Untangling the Relationship between Skill Structure, Imports, and Exports: Evidence from Slovenian Matched Employer-Employee Data[1]

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Abstract

This empirical paper delivers new insights to understanding the linkages between importing and skill upgrading, and importing and exporting. The propensity score matching analysis uses employer-employee panel dataset for Slovenian manufacturing firms. The results show that firms with a better skill structure start importing and later also sustain a higher skill share, compared to non-importing firms. Meanwhile, firms' skill structure deteriorates after firms stop importing. The study also highlights the importance of importing, serving as a prerequisite before the start of exporting through importing intermediate goods and/or technology, and exposing a different function of intermediate and capital goods in the production process.

Keywords: *importing, exporting, skill structure of firms*

JEL Classification: F14, J24

Introduction

Analysis of the sources of higher productivity in firms has been of great interest in various fields of research. These studies show that firms' higher productivity can be attributed to tougher market competition, technological spillovers,

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[1] The Appendices are available on the following website: <https://goo.gl/FoVQhs>.

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human capital, and international trade (Syverson, 2011), to name only a few. Firms, engaged in international 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 is the self-selection of more productive firms into trading activities (Aw, Roberts and Xu, 2011; Vogel and Wagner, 2008; Aw, Roberts and Xu, 2008; Wagner, 2007; Greenaway and Kneller, 2004; and Melitz, 2003). 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; and Verbič, Majcen and Čok, 2014). In addition, both determinants of firm performance – involvement in trading activities and skilled workforce – also have a positive impact on one another. Empirical studies prove that importing has an important impact on the demand for skilled workers (Raveh and Reshef, 2016; Burstein, Cravino and Vogel, 2013; and Parro, 2013).

While empirical studies on international trade primarily emphasized exporting as one of the determinants of higher productivity in firms, more recent studies expose importing as being very important as well (Damijan and Kostevc, 2015; Jienwatcharamongkhol, 2013; and Wagner, 2012). By enabling product and process innovation, importing has proven to have a positive impact on the start of exporting activities, which in sequence enables further innovations (Damijan and Kostevc, 2015). Since previous studies indicate there is a correlation between importing and firms' skill structure, and also highlight the impact of importing on the start of exporting, we were motivated to study these linkages more thoroughly in order to explore these drivers of higher productivity in firms. Subsequently, as previous studies exposed the importance of importing on firm's skill structure and exporting status, we were motivated to especially focus on importing and shed some light on the issues which have not been analysed yet.

The main aims of the analysis are the following. First, to contribute to the empirical studies which exposed the impact of importing status on the firms' skill structure, by taking into account different stages of importing – i.e. before the start of importing, importing starters, importing firms in general, and firms which stop importing – and by studying reverse causalities between firms' skill upgrading and importing. We believe it is important to study these issues as previous studies exposed the importance of importing and skill structure on firms' performance but have, to the best of our knowledge, not yet thoroughly analysed linkages and causalities between the two. The empirical analysis thus examines the differences in the levels of the skill structures of importers and non-importers, import starters and non-importers, and importers and firms which stop importing. Second aim is to further study the interaction between importing and

exporting, by controlling also for the type of importing goods when taking into account sequencing between importing and exporting. In this regard, the analysis examines the impact of having access to 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. Accordingly, we were motivated to empirically analyse the following hypotheses in this study: (i) what is the relationship between importing and a better skill structure of firms; (ii) do firms with a better skill structure start importing; (iii) do importing firms adjust their skill structure after the start of importing; (iv) do firms adjust their skill structure after they stop importing; (v) does having access to technology through importing (measured as importing capital goods) increase the probability of the start of exporting; and (vi) does having access to intermediates through importing (measured as importing intermediate goods) increase the probability of the start of exporting. The last two points presume that firms use importing in order to make their production process more cost effective and in turn increase their productivity. Firms can achieve this by importing higher quantities of more affordable intermediates or importing intermediates of higher quality, or by importing capital goods that are more affordable or of higher quality.

With the aim of studying the abovementioned prepositions, a linked employer--employee panel dataset for Slovenian manufacturing firms is used, covering the period from 1996 to 2010. In order to ensure comparison of firms with similar characteristics, the propensity score matching approach is applied. The dataset is constructed from several data sources with information on firms' financial figures, their values and types of imports, and the characteristics of employees.

