International Fragmentation of Production and Firm productivity: Evidence from Slovenian Manufacturing Firms

Abstract

An increasing number of firms outsource peripheral functions in order to stay focused on their core capabilities. This paper contributes to a limited body of empirical research on the relationship between intermediate inputs offshoring and firm productivity. I use a unique firm-level panel data set of Slovenian manufacturing firms operating in the period 1994–2005 with a detailed accounting information, foreign trade data, and innovation activity. Using propensity score matching techniques to analyze whether firms that start importing intermediate inputs become more productive, I find that new importers become more productive once they start sourcing their inputs abroad. The productivity gap between importers and their domestically-oriented counterparts increases further over time. In addition, I find support for focus effect hypothesis, according to which firms can increase focus on their core competencies and hence improve their productivity by delegating some of the input production to external contractors/subsidiaries. The results suggest a causal relationship from international sourcing of inputs to increased product and process innovation.

Keywords: intermediate inputs outsourcing, firm productivity, R&D, core competence.

1. Introduction

For centuries, international trade mostly encompassed an exchange of finished goods. Nowadays, it increasingly entails segments of value being added in many different locations, giving rise to a growing volume of trade in intermediate goods. Until recently, trade theorists have not paid much attention to trade in intermediate goods. Theoretical and empirical work treated trade as trade in final goods and production process was at best relocated internationally, but rarely broken up to smaller fragments. With the increasing international division of labour through disintegration of the production process, increasing strongly in the 1980s and 1990s in manufacturing and from the mid 1990s in services, trade in intermediate goods called for more attention (Jones and Kierzkowski (1990, 2001), Arndt (2001), Deardorff (2001)). It was recognized that trade in intermediate inputs is closely related to vertical integration, a process of splitting up the value chain and reorganizing it globally according to country cost differences.

The main aim of the paper is to study the effects of vertical fragmentation on firm productivity. The extent of vertical fragmentation will be measured by imports of intermediate goods, so the study will examine whether such imports, whether they are the result of offshore outsourcing or captive offshoring arrangements, improve firm performance. In tight relation to the primary aim, I attempt to provide evidence for the focusing on core capabilities as one of the transmission channels through which imports boost firm productivity. Namely, the main hypothesis of the article states that firms can exploit international outsourcing not only as an efficient means to cutting production costs and enhancing the quality of the inputs, but can use it as a leverage to direct scarce resources on their core business activities. By outsourcing standardized, peripheral components and processes, firms can better concentrate on activities such as research, innovation, sales and marketing, and increase their energies on matters that directly affect competitive positioning. The motivation for the research comes from recent developments in global trade and investment patterns and from several empirical studies indicating that international fragmentation represents the main driver of industrial restructuring and productivity growth.

On the theoretical ground, I provide a theoretical model of the decision of firms about the organization of their production process in a global environment and in a dynamic industry setting. The framework is built upon the theoretical models of Antras (2005a) and Antras and Helpman (2004) but puts firms in a dynamic environment of constant productivity race. I present a partial equilibrium model in which heterogeneous monopolistically competitive firms choose between outsourcing and vertically integrating peripheral functions, and between locating them at home and abroad. Outsourcing is governed by incomplete contracts while vertically integrated firms face relatively higher cost of governance. In addition, firms are allowed to make productivity improving investments in their core capabilities. The model rationalizes the relation between international sourcing of intermediate inputs and focusing on

the core business, as it shows that firms can increase the level of investments and boost productivity growth by fragmenting the production process across borders.

Theoretical predictions derived from the model will be tested on a panel of Slovenian manufacturing firm-level data for the 1994-2005. Slovenia may be considered an interesting case study, given that Hummels et al. (2001) argue that a small open economy is most likely to rely heavily on fragmentation of its production processes. Most of the studies in the field of vertical fragmentation examined the effects of trade in fragmented products on countries' patterns of specialization and resulting implications for factor prices. In this study, I am not concerned with the international trade dimension to outsourcing. Rather, I investigate empirically a firm's decision to offshore part of its production chain and the subsequent effect of such international production sharing on productivity and strategic reorientation of that establishment. Therefore, the aim of the empirical part is to test for productivity effects of international sourcing of intermediate inputs, as well as to identify and characterise that part of the focus on core capabilities effect that conveys itself in an increased innovative endeavours of newly fragmented firms.

