per employee; *Rimsh_1*: regional import share; *Foreign_1*: dummy variable for foreign ownership; *FDI_1*: dummy variable for foreign direct investments. All variables are lagged for one period. Matching method: one nearest neighbour matching with replacement, common caliper: 0.05. Firms in the control group: non-importing firms, firms in the treatment group: importing starters that import also one year after the start of importing. For brevity, the estimates for industry and year dummies are excluded.

Source: SORS, author's calculations

Table B4. Balancing property test in the analysis on the effect of the start of importing capital products on the start of exporting

	Unmatched/ Matched	Bias reduction		t-test	
		% of bias	% of bias reduction	t	pValue
Size_1	Unmatched	110.3		38.43	0.000
	Matched	4.2	96.2	0.76	0.447
Lvae_1	Unmatched	17.9		4.95	0.000
	Matched	-1.1	94.0	-0.22	0.828
Lke_1	Unmatched	29.1		7.91	0.000
	Matched	4.7	83.8	0.96	0.335
Rimsh_1	Unmatched	5.7		1.67	0.095
	Matched	0.9	84.8	0.17	0.867
Foreign_1	Unmatched	31.3		12.75	0.000
	Matched	-7.7	75.5	-1.23	0.217
FDI_1	Unmatched	32.1		21.66	0.000
	Matched	-10.8	66.3	-1.61	0.107

Note. The explanation of variables: *Size_1*: logarithm of the number of employees; *Lvae_1*: logarithm of the value added per employee; *Lke_1*: logarithm of the capital per employee; *Rimsh_1*: regional import share; *Foreign_1*: dummy variable for foreign ownership; *FDI_1*: dummy variable for foreign direct investments. All variables are lagged for one period. Matching method: one nearest neighbour matching with replacement, common caliper: 0.05. Firms in the control group: non-importing firms, firms in the treatment group: importing starters of capital products that import also one year after the start of importing. For brevity, the estimates for industry and year dummies are excluded.

Source: SORS, author's calculations

Table B5. Balancing property test in the analysis on the effect of the start of importing intermediate products on the start of exporting

	Unmatched/ Matched	Bias reduction		t-test	
		% of bias	% of bias reduction	t	pValue
Size_1	Unmatched	61.6		19.53	0.000
	Matched	-3.7	94.0	-0.68	0.498
Lvae_1	Unmatched	9.2		2.55	0.011
	Matched	1.7	81.8	0.34	0.731
Lke_1	Unmatched	22.0		5.85	0.000
	Matched	6.9	68.7	1.40	0.161
Rimsh_1	Unmatched	6.4		1.88	0.060
	Matched	-0.7	88.9	-0.13	0.893
Foreign_1	Unmatched	17.8		6.21	0.000
	Matched	-1.9	89.6	-0.31	0.758
FDI_1	Unmatched	61.6		19.53	0.000
	Matched	-3.7	94.0	-0.68	0.498

Note. The explanation of variables: *Size_1*: logarithm of the number of employees; *Lvae_1*: logarithm of the value added per employee; *Lke_1*: logarithm of the capital per employee; *Rimsh_1*: regional import share; *Foreign_1*: dummy variable for foreign ownership; *FDI_1*: dummy variable for foreign direct investments. All variables are lagged for one period. Matching method: one nearest neighbour matching with replacement, common caliper: 0.05. Firms in the control group: non-importing firms, firms in the treatment group: importing starters of intermediate products that import also one year after the start of importing. For brevity, the estimates for industry and year dummies are excluded.

Source: SORS, author's calculations

Table B6. Balancing property test in the analysis on the self-selection of firms into importing (lagging variables by two periods)

	Unmatched/ Matched	Bias reduction		t-test	
		% of bias	% of bias reduction	t	p-value
Size_2	Unmatched	6.3		1.89	0.058
	Matched	0.6	90.8	0.12	0.905
Lvae_2	Unmatched	-5.5		-1.69	0.091
	Matched	1.1	80.9	0.22	0.823
Lke_2	Unmatched	2.6		0.72	0.474
	Matched	1.1	55.7	0.25	0.806
Rimsh_2	Unmatched	1.4		0.41	0.680
	Matched	0.2	83.8	0.04	0.965
Foreign_2	Unmatched	11.2		3.79	0.000
	Matched	-0.8	92.6	-0.15	0.878
FDI_2	Unmatched	3.6		1.20	0.229
	Matched	-1.3	64.7	-0.23	0.816

Note. The explanation of variables: *Size_2*: logarithm of the number of employees; *Lvae_2*: logarithm of the value added per employee; *Lke_2*: logarithm of the capital per employee; *Rimsh_2*: regional import share; *Foreign_2*: dummy variable for foreign ownership; *FDI_2*: dummy variable for foreign direct investments. All variables are lagged for two periods. Matching method: one nearest neighbour matching with replacement, common caliper: 0.05. Firms in the control group: non-importing firms, firms in the treatment group: importing starters. For brevity, the estimates for industry and year dummies are excluded.

Source: SORS, author's calculations

Appendix C: Additional robustness checks of matching results

Table C1. Results of testing Hypothesis 1: Correlation between importing and a better skill structure of firms is positive

Outcome of interest: skill share				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.1	0.269***	0.027	35,910	33,289
Nearest neighbour (5), caliper: 0.1	0.253***	0.030	35,910	33,289
Radius, caliper: 0.1	0.393***	0.022	35,910	33,289
Kernel, bandwidth: 0.01	0.263***	0.030	35,910	33,289

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing firms); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

Table C2. Results of testing Hypothesis 2: Firms with a better skill structure start importing

Outcome of interest: skill share one year before the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.1	0.206***	0.065	888	28,549
Nearest neighbour (5), caliper: 0.1	0.145***	0.046	888	28,549
Radius, caliper: 0.1	0.111***	0.036	888	28,549
Kernel, bandwidth: 0.01	0.096***	0.036	888	28,549

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

Table C3. Results of testing Hypothesis 3: Skill structure changes in favour of the skilled labour after the start of importing

Outcome of interest: skill share one year after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.1	0.419***	0.085	805	23,640
Nearest neighbour (5), caliper: 0.1	0.351***	0.069	805	23,640
Radius, caliper: 0.1	0.363***	0.057	805	23,640
Kernel, bandwidth: 0.01	0.315***	0.061	805	23,640
Outcome of interest: change in the skill share one year after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.1	0.073	0.045	843	27,765
Nearest neighbour (5), caliper: 0.1	0.030	0.032	843	27,765
Radius, caliper: 0.1	0.024	0.024	843	27,765
Kernel, bandwidth: 0.01	0.029	0.024	843	27,765

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters that import also one year after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

Table C4. Results of testing Hypothesis 4: Importing capital goods has a positive impact on the start of exporting

Outcome of interest: start of exporting one year after the start of importing capital goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.1	1.000E-04	0.006	818	24,038
Nearest neighbour (5), caliper: 0.1	0.002	0.005	818	24,038
Radius, caliper: 0.1	0.004	0.004	818	24,038
Kernel, bandwidth: 0.01	0.003	0.004	799	24,038

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters of capital goods that import also one year after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

Table C5. Results of testing Hypothesis 5: Importing intermediate goods has a positive impact on the start of exporting