Results contribute to the previous research in several ways. First is by showing that firms with a higher skill share start importing and continue preserving a higher skill share, compared to non-importing firms, also after the start of importing. In addition, the study confirms previous findings that importing activities have a positive impact on the demand for skills, and sheds additional light by showing that importing firms additionally increase their skill share in the second year after the start of importing, compared to non-importing firms. On the other hand, firms' skill structure deteriorates after firms stop importing. When analysing the effect of importing on the start of exporting, the study contributes to the field of research by controlling for the type of importing goods and showing that, timewise, starting to import intermediate goods has a different impact on the start of exporting, compared to starting to import capital goods. While importing intermediate goods has an immediate positive impact on the start of exporting in the year after the start of importing these goods, importing 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 confirm a different role of the capital and intermediate goods in firms' production processes. Finally, besides contributing to the field, the paper also adds insights into policy implications by indicating a significant relationship between firms' skill structure and internationalization, which might encourage improvements in firms' skill structure, and revealing the importance for constituting an educational system that would equip future employees with relevant skills and thus minimise skill mismatches.

The remainder of the paper is organised as follows. In the next section, a brief summary of the relevant literature is given. Section two describes the data and presents the descriptive statistics. Introduction of the empirical model is included in section three, while basic results, extensions of the model, and results' discussion are included in section four. The last section summarises and concludes.

1. Literature Review

Since 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, greater trade openness is one of the main reasons for increases in the demand and supply of more educated labour (Crino, 2012; Foster, Stehrer and de Vries, 2012; Bloom, Draca and Van Reenen, 2011; Meschi, Taymaz and Vivarelli, 2008; Muendler, 2004; Attanasio, Goldberg and Pavcnik, 2003; Tokarick, 2002; Feenstra and Hanson, 1999). 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 and Konings, 2007). Bas and Strauss-Kahn (2014) also confirm a strong impact of importing on firms' productivity and export performance as higher number 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 and Strauss-Kahn, 2014).

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, Taymaz and Vivarelli (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 (Meschi, Taymaz and Vivarelli, 2008). Crino (2012) also confirms the skill-biased effects of offshoring, where the latter is defined as the share of service inputs in the total non-energy inputs. The study shows that offshoring increases the demand for high- and medium-skilled labour, while hinders the demand for low-skilled labour.

Bloom, Draca, and Van Reenen (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 addition, the liberalisation of international trade increases competition, which in turn fosters innovation. 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. Lastly, as a consequence of trade liberalisation and hence the decreases 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.

Finally, 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 reasoning is the capital-skill complementarity, which creates the skill-biased trade (Burstein, Cravino and Vogel, 2013; and Parro, 2013). Raveh and Reshef (2016) show that the composition of imports influences the demand for skilled labour and the skill premium since 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.

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 (World Bank, 2015), and had above-average employment rates of tertiary educated workers compared to EU-average (Eurostat, 2016; and Kajzer and Brezigar-Masten, 2008).

To estimate the relationships between importing, exporting, and the skill structure of firms, a linked employer-employee panel dataset for Slovenian manufacturing firms during the period from 1996 to 2010 was used. The dataset contains information on balance sheet data and the income statements of Slovenian manufacturing firms, their import and export activities, the attributes of their employees, and the data on foreign direct investments. The data 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 richness of the dataset enables the empirical analysis to control for several characteristics of firms, i.e. number of employees, capital per employee, value added per employee, ownership, foreign direct investments, types and value of imported products, and takes into account the attributes of employees, i.e. years of schooling, educational level, and wages. In the analysis, we define workers as skilled if they attain at least some form of college degree (Bloom, Draca and Van Reenen, 2011; Tokarick, 2002; and Baldwin and Cain, 2000), which is typically 14 years of educational attainment in Slovenia. For brevity, the following descriptive statistics are presented with a four-year gap for initial years, 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, in comparison to an average firm (Table 1).

However, while the share of skilled employees is above average in importing firms, it is usually below average in exporting firms. Possible reason for this could be the above-average size of exporters. Reducing the number of workers in the recent years in exporting firms led to the increase in the skill share of these firms.