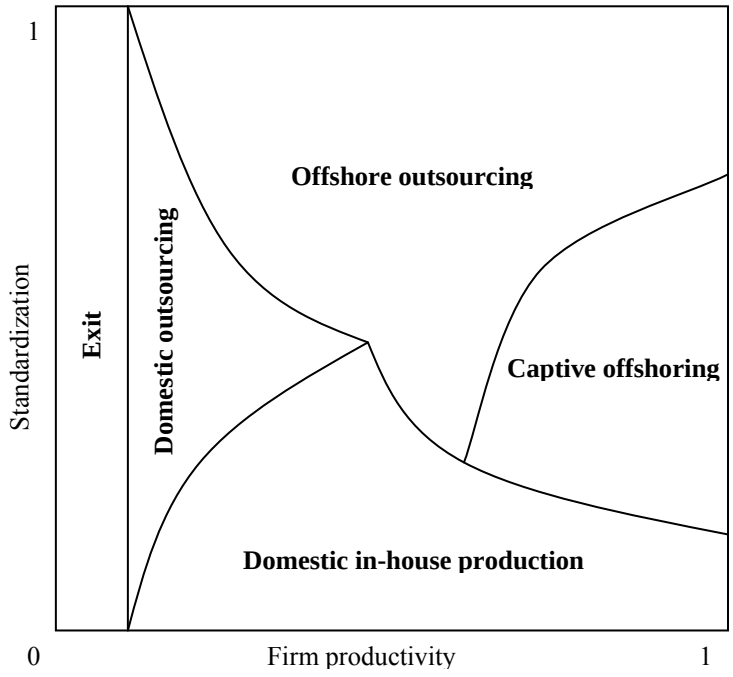
2. Theoretical model

In this chapter, I briefly present a simple extension of Antras (2005a) and Antras and Helpman (2004) models of international sourcing that proposes a mechanism in which internationally acquired intermediate inputs allow for greater specialization in resource use, leading to higher firm productivity.[1] The basic framework is built upon the theoretical models of Antras (2005) and Antras and Helpman (2004) but puts firms in a dynamic environment of constant productivity race. The world consists of two countries, high-wage North and low-wage South. There is a monopolistically competitive industry with horizontally differentiated consumer goods and labour is the only production factor. Production of one unit of each variety requires two types of inputs: high-tech and low-tech components or services. High-tech inputs can only be produced in the North, whereas low-tech inputs can be produced in both countries. As in Melitz (2003), firms in my model differ in productivity levels, drawn upon entry. Draws are random and only distribution of productivity levels is known to firms. Firms that enter the industry observe their productivities and decide whether to exit or start the business. Each firm that stays can choose between outsourcing and vertical integration of low-tech intermediate goods production and between home and low-wage location of the input production. Outsourcing is governed by incomplete contracts while vertically integrated firms face relatively higher cost of governance. In addition, firms face a trade-off between lower variable cost of production in the low-wage foreign country and lower fixed organizational costs in the home country.

[1] Due to lack of space and because the aim of this paper is to present empirical results, I invite the reader to refer to Burger (2007) for a more detailed exposition of the theoretical model.

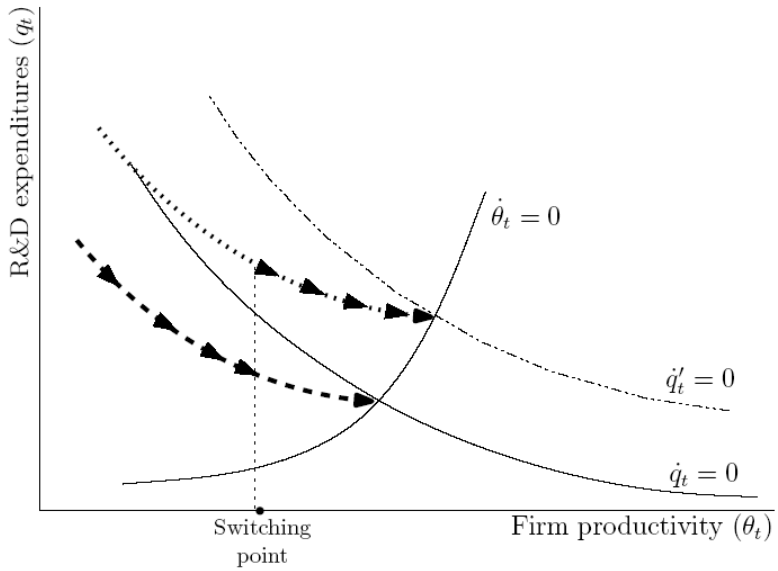
Figure 2-1 displays model's prediction about the choice of organization of value chain as a function of firm's productivity and maturity of its industry. The pattern seems to fit well on what we actually observe in reality. When an industry is still in its early stages, firms internalize their production completely, the fact that we observe for example in biotechnology and hi-tech electronics. After initial stage, a product becomes a little more standardized so that the most productive firms can produce it in a subsidiary in a low-wage country while the least productive firms tend to outsource its production from an independent supplier. This pattern can be seen in pharmaceutical industry where the most successful players perform the production of medicines in their subsidiaries abroad. The most diverse production types emerge later in the product cycle when headquarter services are relatively still important. Examples include automobile industry, microprocessor industry, and chemicals industry. As the production becomes even more manufacturing intensive, vertical integration in the North becomes unattractive because high variable costs outweigh the benefits from incomplete contracting. This is the stage where for instance consumer electronics is right now: assembly phase is most often displaced either to an independent manufacturer in the North or South, or still produced in a foreign subsidiaries in low-wage countries. The last stage of product life-cycle is characterized by manufacturing intensive production so that only arms-length relationships are viable. If we look at the textile and apparel industry, or at the present stage of low communication costs even services like accounting, call-centres, document management, data processing, and different customer services we can observe that these belong to the highly standardized set of industries in which offshoring is prevalent international mode of production.