Outcome of interest: start of exporting one year after the start of importing intermediate goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.1	0.013***	0.005	905	24,038
Nearest neighbour (5), caliper: 0.1	0.009*	0.005	905	24,038
Radius, caliper: 0.1	0.012***	0.004	905	24,038
Kernel, bandwidth: 0.01	0.009**	0.004	900	24,038

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters of intermediate goods that import also one year after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

Table C6. Robustness checks of testing Hypothesis 2: Firms with a better skill structure start importing

Outcome of interest: skill share two years before the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.1	-0.067	0.087	888	24,376
Nearest neighbour (5), caliper: 0.1	-0.018	0.070	888	24,376
Radius, caliper: 0.1	0.018	0.054	888	24,376
Kernel, bandwidth: 0.01	0.026	0.055	888	24,376

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

Table C7. Robustness checks of testing Hypothesis 3: Skill structure changes in favour of the skilled labour after the start of importing

Outcome of interest: skill share two years after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.1	0.527***	0.109	516	19,630
Nearest neighbour (5), caliper: 0.1	0.418***	0.083	516	19,630
Radius, caliper: 0.1	0.444***	0.068	516	19,630
Kernel, bandwidth: 0.01	0.389***	0.071	516	19,630
Outcome of interest: change in the skill share two years after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.1	0.157**	0.064	560	27,677
Nearest neighbour (5), caliper: 0.1	0.103**	0.048	560	27,677
Radius, caliper: 0.1	0.096**	0.039	560	27,677
Kernel, bandwidth: 0.01	0.105***	0.040	560	27,677

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters that import also two years after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

Table C8. Robustness checks of testing Hypothesis 4: Importing capital goods has a positive impact on the start of exporting

Outcome of interest: start of exporting two years after the start of importing capital goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.1	0.006	0.008	723	19,984
Nearest neighbour (5), caliper: 0.1	0.011**	0.005	723	19,984
Radius, caliper: 0.1	0.011***	0.004	723	19,984
Kernel, bandwidth: 0.01	0.010**	0.004	707	19,984

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters of capital goods that import also two years after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

Table C9. Robustness checks of testing Hypothesis 5: Importing intermediate goods has a positive impact on the start of exporting

Outcome of interest: start of exporting two years after the start of importing intermediate goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
Nearest neighbour (1), caliper: 0.1	-0.008*	0.005	795	19,984
Nearest neighbour (5), caliper: 0.1	-0.005*	0.003	795	19,984
Radius, caliper: 0.1	-0.003	0.002	795	19,984
Kernel, bandwidth: 0.01	-0.004**	0.002	790	19,984

Note. *ATT*: average treatment effect on the treated; *se*: bootstrapped standard errors (100 repetitions); *Treated*: firms in the treatment group (i.e. importing starters of intermediate goods that import also two years after the start of importing); *Control*: firms in the control group (i.e. non-importing firms). *Nearest neighbour (1)* denotes one nearest neighbour matching with replacement; *Nearest neighbour (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS, author's calculations

Appendix D: Derivation of the model in Chapter 3

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

$$Y_{it} = A_{it} K_{it}^{\alpha} H_{it}^{\beta} C_{it}^{1-\alpha-\beta} \quad \text{(D1)}$$

As already mentioned, the dependent variable, Y_{it}, is output, A_{it} is productivity, K_{it} is capital, H_{it} is skilled labour, and C_{it} is 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 determine the demand for skilled labour of firm *i* in year *t*, by making derivatives of the equation (D1):

$$P_{it} (\partial Y_{it} / \partial H_{it}) = P_{it} A_{it} K_{it}^{\alpha} \beta H_{it}^{\beta-1} C_{it}^{1-\alpha-\beta} \quad \text{(D2)}$$

First, foreign inputs of firms, F_{it}, are separated into outsourcing (Out_{it}) and offshoring (Off_{it}) activities ($F_{it} = Out_{it} + Off_{it}$), while the domestic inputs of firms, D_{it}, are separated into unskilled labour (L_{it}) and domestic costs (DC_{it}); ($D_{it} = L_{it} + DC_{it}$). Next, I take logarithms of the equation (D2) and get the following:

$$\ln P_{it} + \ln A_{it} + \alpha \ln K_{it} + \beta(\beta-1) \ln H_{it} + (1-\alpha-\beta) \ln(Out_{it} + Off_{it} + L_{it} + DC_{it}) = 0 \quad \text{(D3)}$$

To implement equation (D3) in the data, the equation is first rearranged so that the variable of interest is the skilled labour:

$$-\beta(\beta-1) \ln H_{it} = \ln P_{it} + \ln A_{it} + \alpha \ln K_{it} + (1-\alpha-\beta) \ln(Out_{it} + Off_{it} + L_{it} + DC_{it}) \quad \text{(D4)}$$

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 the explanatory value of the model. Furthermore, as in Hummels et al. (2014), the logarithm of the value of exports (X_{it}) is introduced to capture time varying shocks to the demand of firms' output (P_{it}), and the logarithm of the average wage level in firm *i* and year *t* (W_{it}).

The observed model is therefore the following:

$$\begin{aligned} Skill\_share_{it} = {} & \beta_0 + \beta_1 Out_{it} + \beta_2 Off_{it} + \beta_3 X_{it} + \beta_4 A_{it} + \beta_5 K_{it} + \\ & + \beta_6 W_{it} + \beta_7 DC_{it} + Time_t + Ind_t + \varepsilon_{it} \end{aligned} \quad \text{(D5)}$$

Appendix E: Description of ISCO-88 major occupational groups

ISCO-88 classification arranges occupations in ten major groups. “Managers” are the first major group which includes 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. The 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 onto others. Another major group, “Technicians”, includes 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” includes 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” covers service, shop, and market sales workers whose main tasks consist of providing personal and protective services, and selling goods in shops or at markets. In addition, the group “Agricultural workers” consists 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” includes 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, the group “Machine operators” includes plant and machine operators and assemblers who operate and monitor large scale, and often highly automated, industrial machinery and equipment. “Elementary occupations” combine occupations the main tasks of which in general include simple and routine tasks by using the hand-held tools and in some cases considerable physical effort. Finally, the group “Armed forces” includes individuals, who are serving in the armed forces on a voluntary or compulsory basis and are restricted to accept civilian employment (ILO, 2014).

Appendix F: Complementary tables to Chapter 3

Table F1. 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. The explanations of variables are as follows: *Outsourcing firms*: firms that import intermediate products; *Offshoring firms*: firms that engage in the 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 F2. 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. The explanations of variables are as follows: *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 of 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 F3. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the 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 F4. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the 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 F5. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the 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 F6. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the 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 F7. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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 F8. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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 F9. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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 F10. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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 F11. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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 F12. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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 F13. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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 F14. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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 F15. 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. The 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. The explanation of variables: *Offshoring*: dummy variable, controlling for the outward FDI*; Offshoring_high*: dummy variable, controlling for the 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

Appendix G: Summary in Slovenian language / Daljši povzetek v slovenskem jeziku

Opis raziskovalnega področja doktorske disertacije

Mednarodna menjava igra pomembno vlogo v gospodarskem razvoju, kjer predvsem tri obdobja v zgodovini predstavljajo pomembne mejnike za razvoj mednarodne trgovine in gospodarstva na splošno – industrijska revolucija, obdobje po obeh svetovnih vojnah in trenutno obdobje po letu 1980. V omenjenih obdobjih so se bistveno izboljšale prometne povezave, ki so skupaj z izboljšavami v komunikacijski tehnologiji omogočile razcvet mednarodne menjave (WTO, 2014).