We also analyse how persistent are the new importing and exporting activities of firms. In the first year after the start of importing, 71.2% of firms continue to import, while this share reduces to 55.2% in the second year after the start of importing. Compared to importing firms, exporting firms on average show lower persistency. Among exporting starters, 66.6% of firms continue to export also in the first year after the start of exporting, whereas only 49.9% of firms continue exporting also in the second year.

However, after excluding firms that exit the market, the persistency of importing and exporting starters increases. In this framework, firms on average continue importing in the first and second year after the start of importing, while the share of exporters increases for roughly 15 percentage points in each of the subsequent two years after the start of exporting.

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 firms' skill shares (in %); *Gross wage* – average gross wage in EUR; *Gross wage of skilled* – average gross wage of skilled employees in EUR.

Source: SORS; authors' calculations.

3. Empirical Analysis

As presented in the introduction, the empirical analysis takes into account six hypotheses on the linkages between firms' skill structure and importing, and importing and the start of exporting. Since several papers found a positive impact of importing on the demand for skilled labour (see for example Crino, 2012; Bloom, Draca and Van Reenen 2011; and Meschi, Taymaz and Vivarelli, 2008), we were motivated to analyse these relations more thoroughly. Accordingly, the first four hypotheses study the linkages between firms' skill structure and importing, focusing mainly on the level of firms' skill structure before the start of importing and how the skill structure changes after the start and stop of importing.

In addition, since previous studies suggest it is important to control for the composition of imports (Raveh and Reshef, 2016) and confirm a significant impact of importing on exporting (Bas and Strauss-Kahn, 2014), we were motivated

to combine these findings and analyse them more thoroughly in the last two hypotheses, which study the impact of starting to import intermediate or capital goods on the start of exporting.

3.1. Estimation Methods

With the aim of empirically analysing the abovementioned hypotheses and in order to explore different behavioural patterns of firms that share similar characteristics, the propensity score matching is applied. We follow the definition of Rosenbaum and Rubin (1983), who define it as the conditional probability of receiving a treatment, given the pre-treatment characteristics. Among the advantages of propensity score analysis are that it 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, Reiter and Zanutto, 2004; Becker and Ichino, 2002; and Rubin, 1997). Comparable methodology was for example used also by Burger, Jaklič and Rojec (2008). We apply probit estimation for estimating the propensity scores. Finally, two underlying identifying assumptions were used when estimating the average treatment effects on the treated (ATT); (i) conditional independence or unconfoundedness, and (ii) overlap or common support condition.

When calculating the ATTs, several different matching methods were used in order to increase the robustness of results. These comprise one and five nearest neighbour matching with replacement, radius matching, and kernel matching. Matching with replacement was used in order to additionally reduce the bias by enabling matching between treatment and control units although the control unit has already been matched (Bartolj and Polanec, 2017). In addition, to further enhance robustness of the results, we use two different bandwidths, 0.06 and 0.01, when applying kernel matching, and two different calipers, 0.05 and 0.1, when applying nearest neighbour matching and radius matching. A tighter caliper significantly reduces bias and improves the performance of propensity score matching (Lunt, 2014). As in the several papers that applied propensity score matching, bootstrapped standard errors were used (see for example Heckman, Ichimura and Todd, 1997; Becker and Ichino, 2002; Dehejia and Wahba, 2002; and Dehejia and Wahba, 1999). For implementing the empirical estimation, we use the software Stata.

In order to assure unbiased results, several tests on the quality of matching were made (i.e. the propensity score histograms, the t-test for testing the hypothesis that the mean value of a variable is the same in the treatment and in the control group, and measuring the bias after the matching procedure). The tests on

average confirm that the matching procedure generated an appropriate control group to match the observations in the treatment group. The tests' results and results on matching functions (probit estimations) are available in the Appendix.