Figure 2-1: Optimal organization of intermediate inputs production according to firm productivity and industry maturity.



In addition to the organizational mode, each firm can choose the optimum level of r&d expenditure that yields productivity improvements in the following period. The stability and feasibility of industry equilibrium is justified with Eriscon and Pakes (1996) and Weintraub, Benkard, and Roy (2005) models of firm and industry dynamics. The results of a dynamic optimization in a partial equilibrium are not sensitive to the form of R&D transition equation and are as follows. After a firm decides to reorganize its specialized input production either in terms of outsourcing arrangement or vertically integrated foreign subsidiary, there is an upsurge of its investment going to the core business functions (see Figure 2-2). Higher R&D investment will on average foster productivity growth, bringing it to higher levels in the following periods.

Figure 2-2: Optimal path of firm's R&D expenditures when a change from domestic to foreign sourcing of intermediate inputs occurs



Note: Switching point denotes the productivity level that allows a firm to profitably switch from domestic to foreign sourcing of intermediate inputs.

Figure 2-2 shows that internationalization is a sequential process as proposed in the IB literature by evolutionary models. Firms need some time to gain organizational knowledge and increase production productivity before they can switch to a more demanding organization of their production process. Next, there is an upward shift in the level of investment in innovation or channelling more resources to core functions. At the same time, a boost in productivity occurs because higher investment levels yield higher productivity gains. However, productivity growth eventually eases, which is consistent with the empirical results on firm-level productivity gains from FDI. By delegating component production or carrying out peripheral processes to external partners or subsidiaries, firms are able to channel extra resources to the most essential business functions, which gives rise to productivity improvements in the following periods. Third, my theoretical model also rationalizes the phenomena of born-globals because the most productive firms in the industry immediately internationalize part of their production. It also explains why only the most productive firms

are able to self-select into global production chains, the fact corroborated numerous times in the empirical literature.

3. Review of empirical evidence

Because firms are heterogeneous in their size and performance measures even within narrowly defined industries, aggregation tends to conceal the mechanism and pattern of fragmentation-productivity link. For example, it could be that productivity growth at the sectoral level is due to relocation of resources towards more productive firms and closure of firms at the lower tail of productivity distribution, but has nothing to do with productivity growth at the firm-level. Both mechanisms – industry-level structural shifts and micro level increases in productivity – are beneficial from a social point of view. Nevertheless, the former is a one-off, static gain from outsourcing, whereas the latter is a long-run effect, the thing that should interest forward-looking firms, employees, and policymakers in the era of global competition. Due to only recent emergence of available data that combine accounting information with the data on international trade flows at the firm-level, the empirical evidence to date is relatively scarce, yet no less revealing.

Some of the earliest studies to estimate the effects of production sharing on plant productivity using micro-data include Görzig and Stephan (2002) and Girma and Görg (2004). Neither of them, however, distinguishes between domestic and international sourcing. Görg and Hanley (2003) use plant level data for the electronics industry in Ireland to examine the effect of international outsourcing of intermediate inputs on labour productivity. In the pooled sample of firms, the authors find no significant impact of offshore outsourcing in either materials or services on productivity levels or growth. When they split the sample into upstream and downstream sector (firms closer to customer), the firms in the latter appear to increase the level and growth of labour productivity as they increase the intensity of international service outsourcing, but not in case of material outsourcing.

Using the same data set, Görg and Hanley (2005) study the impact of international outsourcing on firm productivity. In this study, however, they focus on total factor productivity as a measure of productivity, split the observations in export-intensive and non-intensive plants, and control for unobserved firm-specific and time-invariant effects by employing FE and IVFE estimations. In contrast to results in Görg and Hanley (2003a), they do find a significant positive correlation between international outsourcing on TFP in the whole sample of firms. When making a distinction between material and services outsourcing, only the former seem to affect the productivity levels.