Mednarodna menjava je bila interes proučevanja ekonomistov skozi več stoletij, omenjenim spremembam v družbi pa so se hkrati prilagajali tudi teoretični modeli mednarodne menjave, ki so se na začetku večinoma posvečali proučevanju tokov med državami, ki proizvajajo enake proizvode ob različnih produktivnostih. Še pred izdajo Smithove knjige Bogastvo narodov je David Hume doprinesel k teoriji mednarodne menjave z nasprotovanjem merkantilistom, da neto izvoz ne povečuje blagostanja, saj povzroča višanje domačih cen, kar sčasoma vodi v večanje uvoza. V drugi polovici 18. stoletja je Adam Smith razvil teorijo absolutnih prednosti, ki mednarodno menjavo pogojuje z razlikami v absolutnih produktivnostih med državami. V omenjenem modelu je delo edini produkcijski dejavnik, države pa med seboj primerjajo absolutne produktivnosti dela v proizvodnji določene dobrine, kjer najbolj produktivna država – torej država z najvišjo absolutno produktivnostjo – postane izvoznica proizvoda. Posamezna država se kasneje specializira v proizvodnji izdelka, ki ga proizvaja z največjo absolutno produktivnostjo, medtem ko uvaža proizvod, v katerem dosega nižje produktivnosti v primerjavi z drugo državo. V primeru, da državi nimata absolutne prednosti v proizvodnji nobenega proizvoda, ne pride do mednarodne menjave (Krugman, Obstfeld & Melitz, 2012).

Pol stoletja kasneje je David Ricardo razširil zgornji model z vključitvijo primerjalnih prednosti. V modelu države mednarodno trgujejo, če obstaja med njimi relativna razlika v produktivnostih oziroma oportunitetnih stroških, država izvoznica pa ima primerjalno prednost v proizvodnji določenega proizvoda, če dosega relativno višjo produktivnost oziroma relativno nižje oportunitetne stroške. Posamezna država se kasneje tudi specializira v proizvodnji proizvoda, kjer dosega primerjalne prednosti. Glede na zaključke tega modela pogoj za mednarodno menjavo niso več razlike v absolutnih prednostih med državama, temveč razlike v primerjalnih prednostih (Krugman, Obstfeld & Melitz, 2012).

Zaključki Ricardovega modela primerjalnih prednosti so bili kasneje uporabljeni v Heckscher-Ohlin (H-O) modelu, ki predvideva, da bodo države prilagodile proizvodnjo določenega proizvoda glede na svojo faktorsko obilnost. Omenjeni model sta zastavila Eli Heckscher in Bertil Ohlin. Glede na prejšnje modele je noviteta H-O modela vključitev dveh produkcijskih faktorjev, kapitala in dela, v analizo. Države med seboj primerjajo

relativno obilnost obeh produkcijskih faktorjev. Država z višjim deležem kapitala v primerjavi z delom (torej kapitalsko obilna država) se bo specializirala v proizvodnji kapitalsko intenzivnega proizvoda in ga kasneje tudi izvažala. Po drugi strani pa se bo delovno obilna država specializirala v proizvodnji delovno intenzivnega proizvoda, ga izvažala ter uvažala kapitalsko intenziven proizvod. Medtem ko v modelih absolutnih in primerjalnih prednosti zaradi uporabe le enega produkcijskega dejavnika ni bilo relativnih učinkov zaslužkov lastnikov določenega faktorja, Stolper-Samuelsonov teorem v H-O modelu predvideva, da se bodo dobički lastnikov relativno obilnega faktorja kot posledica mednarodne menjave povečali, medtem ko se bodo dobički lastnikov relativno redkega produkcijskega faktorja znižali (Krugman, Obstfeld & Melitz, 2012).

Kasnejši teoretični modeli so v analizo vključili tudi različne donose obsega in tipe konkurence. Krugmanov (1979) model sloni na monopolistični konkurenci, v nasprotju s prejšnjimi modeli, ki so kot razlog za mednarodno menjavo uporabljali razlike med državami in razlike v tehnologiji (na primer Smith in Ricardo) ali razlike v faktorski obilnosti (na primer H-O model) pa Krugmanov (1979) model kot razlago za nastanek mednarodne menjave uporablja donose obsega. Posledično se mednarodna menjava razvije tudi med podobnimi državami, v katerih prevladujejo podobne preference, nivo tehnologije ali obilje faktorskih dejavnikov. Različni donosi obsega so bili uporabljeni tudi v modelu Panagariya (1981), ki proučuje proizvodnjo in mednarodno menjavo in ki vzame v obzir proizvodnjo dveh sektorjev in dveh dobrin v dveh državah, ki sta različno veliki. Ena izmed dobrin je proizvedena v sektorju z naraščajočimi donosi obsega, medtem ko je druga dobrina proizvedena v sektorju s padajočimi donosi obsega. Zaključki modela kažejo, da bo velika država izvažala dobrino, proizvedeno v sektorju z naraščajočimi donosi obsega, medtem ko bo majhna država izvažala dobrino, proizvedeno v sektorju s padajočimi donosi obsega. Z namenom analiziranja razlogov za koncentracijo proizvodnje v določenih regijah je Krugman (1991) v svoji kasnejši analizi razvil geografski model, ki upošteva ekonomije obsega in transportne stroške. Rezultati modela po eni strani nakazujejo, da se bo ob visokih transportnih stroških in šibki ekonomiji obsega proizvodnja skoncentrirala okrog območja z višjim povpraševanjem. Po drugi strani pa se ob nizkih transportnih stroških in povečani ekonomiji obsega proizvodnja še dodatno poveča na področjih, ki so imela že prvotno večjo koncentracijo proizvodnje.

Zgoraj omenjeni modeli so večinoma proučevali mednarodno menjavo na ravni držav ali dejavnosti. Melitzov (2003) model zato predstavlja pomemben mejnik v teoriji mednarodne menjave, saj za analiziranje mednarodne menjave gradi na modelu na ravni podjetja. Rezultati modela nakazujejo, da bodo pred liberalizacijo mednarodne trgovine na trgu proizvajala le podjetja z zadostno ravnijo produktivnosti. Poleg tega primerjava med podjetji, ki so na trgu že dlje časa, in novo nastalimi podjetji kaže, da imajo slednja v povprečju nižjo raven produktivnosti in so podvržena večji verjetnosti, da prenehajo s poslovanjem, v primerjavi s podjetji, ki so na trgu že dalj časa. Model v nadaljevanju kontrolira tudi za izvoz, ki za podjetja predstavlja višje stroške. Slednji povzročijo, da se za

izvoz odločijo le najbolj produktivna podjetja, ki lahko krijejo višje stroške. Zaključki modela kažejo, da tudi v času odprtega gospodarstva s poslovanjem prenehajo najmanj produktivna podjetja. Hkrati najbolj produktivni izvozniki zaradi dodatne prodaje na izvoznih trgih povečajo skupno vrednost prodaje. Posledično nivo produktivnosti v gospodarstvu naraste, tržni delež in dobički pa se povečajo v najbolj produktivnih podjetjih.