3.2. Estimating the Relationship between Skill Structure and Imports

When estimating the first hypothesis on the direction of relationship between importing and firms' skill structure, we explore the differences in the skill structures of importers and non-importers. We follow Damijan and Kostevc (2015), and Yang and Mallick (2010) when estimating the propensity scores, using the model (1), where the propensity score equals the probability of being an importer ($P(IMP_{it} = 1)$), based on certain characteristics of firms:

$$P(IMP_{it} = 1) = f(Size_{it}, Lvae_{it}, Lke_{it}, Rimsh_{it}, Foreign_{it}, FDI_{it}, Time_t, Ind_t) \quad (1)$$

The explanatory variables in the model (1) 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 the 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). Since the aim of the first hypothesis is to analyse the relationship 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. The ATT is computed in the following way:

$$ATT_1 = E\left[Skill_{it}(1) - Skill_{it}(0) \mid P(IMP_{it} = 1)\right] \quad (2)$$

ATT_1 reports the difference between potential outcomes with and without treatment; $Skill_{it}(1)$ and $Skill_{it}(0)$, respectively. The outcome of interest, $Skill_{it}$, refers to the skill structure of a firm i in year t. Importing firms ($IMP_{it} = 1$) represent the treatment group and non-importing firms ($IMP_{it} = 0$) the control group.

The second hypothesis explores whether importing starters have a better skill structure than non-importing firms. The following model has been used for estimating the propensity scores:

$$P(IMPstart_{it} = 1) = f(Size_{it-1}, Lvae_{it-1}, Lke_{it-1}, Rimsh_{it-1}, Foreign_{it-1}, FDI_{it-1}, Time_t, Ind_t) \quad (3)$$

The variable $IMPstart_{it}$ denotes importing starters, which start importing in the period *t* and have not been importing in the previous years. When calculating the propensity scores, the control variables are lagged for one period and are parallel to the ones in the model (1). For testing the second hypothesis, the ATT is computed in the following way:

$$ATT_2 = E\left[Skill_{it-1}(1) - Skill_{it-1}(0) \mid P(IMPstart_{it} = 1)\right] \quad (4)$$

In equation (4), ATT_2 reports the difference in the skill shares between importing starters ($IMPstart_{it} = 1$; treatment group) and non-importing firms ($IMP_{it} = 0$; control group), where the outcome of interest, $Skill_{it-1}$, refers to the skill share of firm *i* one year before the start of importing, and *t* refers to the entrance year of importing.

The third hypothesis examines whether importing starters adjust their skill structure after the start of importing, using also differences-in-differences matching estimator. When calculating the propensity scores, control variables are parallel to the model (3):

$$\begin{gathered} P(IMPstart_{it} = 1,\ IMP_{it+1} = 1) = \\ f(Size_{it-1}, Lvae_{it-1}, Lke_{it-1}, Rimsh_{it-1}, Foreign_{it-1}, FDI_{it-1}, Time_t, Ind_t) \end{gathered} \quad (5)$$

The treatment group 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 ($IMPstart_{it} = 1,\ IMP_{it+1} = 1$), while the control group consists of non-importing firms ($IMP_{it} = 0,\ IMP_{it+1} = 0$). Since this hypothesis takes into account two different outcomes of interest, two average treatment effects on the treated were calculated:

$$ATT_3 = E\left[Skill_{it+1}(1) - Skill_{it+1}(0) \mid P(IMPstart_{it} = 1,\ IMP_{it+1} = 1)\right] \quad (6)$$

$$ATT_4 = E\left[Skill\_d_{it+1}(1) - Skill\_d_{it+1}(0) \mid P(IMPstart_{it} = 1,\ IMP_{it+1} = 1)\right] \quad (7)$$

The outcome of interest in ATT_3 is the skill share one year after the start of importing ($Skill_{it+1}$), while in the ATT_4 it is the change in the skill share after the start of importing ($Skill\_d_{it+1} = Skill_{it+1} - Skill_{it}$). Again, the *t* in equations (6) and (7) refers to the entrance year of importing.

Finally, the fourth hypothesis examines whether firms adjust their skill structure after they stop importing. Estimation of the propensity scores is again parallel to the model (3):

$$\begin{gathered} P(IMP_{it} = 1,\ IMP_{it+1} = 0) = \\ f(Size_{it-1}, Lvae_{it-1}, Lke_{it-1}, Rimsh_{it-1}, Foreign_{it-1}, FDI_{it-1}, Time_t, Ind_t) \end{gathered} \quad (8)$$