Görg, Hanley and Strobl (2004) conduct a study very similar to Görg and Hanley (2003a) but on a longer time period (1990-1998) and the whole manufacturing sector. Apart from identifying material inputs and services outsourcing separately, they are able to distinguish

between exporters and non-exporters and between domestic and foreign-owned plants. GMM estimation according to Arellano and Bond (1991) provided evidence that international outsourcing of services does not appear to have any significant impact on productivity level regardless of model specification. On the other hand, outsourcing of materials has a positive and statistically significant coefficient in the pooled sample as well as in the subsamples of domestic and foreign-owned firms.

Criscuolo and Leaver (2005) focus on international outsourcing of services and study its impact on firm productivity in manufacturing and services sectors. Descriptive evidence shows that offshorers are on average larger, more productive, have higher intermediates-to-labour and capital-to-labour ratios, pay higher wages, and have more ICT capital. In line with theoretical predictions of recent trade models (Helpman, Melitz and Yeaple 2004, Antras and Helpman 2004), multinational firms are the most (labour) productive firms, followed by service exporters, service importers and non-importers. Similar rankings hold for output, employment, intermediates and capital. Econometric evidence suggests that, controlling for other dimensions of global engagement, industrial affiliation, regional location, capital intensity and age, a 10 percentage point increase in offshoring intensity is associated with a 0.37% increase in total factor productivity for the whole sample of firms.

Analyzing plant-level data for Indonesian manufacturing firms in the period 1988-1996, Blalock and Veloso (2007) present evidence that firms in industries supplying increasingly import-intensive sectors exhibit greater productivity growth than other firms. Unlike Amiti and Konings (2005), they ignore the direct benefits to importing firms and ignore the effects of trade liberalization. The results suggest that factory output increases approximately by 0.12% as the proportion of downstream materials imported rises by 1%. Using Indonesian manufacturing data from 1991-2001, Amiti and Konings (2005) study the effect of trade liberalization on plant productivity by disentangling the gains to those arising from lower output tariffs and those fostered by lower tariffs on intermediate inputs. The results show that a reduction of input tariffs has much larger effects on productivity growth than the decline of output tariffs. The result particularly relevant for my study is the finding that the effect of reducing input tariffs is much higher for importers than for non-importing firms. In addition, import status and the share of imported inputs in total intermediate inputs both exhibit positive association with firm productivity.

A study from Van Biesebroeck (2007) examines somewhat different issue than the effect of importing material inputs on firm productivity. In evaluating five different productivity estimation techniques, however, a section is devoted to investigating the effect of five channels as an engine of productivity growth: exporting output, importing materials, acquiring external technology, frequent capital investment, and high levels of human capital. Regressing average productivity growth over the entire period for each firm on these five variables, time, industry, and location dummies generates somewhat mixed results for the role of importing inputs.

Employing a data set of 9.500 Brazilian manufacturers for the years 1986-1998, Muendler (2004) separates and analyzes three different mechanisms behind trade-induced productivity change: i)competitive push, which brings pressures to improve existing business processes in order to cope with the competitive shifts from lower inward trade barriers; ii) foreign input push, which allows firms to adopt new production methods by importing high-quality equipment and intermediate inputs; iii) competitive elimination, by which increased foreign competition induces exit of the least efficient firms which leads to higher average productivity. Based on three alternative methods for productivity level calculation, the evidence points in the direction of strong competitive push effects as a source of firm-level productivity change, while the effect from intermediate goods imports are found to be relatively unimportant.

MacGarvie (2006) explores in detail one of the channels of international-trade-induced productivity change at the firm level. The focus of the paper is on the type of technological diffusion that can be measured with patent citations, which is only a subset of R&D spillovers. The findings suggest that after controlling for factors that affect citation behaviour, the inventions of importers are more likely to be influenced by foreign patents than those of similar non-importers. Point estimates imply that a 10% increase in imports is associated with a 0.6% increase in backward citations per patent.

Using firm- and plant-level U.S. manufacturing data, Kurz (2006) shows that outsourcing plants and firms have significantly higher employment, total sales, value added, capital, investment and skilled-worker fractions, even after controlling for various plant and firm characteristics. Outsourcers are on average more productive (in terms of total factor productivity) as the probit results confirm Antras and Helpman (2004) theory that only more productive firms are able to cover the fixed costs of choosing the outsourcing organizational form. An increase of productivity of one standard deviation raises probability of engaging in outsourcing for 1.61 to 2 percentage points for plants and 1.7 to 3.2 percentage points for firms. Lastly, firm-level productivity growth is significantly higher for outsourcers (from 0.53 to 1.5 percent per year), whereas this result does not hold at the plant level.