Melitzov (2003) model predstavlja osnovo mnogim teoretičnim modelom mednarodne menjave, ki so nastali v zadnjih letih. Bustosova (2011a) razširi njegov model preko možnosti za povečanje ravni tehnologije podjetij. V modelu imajo podjetja možnost, da v zameno za plačilo dodatnih fiksnih stroškov povečajo raven tehnologije, ki ima za posledico znižanje mejnih stroškov proizvodnje. Zaključki modela kažejo, da le najbolj produktivna podjetja investirajo v višji nivo tehnologije in pričnejo z izvažanjem, podjetja s srednjo ravnijo produktivnosti izvažajo, toda ne povečajo svoje ravni tehnologije, medtem ko najmanj produktivna podjetja ne pričnejo izvažati niti ne povečajo ravni tehnologije.

V naslednjem modelu Bustosova (2011b) v obzir vzame tudi nivo znanja zaposlenih v podjetjih. Tako kot v prejšnjem modelu imajo podjetja možnost, da v zameno za dodatne fiksne stroške investirajo v višji nivo tehnologije, kar v teh podjetjih kasneje povzroči znižanje mejnih stroškov proizvodnje, model pa kontrolira tudi za stroške dela v nizko- in visoko-tehnoloških podjetjih. Stroški plač delavcev z višjim nivojem znanja tako predstavljajo višji delež v podjetjih z visoko ravnijo tehnologije. V skladu z zaključki prejšnjega modela se pred liberalizacijo mednarodne trgovine, ko so stroški mednarodne menjave visoki, za investiranje v višji nivo tehnologije odločijo le najbolj produktivna izvozna podjetja, podjetja s srednjim nivojem produktivnosti le izvažajo, toda ne vlagajo v pridobitev višjega nivoja tehnologije, medtem ko najmanj produktivna podjetja ne izvažajo in nadaljujejo z uporabo nizkega nivoja tehnologije. Po liberalizaciji mednarodne trgovine in znižanju stroškov izvoza nizko-tehnološka podjetja oblikujejo štiri različne skupine. Najmanj produktivna med njimi prenehajo s poslovanjem, z naraščanjem nivoja produktivnosti pa podjetja ostanejo na trgu, začnejo z izvažanjem, toda hkrati znižajo nivo znanja in ne investirajo v višji nivo tehnologije, ali pa začnejo z izvažanjem ter povečajo raven tehnologije in raven znanja. Podjetja s srednjim nivojem produktivnosti nadaljujejo z izvažanjem ter povečajo raven tehnologije in znanja, najbolj produktivna visoko-tehnološka podjetja pa nadaljujejo z izvažanjem, toda znižajo raven znanja.

Nadgradnjo Melitzovega (2003) modela predstavlja tudi analiza Amiti in Davis (2011), ki v modelu kontrolirata za uvoz, glavni namen študije pa je proučevanje vpliva liberalizacije mednarodne trgovine na plače. Podobno kot izvozniki se tudi uvozniki srečujejo z večjimi fiksnimi stroški. Zaključki modela nakazujejo, da najmanj produktivna podjetja prenehajo s poslovanjem, podjetja, ki poslujejo le na domačem trgu, znižajo raven plač, medtem ko izvozniki in uvozniki povečajo raven plač. Poleg tega model zaključuje, da bolj

dobičkonosna podjetja z višjim nivojem plač uvažajo večji delež vmesnih proizvodov in izvažajo večji delež končnih proizvodov.

Zaključki zgoraj omenjenih teoretičnih modelov nakazujejo na superiorne lastnosti uvoznih in izvoznih podjetij v primerjavi s podjetji, ki niso mednarodno dejavna, in so bili večkrat preverjeni tudi v empiričnih modelih. Empirične analize so bile sprva usmerjene predvsem v analiziranje karakteristik izvoznikov. Rezultati potrjujejo, da imajo izvozniki višje število zaposlenih, večji obseg prodaje ter višji nivo plač in produktivnosti, v primerjavi s podjetji, ki ne izvažajo. Eden izmed razlogov je, da začnejo izvažati podjetja, ki so imela že pred začetkom izvažanja superiorne karakteristike v primerjavi z ostalimi podjetji (to je bilo na primer potrjeno v Yang & Mallick, 2010; in v Bernard & Jensen, 1999). Predvsem pomembna naj bi bila pred začetkom izvažanja rast zaposlenosti in plač, saj ima rast teh dveh dejavnikov pomemben vpliv na začetek izvažanja podjetij. Začetek izvažanja tako podjetjem in njihovim zaposlenim doprinese veliko koristi in ugodnosti, na primer višje plače, boljše zaposlitvene možnosti v prihodnosti, povečanje prodaje, zaposlenosti, inovacij in produktivnosti ter večjo verjetnost obstoja na trgu (Bernard & Jensen, 1999).

Poleg tega, da se za začetek izvažanja odločijo podjetja, ki imajo superiorne karakteristike, empirične študije potrjujejo tudi, da izvoz dodatno vpliva na izboljšanje karakteristik podjetij tudi po začetku izvažanja. Po začetku izvažanja so se kitajskim izvoznim podjetjem v primerjavi z ne-izvozniki povečali rast prodaje, produktivnost in zaposlenost (Yang & Mallick, 2010). Analiza slovenskih podjetij v predelovalnih dejavnostih pa je pokazala, da obstajajo tudi razlike med samimi izvozniki; bolj produktivni izvozniki namreč izvažajo na trge z višjo ravnijo konkurenčnosti, kar še dodatno poveča njihovo produktivnost v primerjavi z ostalimi izvozniki (Kostevc, 2009).

Medtem ko je bila večina študij osredotočena na analiziranje izvoznikov, so šele kasnejše analize izpostavile tudi pomen uvoznikov. Študija, narejena na podlagi podatkov španskih podjetij v predelovalnih dejavnostih, kaže, da začnejo uvažati bolj produktivna podjetja. Preko uvoza imajo podjetja nato dostop do novejših, cenejših in/ali kakovostnejših izdelkov, kar ima za posledico znižanje stroškov in omogoča večja vlaganja v inovacije. Začetku uvažanja tako sledi povečanje inovacij, ki pa ima kasneje pozitiven vpliv na začetek izvažanja, čemur ponovno sledi povečanje inovacij (Damijan & Kostevc, 2015). Analiza belgijskih podatkov kaže, da produktivnejša podjetja uvažajo večji delež svojih vmesnih proizvodov iz tujine, kar dodatno poveča njihovo produktivnost (Amiti, Itskhoki & Konings, 2014). Pozitiven vpliv uvoza na povečanje produktivnosti podjetij je bil potrjen tudi v analizi, narejeni na podlagi madžarskih podatkov. Poleg tega je študija potrdila tudi pozitiven vpliv uvoza na madžarsko gospodarsko rast (Halpern, Koren & Szeidl, 2011).