The treatment group consists of firms that have been importing in the current year but have stopped importing in the following year ($IMP_{it} = 1,\ IMP_{it+1} = 0$). The control group consists of importing firms ($IMP_{it} = 1,\ IMP_{it+1} = 1$). Similarly as in the previous example, two different methods for calculating the ATT were used:

$$ATT_5 = E\left[Skill_{it+1}(1) - Skill_{it+1}(0) \mid P(IMP_{it} = 1,\ IMP_{it+1} = 0)\right] \quad (9)$$

$$ATT_6 = E\left[Skill\_d_{it+1}(1) - Skill\_d_{it+1}(0) \mid P(IMP_{it} = 1,\ IMP_{it+1} = 0)\right] \quad (10)$$

The outcome of interest in ATT_5 is firm's skill share after the stop of importing ($Skill_{it+1}$), while in the ATT_6 it is the change in the skill share after the stop of importing ($Skill\_d_{it+1} = Skill_{it+1} - Skill_{it}$), where the t in equations (9) and (10) refers to the last year of importing.

3.3. Estimating the Effect of Starting to Import on the Start of Exporting

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 classification of Broad Economic Categories (BEC) was used for defining intermediate and capital goods. Estimation of the propensity scores for the last two hypotheses is again parallel to the model (3).

Estimating the propensity scores when analysing the effect of starting to import capital goods on the start of exporting is the following:

$$\begin{gathered} P(IMPstart\_c_{it} = 1,\ IMP\_c_{it+1} = 1) = \\ f(Size_{it-1}, Lvae_{it-1}, Lke_{it-1}, Rimsh_{it-1}, Foreign_{it-1}, FDI_{it-1}, Time_t, Ind_t) \end{gathered} \quad (11)$$

The treatment group consists of firms that start importing capital goods and continue importing these goods also one year after the start of importing ($IMPstart\_c_{it} = 1,\ IMP\_c_{it+1} = 1$). 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 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 89.1%). The control group consists of non-importing firms ($IMP_{it} = 0,\ IMP_{it+1} = 0$).

When analysing the effect of starting to import intermediate goods on the start of exporting, the procedure for estimating the propensity scores is as follows:

$$\begin{gathered} P(IMPstart\_i_{it} = 1,\ IMP\_i_{it+1} = 1) = \\ f(Size_{it-1}, Lvae_{it-1}, Lke_{it-1}, Rimsh_{it-1}, Foreign_{it-1}, FDI_{it-1}, Time_t, Ind_t) \end{gathered} \quad (12)$$

The treatment group consists of firms that start importing intermediate goods and continue importing these goods one year after the start of importing ($IMPstart\_i_{it} = 1, IMP\_i_{it+1} = 1$). Again, 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 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 73.1%). The control group consists of non-importing firms ($IMP_{it} = 0, IMP_{it+1} = 0$).

The two average treatment effects on the treated, ATT_7 and ATT_8, were calculated in the following way:

$$ATT_7 = E\left[EXPstart_{it+1}(1) - EXPstart_{it+1}(0) \mid P(IMPstart\_c_{it} = 1, IMP\_c_{it+1} = 1)\right] \quad (13)$$

$$ATT_8 = E\left[EXPstart_{it+1}(1) - EXPstart_{it+1}(0) \mid P(IMPstart\_i_{it} = 1, IMP\_i_{it+1} = 1)\right] \quad (14)$$

The outcome of interest in ATT_7 is the start of exporting one year after the start of importing capital goods ($EXPstart_{it+1}$), where t in equation (13) refers to the year when a firm started importing capital goods. Meanwhile, the outcome of interest in ATT_8 is the start of exporting one year after the start of importing intermediate goods ($EXPstart_{it+1}$), where t in equation (14) refers to the year when a firm started importing intermediate goods.

4. Results

The following tables present the results on the linkages between imports and firms' skill structure, and starting to import on the start of exporting. The base results in general comprise the period one year before or after the treatment, while the model extensions deal with two years before or after the treatment.

4.1. Results of the Basic Model

The analysis on the differences in the skill structures of importers and non-importers shows that importers have a higher share of skilled employees than non-importers (Table 2). Depending on the chosen method, the share of skilled employees in importing firms is on average higher for 0.25 to 0.33 percentage points (pp), compared to non-importing firms. In addition, results show that future importers have on average a 0.10 to 0.21 pp higher skill share already one year before starting to import (Table 3). In turn, one year after the start of importing, new importers sustain a skill share that is on average higher for 0.34 to 0.43 pp, compared to non-importing firms (Table 4).