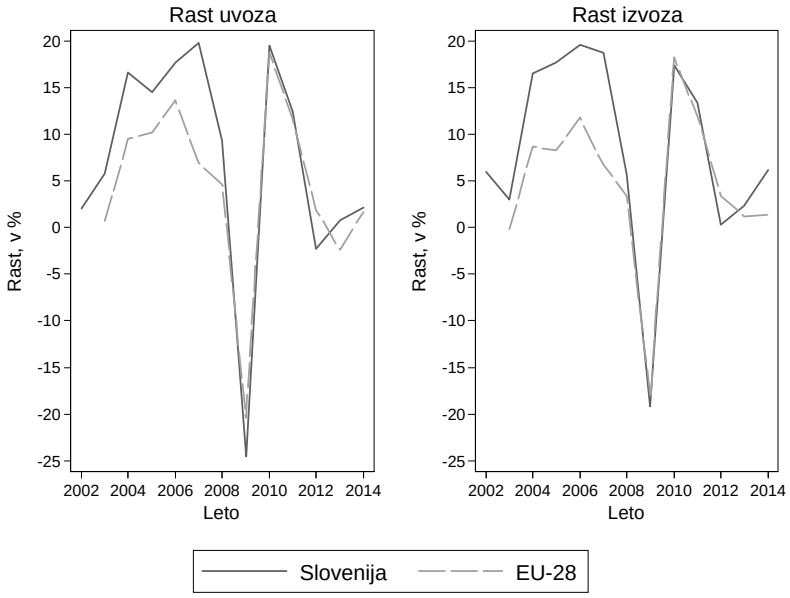
Pomembne za to doktorsko disertacijo pa so tudi empirične analize, ki proučujejo povezavo med mednarodno menjavo in povpraševanjem po delu. Analiza slovenskih

predelovalnih podjetij je pokazala, da liberalizacija investicij različno vpliva na podjetja z različnimi ravnmi produktivnosti – najbolj produktivnim podjetjem se produktivnost dodatno poveča, v najmanj produktivnih podjetjih pride do zmanjšanja zaposlenosti, v srednje produktivnih podjetjih pa pride tako do povečanja produktivnosti kot do zmanjšanja zaposlenosti (Zajc Kejžar & Ponikvar, 2004). Študija italijanskih podjetij v predelovalnih dejavnostih, katere cilj je bila analiza vpliva *offshoringa* na povpraševanje po delovni sili, kaže, da ima *offshoring* v nizko razvite države negativen vpliv na povpraševanje po delovni sili. Pomen študije je predvsem v razlikovanju med nizko- in visoko-razvitimi državami, pomanjkljivost pa v ne-razlikovanju med znanjem zaposlenih (Lo Turco & Maggioni, 2012). Feenstra in Hanson (1996, 1999) v svojih dveh študijah kontrolirata tudi raven znanja zaposlenih, glavni namen študij pa je analiza vpliva *outsourcinga* na povpraševanje po izobraženi delovni sili (Feenstra & Hanson, 1996) ter na plače izobraženih delavcev (Feenstra & Hanson, 1999) v Združenih državah Amerike. Rezultati kažejo, da ima *outsourcing* pozitiven vpliv na povpraševanje po izobraženi delovni sili in na nivo njihovih plač. Zaradi povečane globalizacije in liberalizacije mednarodne trgovine v državah v razvoju, se je v razvitih državah večkrat pojavil strah pred zmanjševanjem števila delovnih mest. Številne analize kažejo, da je strah povečini neutemeljen, saj je vpliv omenjenih dejavnikov na zaposlenost izobraženih večinoma pozitiven, negativen vpliv pa se kaže na zaposlenosti najmanj izobraženih delavcev (Mion & Zhu, 2013; Hijzen et al., 2005; Egger & Egger, 2003; in Strauss-Kahn, 2003).

Raziskovalni namen doktorske disertacije

Zgoraj omenjeno povečanje liberalizacije mednarodne menjave in globalizacije se odraža tudi v statističnih podatkih. Slika G1 prikazuje rast izvoza in uvoza v Sloveniji in v EU. Tako izvoz kot uvoz sta v Sloveniji pred začetkom svetovne krize dosegala višje stopnje rasti v primerjavi s povprečjem EU-28.

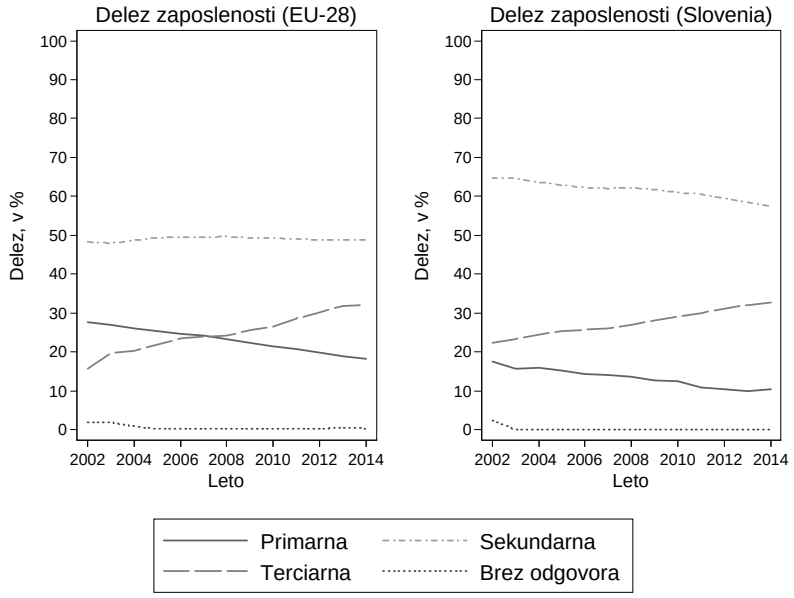
Slika G1. Rast izvoza in uvoza v Sloveniji in v EU-28



Vir: Statistični urad Republike Slovenije, lastni izračuni

Sledeča grafa prikazujeta preteklo gibanje deleža in stopnje zaposlenosti po različnih stopnjah izobrazbe za Slovenijo in EU-28. Največji delež v celotni zaposlenosti pripada delavcem s sekundarno izobrazbo, sledijo jim delavci s terciarno in primarno izobrazbo (Slika G2). V Sloveniji se je v opazovanem obdobju delež zaposlenih s sekundarno in primarno izobrazbo znižal, medtem ko se je delež zaposlenih z doseženo terciarno izobrazbo povečal. Podobni trendi so razvidni tudi iz podatkov EU z izjemo deleža delavcev s sekundarno izobrazbo, ki je ostal v opazovanem obdobju približno enak.

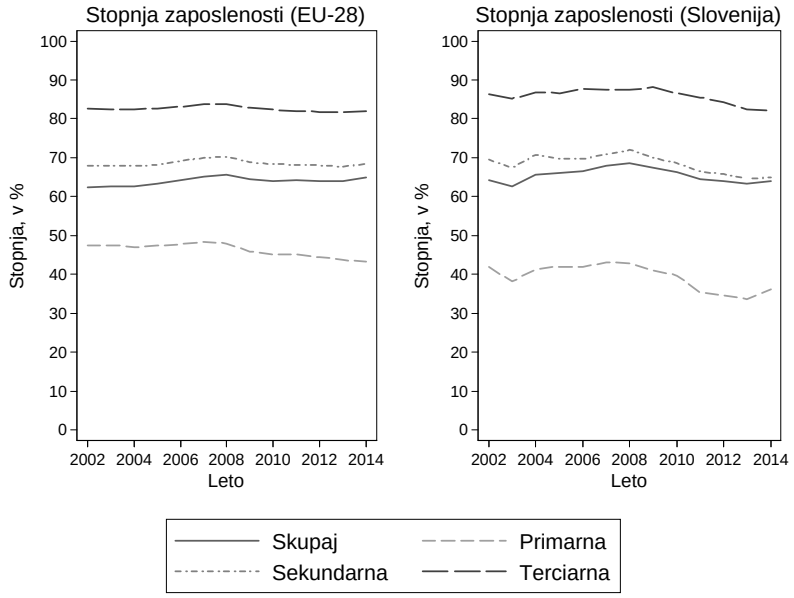
Slika G2. Delež zaposlenosti glede na stopnjo izobrazbe v Sloveniji in v EU-28



Vir: Statistični urad Republike Slovenije, lastni izračuni

Podobni trendi so razvidni tudi iz podatkov, ki prikazujejo stopnje zaposlenosti delavcev z različnimi stopnjami izobrazbe v Sloveniji in v EU-28. Nadpovprečne stopnje zaposlenosti dosegajo delavci s terciarno in sekundarno izobrazbo, medtem ko so stopnje zaposlenosti delavcev s primarno izobrazbo pod povprečjem (Slika G3).

Slika G3. Stopnja zaposlenosti glede na stopnjo izobrazbe v Sloveniji in v EU-28



Vir: Statistični urad Republike Slovenije, lastni izračuni

Kot majhno in odprto gospodarstvo je Slovenija zelo odvisna od tendenc dogajanja v globalnem okolju. Poleg tega se je struktura zaposlenih v zadnjem obdobju spremenila v korist terciarno izobraženim zaposlenim. Glede na prikazane statistične trende motivacija doktorske naloge sloni na nadaljnji analizi povezav in kavzalnosti med mednarodno menjavo in ravnijo znanja v slovenskih podjetjih z namenom doprinosa k znanosti. Glede na zgoraj prikazane statistike in karakteristike države je Slovenija primerna in zanimiva za izdelavo podrobne analize.

Glavni namen teoretičnega modela v prvem poglavju je doprinos k znanosti preko vključitve možnosti uvoza v model heterogenih podjetij ter analiza posameznikovih odločitev za povečanje nivoja znanja. Cilj teoretičnega modela je analiza naslednjih dveh raziskovalnih vprašanj: *(i) Kakšen je vpliv posameznikove odločitve za povečanje nivoja znanja na kasnejše povpraševanje podjetij po delovni sili?* in *(ii) Ali sprejemajo nizko- in visoko-tehnološka podjetja različne odločitve glede zaposlovanja delavcev z višjim nivojem strokovnega znanja ter različne odločitve glede začetka uvažanja in/ali izvažanja?*

Glavni cilj drugega poglavja je empirična analiza nekaterih zaključkov teoretičnega modela prejšnjega poglavja. Namen empirične analize je predvsem obravnavanje naslednjih raziskovalnih vprašanj: *(i) Ali se podjetja z relativno boljšo izobrazbeno strukturo odločijo za začetek uvažanja?; (ii) Ali podjetja po začetku uvažanja dodatno izboljšajo strukturo znanja zaposlenih?* in *(iii) Ali ima začetek uvažanja zaradi uvažanja vmesnih dobrin in/ali povečanja ravni tehnologije pozitiven vpliv na začetek izvažanja?*

Namen empiričnega modela v tretjem poglavju je analiza vpliva *outsourcinga* in *offshoringa* na raven znanja zaposlenih v slovenskih podjetjih in presoja naslednjih raziskovalnih vprašanj: *(i) Ali vključitev obeh dejavnikov – offshoringa in outsourcinga – v en model spremeni rezultate dozdajšnjih analiz, ki so v svojih modelih kontrolirale le enega izmed obeh dejavnikov?; (ii) Ali kontroliranje destinacije outsourcinga in offshoringa pripelje do novih zaključkov?* in *(iii) Ali vključitev informacije o vrsti poklica v definicijo strokovnega znanja zaposlenih predstavlja doprinos k zaključkom analize?*

Opis raziskovalnih metod in podatkov

Raziskovalne metode so bile uporabljene v skladu s postavljenimi raziskovalnimi cilji posameznega poglavja. Teoretični model prvega poglavja predstavlja razširitev teoretičnih modelov Melitza (2003), Bustosove (2011a, 2011b) ter Amiti in Davis (2011) preko vključitve analize posameznikovih odločitev v model. Ta del modela temelji na modelih Stark in Wang (2001), Stark, Helmenstein in Prskawetz (1998), Stark in Chau (1998) ter Stark, Helmenstein in Prskawetz (1997). Zasnova empiričnega modela v drugem poglavju temelji na modelih Damijana in Kostevca (2015) ter Yang in Malllick (2010), ki so v svojih analizah uporabili *propensity score matching*. Razširitev omenjenih analiz predstavlja podrobna analiza sekvenc med uvozom in izvozom, kjer model v doktorski disertaciji vzame v obzir tudi vrsto uvoza in strukturo znanja podjetij. Robustnost

rezultatov je bila povečana preko uporabe številnih variacij *matching* metod. Empirična analiza v tretjem poglavju uporablja ocenjevalne metode za analizo panelnih podatkov: *pooled OLS*, oziroma metodo najmanjših kvadratov, metodo fiksnih učinkov ter metodo slučajnih učinkov. Z namenom doseganja večje robustnosti rezultatov so bile ponovno uporabljene različne variacije modelov.

Empirični analizi v drugem in tretjem poglavju uporabljata podatke, pridobljene na podlagi različnih podatkovnih baz, ki skupaj tvorijo bogate panelne podatke na ravni podjetij in zaposlenih v slovenskih podjetjih v obdobju od leta 1996 do 2010. Nabor podatkov obsega informacije o bilancah stanja in izkazih uspeha slovenskih podjetij (npr. število zaposlenih, kapital na zaposlenega, dodana vrednost na zaposlenega), o mednarodnem delovanju podjetij (npr. vrednost in obseg uvoza in izvoza, vrsta izvoženih in uvoženih proizvodov ter destinacija uvoza in izvoza), o lastnostih zaposlenih (npr. spol, starost, bruto plača, stopnja izobrazbe, vrsta poklica) ter o naložbah rezidentov v tujini oziroma tujih neposrednih investicijah (TNI) za posamezno slovensko podjetje. Nabor podatkov tako vključuje več podatkovnih baz: dohodninske podatke posameznikov, transakcije o izvozu in uvozu blaga, Statistični register delovno aktivnega prebivalstva (SRDAP), računovodske podatke na ravni podjetja ter TNI. Podatki so bili pridobljeni v sodelovanju s Statističnim uradom Republike Slovenije (SURS), s Finančno upravo Republike Slovenije (FURS), Agencijo Republike Slovenije za javnopravne evidence in storitve (AJPES) in Banko Slovenije.

Povzetek glavnih ugotovitev doktorske disertacije

Glavni namen doktorske disertacije je analiza povezav in kavzalnosti med uvozom, izvozom ter strukturo znanja zaposlenih v podjetjih.