Table 2

Results of Testing Hypothesis 1 (the direction of the relationship between importing and a better skill structure of firms)

Outcome of interest: skill share				
Matching method	**ATT**	**se**	**Treated**	**Control**
NN (1), caliper: 0.05	0.268***	0.030	35,910	33,289
NN (5), caliper: 0.05	0.252***	0.030	35,910	33,289
Radius, caliper: 0.05	0.332***	0.021	35,910	33,289
Kernel, bandwidth: 0.06	0.319***	0.021	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). *NN (1)* denotes one nearest neighbour matching with replacement; *NN (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS; authors' calculations.

Table 3

Results of Testing Hypothesis 2 (whether 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**
NN (1), caliper: 0.05	0.205***	0.068	1,604	28,549
NN (5), caliper: 0.05	0.145***	0.054	1,604	28,549
Radius, caliper: 0.05	0.104**	0.043	1,604	28,549
Kernel, bandwidth: 0.06	0.104**	0.043	1,604	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). *NN (1)* denotes one nearest neighbour matching with replacement; *NN (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS; authors' calculations.

Table 4

Results of Testing Hypothesis 3 (whether importing firms adjust their skill share after the start of importing)

Outcome of interest: skill share one year after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
NN (1), caliper: 0.05	0.433***	0.089	805	23,640
NN (5), caliper: 0.05	0.356***	0.063	805	23,640
Radius, caliper: 0.05	0.343***	0.053	805	23,640
Kernel, bandwidth: 0.06	0.340***	0.053	805	23,640
Outcome of interest: change in the skill share one year after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
NN (1), caliper: 0.05	0.090**	0.039	843	27,765
NN (5), caliper: 0.05	0.034	0.032	843	27,765
Radius, caliper: 0.05	0.030	0.027	843	27,765
Kernel, bandwidth: 0.06	0.030	0.027	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). *NN (1)* denotes one nearest neighbour matching with replacement; *NN (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS; authors' calculations.

Although the results show that firms with a better skill structure start importing and later maintain a higher skill share after the start of importing, the majority of results do not confirm that firms additionally improve their skill structure after the start of importing. Finally, firms seem to decrease their skill share and have a lower skill share after they stop importing, comparing to firms that continue importing (Table 5).

T a b l e 5

Results of Testing Hypothesis 4 (whether firms adjust their skill structure after they stop importing)

Outcome of interest: skill share after the stop of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
NN (1), caliper: 0.05	–0.217***	0.050	3,371	25,227
NN (5), caliper: 0.05	–0.280***	0.039	3,371	25,227
Radius, caliper: 0.05	–0.304***	0.030	3,371	25,227
Kernel, bandwidth: 0.06	–0.302***	0.030	3,371	25,227
Outcome of interest: change in the skill share after the stop of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
NN (1), caliper: 0.05	–0.067***	0.022	3,360	25,214
NN (5), caliper: 0.05	–0.053***	0.020	3,360	25,214
Radius, caliper: 0.05	–0.060***	0.015	3,360	25,214
Kernel, bandwidth: 0.06	–0.060***	0.016	3,360	25,214

Note: *ATT* – average treatment effect on the treated; *se* – bootstrapped standard errors (100 repetitions); *Treated* – firms in the treatment group (i.e. firms that have been importing in the current year but have stopped importing in the next years); *Control* – firms in the control group (i.e. importing firms). *NN (1)* denotes one nearest neighbour matching with replacement; *NN (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS; authors' calculations.

Since it would be interesting to further analyse when future importers start increasing their skill shares and whether firms improve the level of their skill shares after the start of importing, we study these points more thoroughly in the model extensions by taking into account also two periods before and after the start of importing.

When analysing the linkages between importing and firms' skill structure two years before the start of importing, the control variables for calculating the propensity scores were lagged for two periods and were parallel to the ones in the model (3). These results are presented in the next subsection.

Subsequent results show the impact of starting to import capital or intermediate goods on the start of exporting. The results suggest that 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, while the start of importing capital goods does not seem to have an immediate impact on the start of exporting (Table 6).