Prvo poglavje zajema teoretični model, ki analizira posameznikove odločitve glede investiranja v nadgradnjo spretnosti in znanja ter odločitve podjetij glede investiranja v višji nivo tehnologije in začetka mednarodne menjave. Z namenom temeljite analize posameznikovega obnašanja in poslovne strategije podjetja je bil model razdeljen na dva dela. Prvi del analizira posameznikove odločitve glede nadgradnje znanja. V tem delu model primerja spodbude za investiranje v nadgradnjo znanja in višje stopnje izobrazbe visoko in nizko sposobnih posameznikov. Ker model predpostavlja, da so stroški izobraževanja nizko sposobnih posameznikov neprimerljivo višji v primerjavi s stroški visoko sposobnih posameznikov, lahko le slednji pridobijo višjo raven izobrazbe. V času zaposlitve posledično visoko sposobni in visoko izobraženi posamezniki zahtevajo višje plače, da z njimi kompenzirajo pretekle višje stroške izobraževanja. Visoke plače v podjetjih tako signalizirajo zaposlenost visoko sposobnih in visoko izobraženih posameznikov. Omenjeno je kasneje uporabljeno v drugem delu modela, ki proučuje poslovne odločitve podjetij. V tem delu se podjetja še pred liberalizacijo mednarodne menjave odločajo, ali bodo investirala v pridobitev višje tehnologije ali ne. Prednosti investiranja v višjo tehnologijo predstavljajo nižji mejni stroški proizvodnje, toda na račun

višjih fiksnih stroškov. Zaradi slednjih se le najbolj produktivna podjetja odločijo za investiranje v višji nivo tehnologije. Po liberalizaciji mednarodne trgovine se stroški mednarodne menjave znižajo do te mere, da se podjetja odločajo tudi glede začetka uvažanja in izvažanja. Slednje za podjetja ponovno predstavlja povišanje stroškov, prednosti pa se kažejo v povišanih prihodkih in/ali povišani zaposlenosti visoko izobraženih delavcev. Rezultati modela kažejo, da najbolj produktivna med nizko-tehnološkimi podjetji povečajo delež visoko izobraženih zaposlenih ter začnejo izvažati in uvažati, srednje produktivna med nizko-tehnološkimi podjetji povečajo delež visoko izobraženih zaposlenih in začnejo z uvažanjem, medtem ko najmanj produktivna nadalje poslujejo le na domačem trgu. Rezultati nizko-tehnoloških podjetij tako kažejo na pomen začetka uvažanja za povečanje nivoja produktivnosti pred začetkom izvažanja. Omenjen zaključek je bil potrjen tudi v empiričnih študijah (na primer v Damijan & Kostevc, 2015 in Altomonte & Békés, 2010). Rezultati visoko-tehnoloških podjetij po drugi strani kažejo, da najmanj produktivna med njimi ne začnejo z izvajanjem mednarodnih dejavnosti, medtem ko je odločitev visoko produktivnih visoko-tehnoloških podjetij glede mednarodne menjave odvisna od njihovega nivoja produktivnosti, povišanja relativne zaposlenosti visoko izobraženih delavcev pred in po začetku uvažanja ter zunanjih dejavnikov. Slednje se nanaša predvsem na višino stroškov izvoza in uvoza.

Model v drugem poglavju empirično preveri posamezne zaključke teoretičnega modela iz prejšnjega poglavja. Glavni namen analize povezav in kavzalnosti med strukturo znanja zaposlenih in uvozom je preverba, ali uvozniki zaposlujejo višji delež delavcev z višjo stopnjo izobrazbe, v primerjavi s podjetji, ki ne uvažajo; ali imajo podjetja še pred začetkom uvažanja relativno večji delež visoko izobraženih v primerjavi z ne-uvozniki; ter ali podjetja še dodatno povečajo delež visoko izobraženih po začetku uvažanja. V delu analize, ki proučuje vpliv uvoza na začetek izvažanja pa model kontrolira tudi vrsto uvoza, in sicer uvoz kapitalskih in uvoz vmesnih dobrin. Za potrebe analize so bili uporabljeni panelni podatki na ravni slovenskih podjetij in zaposlenih v predelovalnih dejavnostih v obdobju od 1996 do 2010. Podatki združujejo več podatkovnih baz in med drugim vključujejo informacije o bilancah stanja in izkazih uspeha podjetij (na primer število zaposlenih, kapital na zaposlenega, dodana vrednost na zaposlenega, lastništvo, tuje neto investicije), uvozu in izvozu (na primer vrednost izvoza in uvoza ter tip dobrine uvoza) ter lastnosti zaposlenih (na primer število let šolanja, stopnja izobrazbe in višina plače). Za namen kontroliranja merljivih razlik med uvozniki in ne-uvozniki je bila uporabljena metoda *propensity score matching*, za namen povečanja robustnosti rezultatov pa so bile uporabljene različne variacije *matching* metod. Rezultati kažejo, da začnejo uvažati podjetja, ki so imela že pred začetkom uvažanja relativno boljšo izobrazbeno strukturo zaposlenih. Poleg tega se izobrazbena struktura podjetij dodatno izboljša v drugem letu po začetku uvažanja v primerjavi s podjetji, ki ne uvažajo. V primerjavi z ne-uvozniki uvozniki tudi ohranijo relativno boljši delež visoko izobraženih zaposlenih v prvem in drugem letu po začetku uvažanja. Nadalje, pozitiven vpliv začetka uvažanja vmesnih dobrin na začetek izvažanja se kaže že po prvem letu začetka uvažanja. Po drugi strani pa

ima začetek uvažanja kapitalskih dobrin pozitiven vpliv na začetek izvažanja šele v drugem letu po začetku uvažanja. Razlaga za omenjene razlike je lahko posledica različne rabe vmesnih in kapitalskih proizvodov v proizvodnem procesu. Natančneje, ker so vmesni proizvodi večinoma v obliki surovin s krajšim rokom trajanja ter potrebujejo nadaljnjo predelavo ali so uporabljeni za preprodajo, je vpliv uvoza vmesnih proizvodov na proizvodni proces in posledično tudi na izvoz takojšen, vendar kratko trajajoč. Po drugi strani pa zamenjava kapitalskih dobrin večinoma ni kratkotrajen proces, podjetja pa te dobrine kasneje uporabljajo skozi daljše obdobje, zato se njihov učinek na začetek izvažanja zgodi z zamikom.

Zadnja analiza v tretjem poglavju proučuje vpliv *offshoringa* in *outsourcinga* na relativno zaposlenost strokovno usposobljenih delavcev v slovenskih predelovalnih in storitvenih podjetjih. V analizi so bili uporabljeni podobni panelni podatki na ravni podjetij in zaposlenih kot v prejšnjem poglavju, v obdobju od 1997 do 2010, podatki pa vsebujejo nekatere dodatne informacije, na primer destinacijo uvoza in izvoza, destinacijo tujih neposrednih investicij ter vrsto poklica zaposlenih. Slednja informacija je bila uporabljena kot dodatna mera za definiranje ravni znanja zaposlenih. Empirična analiza je bila razdeljena na dva dela. Prvi del vključuje osnovni model, ki proučuje vpliv *offshoringa* in *outsourcinga* na relativno zaposlenost strokovno usposobljenih delavcev v podjetjih. Strokovna usposobljenost delavcev je v prvem delu modela merjena glede na raven izobrazbe delavcev. V drugi del so vključene razširitve modela, ki kontrolirajo za dejavnike *offshoringa* v visoko- in nizko-razvite države in *outsourcinga* iz visoko- in nizko-razvitih držav. Poleg tega drugi del modela razširi opredelitev strokovne usposobljenosti delavcev preko vključitve vrste poklica posameznika. Tri glavne skupine poklicev klasifikacije ISCO-88 definirajo posameznike z višjo stopnjo znanja v drugem delu modela: vodje (*Managers*), profesionalci (*Professionals*) in tehniki (*Technicians*). Za potrebe analize so bile uporabljene ocenjevalne metode za panelne podatke (*pooled OLS* oziroma metoda najmanjših kvadratov, metoda fiksnih učinkov ter metoda slučajnih učinkov). Rezultati modelov v povprečju nakazujejo pozitiven vpliv *offshoringa* na strukturo znanja podjetij. Analiza podatkov v predelovalnih dejavnostih kaže, da ima *offshoring* v visoko razvite države pozitiven in podoben vpliv na strukturo znanja podjetij kot *offshoring* v nizko razvite države. V storitvenih podjetjih pa rezultati nakazujejo na šibkejši vpliv *offshoringa* v visoko razvite države napram *offshoringu* v nizko razvite države. Ko se v definicijo znanja zaposlenih vključi tudi poklic posameznika, rezultati za predelovalna podjetja kažejo na močnejši vpliv *offshoring-a* v visoko razvite države na relativno stopnjo zaposlenosti profesionalcev v primerjavi z *offshoringom* v nizko razvite države. Rezultati za podjetja v predelovalnih dejavnostih se ne spreminjajo bistveno, ko so uporabljene različne definicije ravni znanja v podjetjih. Nasprotno pa se rezultati ob uporabi različnih definicij bistveno razlikujejo v storitvenih podjetjih. Ko definicija znanja zajema le poklic posameznika, ima *offshoring* v visoko razvite države šibkejši vpliv na relativno zaposlenost tehnikov kot *offshoring* v nizko razvite države. Ko definicija znanja zajema tako poklic posameznika kot tudi stopnjo izobrazbe, pa *offshoring* v visoko razvite

in nizko razvite države kaže primerljiv in pozitiven vpliv na relativno stopnjo zaposlenosti terciarno izobraženih vodij. Stopnja izobrazbe ima torej različen vpliv na zaposlenost različnih skupin poklicev. Rezultati tako nakazujejo, da podjetja razlikujejo med različno izobraženimi posamezniki znotraj istega poklica, kar je v skladu z zaključki prejšnjega poglavja. Z namenom povečanja robustnosti rezultatov sta bili v analizo vključeni tudi velikost podjetja ter uporaba različnih definicij spremenljivke za dodano vrednost, ki sta potrdili rezultate osnovnih modelov.

Znanstveni prispevek doktorske disertacije in možnosti za nadaljnje raziskave

Teoretični model ima dva glavna prispevka k znanosti. Model vključuje in analizira odločitve uvoznikov, s čimer razširi vsebino teoretičnih modelov heterogenih podjetij Bustosove (2011a, 2011b) ter Melitza (2003). Omenjeno je pomembno, ker je veliko empiričnih študij izpostavilo pomembnost vključitve uvoza v analize, saj ima le-ta pozitiven vpliv na kasnejši začetek izvažanja (na primer študija Damijana in Kostevca (2015), narejena na podlagi podatkov španskih podjetij). Model analizira in kontrolira tudi odločitve posameznikov glede investiranja v višji nivo znanja, s čimer razširi vsebino dosedanjih teoretičnih modelov mednarodne menjave. Rezultati posameznikovih odločitev glede investiranja v višji nivo znanja so kasneje uporabljeni v delu, ki proučuje obnašanje podjetij, saj omenjene odločitve posameznikov vplivajo na kasnejše povpraševanje podjetij po delovni sili. Model omogoča tudi številne možnosti za nadaljnje raziskave, med katerimi so bile naslednje uporabljene v empiričnem modelu v drugem poglavju: (i) bodoči uvozniki imajo boljšo strukturo znanja zaposlenih pred začetkom uvažanja; (ii) po začetku uvažanja se zaposlenost v podjetjih spremeni v korist zaposlenih z boljšo strukturo znanja; (iii) začetek uvažanja ima preko dostopa do cenejših tehnologij in/ali cenejših vmesnih proizvodov pozitiven vpliv na začetek izvažanja. V kasnejših analizah bi lahko vzeli v obzir teoretični model, ki je v dozdajšnji obliki dokaj statičen (tj. ne omogoča hkratne primerjave med na primer odločitvami podjetja glede začetka mednarodnih aktivnosti in začetka vlaganja v višji nivo tehnologije). Omenjena statičnost modela tako ne odraža v celoti kompleksnih odločitev, ki jih morajo sprejemati podjetja v današnjem hitro-spreminjajočem se svetu.

Znanstveni prispevek empiričnega modela v drugem poglavju je analiza povezav med uvozniki in strukturo znanja zaposlenih v podjetjih ter vpliv začetka uvažanja na začetek izvažanja. Natančneje, v analizi so vzete v obzir vse faze uvažanja ter povezava s strukturo znanja zaposlenih v podjetjih, tj. pred začetkom uvažanja, prvi dve leti po začetku uvažanja in uvozniki na splošno. Poleg tega je v analizi pri proučevanju vpliva začetka uvažanja in začetka izvažanja upoštevana vrsta uvoza ter s tem povečana razlagalna moč dobljenih rezultatov in doprinos k znanosti, saj so se dosedanje empirične študije osredotočale predvsem na analizo povezav med uvozniki, izvozniki in ravnijo tehnologije v podjetjih (na primer Damijan & Kostevc, 2015; ter Yang & Mallick, 2010). Nenazadnje pa lahko zaključki analize koristijo tudi zakonodajalcem, podjetjem, zaposlenim, brezposelnim in študentom. Zakonodajalci bi z dodatno stimulacijo mednarodnih aktivnosti in izboljšanjem

strukture znanja domačih podjetij tako lahko povečali produktivnost in konkurenčnost domačega poslovnega okolja. V skladu z rezultati analize bi morala imeti tudi podjetja višje spodbude za zaposlovanje posameznikov z višjim nivojem znanja, medtem ko bi morali imeti študentje, brezposelni in zaposleni interese za doseganje višje izobrazbene ravni in pridobivanje dodatnega znanja. Možnost za izboljšavo v prihodnjih študijah predstavlja vključitev inovacij v empirično analizo, saj bi to omogočilo empirično preverbo dodatnih zaključkov teoretičnega modela doktorske disertacije.

Prvi prispevek empirične analize v tretjem poglavju je vključitev obeh mer strateškega pozicioniranja podjetij v mednarodni menjavi, torej *offshoringa* in *outsourcinga*, v en model. Prejšnje analize so namreč v svoje modele vključevale le enega izmed obeh faktorjev. Ker pa zaključki preteklih študij potrjujejo, da imata oba faktorja vpliv na povpraševanje po delovni sili ter da bo njun obseg v prihodnosti še naraščal, je bilo pomembno vključiti oba faktorja v eno analizo. Dodaten prispevek analize je kontroliranje visoko- in nizko-razvitih držav, kar omogoča nove interpretacije rezultatov glede države izvora *offshoringa* in *outsourcinga*. Ker je bila v prejšnjih analizah vzpostavljena pomembnost diferenciacije med podjetji v predelovalnih in storitvenih dejavnostih, je bila empirična analiza te doktorske disertacije narejena posebej za obe vrsti dejavnosti. Z namenom povečanja razlagalne moči modela in dejstva, da posamezniki ne pridobivajo znanj samo v času formalnega izobraževanja, je v analizi v definicijo znanja posameznika poleg stopnje izobrazbe vključena tudi vrsta poklica. Možnosti za nadaljnje raziskave predstavlja definicija *offshoringa*, ki v tej analizi vključuje le informacijo o prisotnosti tujih neposrednih investicij ter vrsto države (tj. nizko- in visoko-razvite države), ne pa tudi na primer vrednosti tujih neposrednih investicij.