T a b l e 6

Results of Testing Hypotheses 5 and 6 (whether importing capital or intermediate goods increases the probability of starting to export)

Outcome of interest: start of exporting one year after the start of importing capital goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
NN (1), caliper: 0.05	0.000	0.006	819	24,038
NN (5), caliper: 0.05	0.001	0.005	819	24,038
Radius, caliper: 0.05	0.003	0.004	819	24,038
Kernel, bandwidth: 0.06	0.003	0.004	819	24,038
Outcome of interest: start of exporting one year after the start of importing intermediate goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
NN (1), caliper: 0.05	0.010*	0.006	905	24,038
NN (5), caliper: 0.05	0.006	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 capital or intermediate goods that import these goods also one year after the start of importing); *Control* – firms in the control group (i.e. non-importing firms). *NN (1)* denotes one nearest neighbour matching with replacement; *NN (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS; authors' calculations.

These results could also point to the different characteristics and usage of intermediate and capital goods in firm's production process, where 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 into account also the second period and makes additional robustness checks.

4.2. Results of the Model Extensions

In the extensions of the model, we focus on exploring more thoroughly those hypotheses which left open some questions in order to settle some minor qualms. First, we test whether skill shares of non-importing firms and importing starters are significantly different also two years before the start of importing. The results show that firms do not have a significantly different skill structure two years before the start of importing and therefore indicate that firms additionally increase their skill share only one year before the start of importing.

Next, the level of the skill share and its change two years after the start of importing are analysed. In line with the results from the basic model, the skill share of importing starters is higher also two years after the start of importing, while the results of the model extensions contribute to the previous results by indicating that firms additionally increase their skill share two years after the start of importing, compared to non-importing firms (Table 8).

T a b l e 7

Model Extensions of Testing Hypothesis 2 (whether 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**
NN (1), caliper: 0.05	–0.067	0.090	888	24,376
NN (5), caliper: 0.05	–0.018	0.070	888	24,376
Radius, caliper: 0.05	0.023	0.052	888	24,376
Kernel, bandwidth: 0.06	0.022	0.052	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). *NN (1)* denotes one nearest neighbour matching with replacement; *NN (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS; authors' calculations.

T a b l e 8

Model Extensions of Testing Hypothesis 3 (whether importing firms adjust their skill share after the start of importing)

Outcome of interest: skill share two years after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
NN (1), caliper: 0.05	0.281*	0.157	224	16,400
NN (5), caliper: 0.05	0.273**	0.125	224	16,400
Radius, caliper: 0.05	0.396***	0.108	224	16,400
Kernel, bandwidth: 0.06	0.393***	0.108	224	16,400
Outcome of interest: change in the skill share two years after the start of importing				
Matching method	**ATT**	**se**	**Treated**	**Control**
NN (1), caliper: 0.05	0.218**	0.096	252	23,545
NN (5), caliper: 0.05	0.143*	0.077	252	23,545
Radius, caliper: 0.05	0.140**	0.070	252	23,545
Kernel, bandwidth: 0.06	0.140**	0.070	252	23,545

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). *NN (1)* denotes one nearest neighbour matching with replacement; *NN (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS; authors' calculations.

Analysing the impact on starting to export in the second year after the start of importing capital or intermediate goods confirms that intermediate and capital goods have a different function in firms' production processes. Results indicate that the majority of firms start exporting in the succeeding year after the start of importing intermediate goods, which is reflected in the negative coefficients in the model extensions on the start of exporting two years after the start of importing intermediate goods (Table 9). On the other hand, importing capital goods seems to have a delayed effect on the start of exporting since firms start exporting only in the second year after the start of importing these goods (Table 9).

As aforementioned, these results point to a different role of intermediate and capital goods in the production process. Accordingly, while intermediate goods usually require additional manufacturing processing or are used for resale, importing capital goods takes 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.

T a b l e 9

Model Extensions of Testing Hypotheses 5 and 6 (whether importing capital or intermediate goods increases the probability of starting to export)

Outcome of interest: start of exporting two years after the start of importing capital goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
NN (1), caliper: 0.05	0.011	0.007	723	19,984
NN (5), caliper: 0.05	0.011*	0.006	723	19,984
Radius, caliper: 0.05	0.010**	0.005	723	19,984
Kernel, bandwidth: 0.06	0.010**	0.005	723	19,984
Outcome of interest: start of exporting two years after the start of importing intermediate goods				
Matching method	**ATT**	**se**	**Treated**	**Control**
NN (1), caliper: 0.05	–0.008*	0.004	795	19,984
NN (5), caliper: 0.05	–0.006*	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 capital or intermediate goods that import these goods also one year after the start of importing); *Control* – firms in the control group (i.e. non-importing firms). *NN (1)* denotes one nearest neighbour matching with replacement; *NN (5)* denotes five nearest neighbours matching with replacement. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: SORS; authors' calculations.

Finally, to enhance robustness of the results, we also control for the potential breaks in the series. Although we control for the year specific effects when calculating the matching functions, we believe it is relevant to anew estimations for the selected sub-periods as several events occurred during the observation period which could influence the results. These potential policy events and crises comprise the Russian crisis in 1998, Slovenia's accession to the EU in 2004, introduction of the euro in 2007, and the start of financial crisis in 2008. Since the effects of the Russian crisis on Slovenia were small due to relatively small volume of trading with Russia during that period (i.e. according to the IMAD Spring report from 1999, the share of exports to the former Soviet Union countries has been around 5% in the years before the Russian crisis), this event was excluded. In addition, owing to insufficient time frame, it was also not possible

to control for introduction of the euro or for the recent financial crisis. Therefore, we replicate the basic analysis for the two sub-periods before and after Slovenia's accession to the EU. The results presented in the Supplementary tables show that the estimated effects in both sub-periods are on average comparable to the previous results. Contrasting the ATTs of the two sub-periods shows that the differences between the skill shares of importing and non-importing firms become on average more pronounced and in favour of the importing firms after Slovenia entered the EU. On the other hand, before Slovenia's accession to the EU, importing intermediate goods continues to show a positive impact on the start of exporting in the succeeding year after the start of importing these goods, whereas this effect becomes insignificant after entering the EU. Since the scope of our analysis is limited in providing a reliable explanation for the latter conclusion, it would be interesting to analyse this result in further detail in future studies. Supplementary tables are available in the Appendix.

Additional robustness checks that include alterations of matching methods (e.g. changing the calipers and the bandwidths) on average confirm previous results and are available in the Appendix.

Conclusions

The aim of this study was to test: (i) whether firms with a better skill structure start importing; (ii) whether firms adjust their skill structure after the start or the stop of importing; and (iii) what is the effect of the start of importing intermediate or capital goods on the start of exporting. These linkages between importing and the skill structure of firms, and importing and exporting were studied using the employer-employee panel dataset for 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 shows that firms with a better skill structure start importing and that they also sustain a higher skill share than the non-importing firms in the first two years 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. On the other hand, firms' skill structure deteriorates after firms stop importing. The results also add new insights regarding the impact of starting to import intermediate or capital goods on the start of exporting. Importing intermediate goods has a positive impact on the start of exporting already in the first year after the start of importing these goods. 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 to a different function of the capital and intermediate goods in firms' production processes. While intermediate goods usually refer to raw materials and thus have relatively short expiration date, require further processing, or are used for resale, capital goods usually refer to firms' fixed assets, are employed in firms' production process, and used to increase firms' productive capacities. In order to limit the costs of stockholding, firms make an effort to store intermediate goods economically and use them as soon as possible after purchasing, while on the other hand, investing in capital goods takes longer to be incorporated in the production process and therefore to show effect.

Besides researchers in this field, governments, firms, workers, jobseekers, and students will also benefit from this study. Since firms with a better skill structure start importing, it is important for the governments to focus on establishing an environment that encourages international cooperation, provide solid foundations for education system that would equip the students with adequate skills, and stimulate firms' skill upgrading in order to further increase the productivity and competitiveness of domestic firms. Moreover, firms should have greater incentives for hiring skilled individuals since higher employment of skilled employees seems to be important for the start of importing, which consequently has a positive impact on the start of exporting. Students, workers, and individuals in the job market should in turn have higher incentives for attaining college degrees and acquiring additional on-the-job trainings in order to increase their employability. In the future studies, it would be interesting to analyse also the causality between exporting and the skill structure of firms, and whether there also exists a reverse causality between exporting and importing.

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