Halpern et al. (2006) examine the effects of imports on productivity at the firm level using a panel of Hungarian exporters[2] in the period 1992-2003. They build a simple structural model of firms using domestic and foreign inputs in the production process and show that imported intermediates increase firm output through two channels: i) a love-of-variety effect due to imperfect substitution (as in Krugman, 1979) and ii) a quality effect according to which foreign goods are of superior quality than their domestic counterparts (as in Grossman and Helpman, 1991). The results corroborate positive effect of imports on productivity. An increase of imported intermediates from 0 to 100 percent of total intermediate inputs increases

[2] The sample is further biased by the fact that only large exporters (with exports larger than 500.000 US dollars in any of the years) were taken into account.

firm productivity by an average of 14 percent. About two thirds of this effect comes from the imperfect substitution of domestic and foreign inputs, while the remaining third emanates from higher quality of foreign goods.

Although much of the academic literature on international fragmentation of production is theoretical, looks at the relationship between outsourcing and wages, or measures the importance of outsourcing in the global economy, there is a limited, yet emerging body of empirical work on the relationship between international production sharing and productivity. Review of existing empirical literature at the industry and plant/firm-level has shown that indeed there is a strong evidence for the positive relationship between productivity and offshoring but none of the studies investigates the causality issue or delves deeper into the workings of fragmentation-to-productivity transmission mechanism. Present paper aims to fill this gap and is to my knowledge the first study to apply propensity score matching on firm-level import data as well as the first study to use a longitudinal Community Innovation Survey data linked with firm-level accounting and international trade data.

4. Methodology

4.1. Research hypotheses

The following nine hypotheses can be derived from my theoretical model and will be tested in the empirical part:

H1: Firms that import intermediate inputs are on average better than non-importing firms in terms of productivity, revenue, size, capital intensity and survival probability.

H2: Productivity is positively correlated with the intensity of foreign sourcing of intermediate inputs.

The next three hypotheses describe the theoretical predictions about the ordering of firms into input sourcing regimes according to their productivity levels. The theory predicts the following assortment of organization modes in an increasing level of productivity: domestic sourcing, offshore outsourcing and captive offshoring. Hypotheses 3-6 systematically test each of the pairwise sequences.

H3: importers of intermediate inputs stochastically dominate non-importers in terms of the productivity distribution.

H4: Offshore outsourcing firms (importers of intermediate inputs without foreign direct investments abroad) stochastically dominate non-importers in terms of the productivity distribution.

H5: Firms performing captive offshoring (importers of intermediate inputs with foreign direct investments abroad) stochastically dominate offshore outsourcing firms in terms of the productivity distribution.

The next two hypotheses test the phenomenon of self-selection into cross-border vertical fragmentation. The first hypothesis tests the existence of the self-selection of more efficient firms into imports, while the second hypothesis asserts that prospective investors abroad are more productive than those that will choose to remain importers of intermediate inputs.

H6: Self-selection into foreign sourcing: more productive firms choose to purchase some of its intermediate inputs abroad.

H7: Self-selection into captive offshoring: better importing firms choose to engage in outward foreign direct investment.

The last two hypotheses are the key hypotheses of my paper and test if the decision to start importing intermediate inputs leads to subsequent productivity increase, and, most importantly, whether such growth encompasses the enhancement of product and process innovation.

H8: Foreign sourcing of intermediate inputs increases productivity level and productivity growth.

H9: Foreign sourcing of intermediate inputs enables firms to focus on their core competencies, which leads to higher process and product innovation.

This section provided an explicit list of hypotheses to be tested in the empirical part, while the following sections in turn present empirical model and econometric techniques that will enable me to perform these tests.

4.2. The choice of econometric methods

To be able to explore the effect of foreign sourcing of intermediate inputs on productivity, I need a measure of it in the first place. Besides using value added per employee, I will employ total factor productivity derived from production function estimation. However, any estimation approach dealing with production function estimation has to contend with some crucial endogeneity issues. First, part of the productivity shock (ω_{it}) is unobservable to the econometrician but known to a firm when choosing the amount of inputs. The identification problem arises because ω_{it} becomes integral part of the error term, while at the same time inputs are determined on the basis of the productivity shock. This implies that the regressors are correlated with the error term. Such violation of orthogonality condition results in

inconsistent and biased parameter estimates. The bias is more pronounced the more responsive the input is to a current productivity shock (see Marschak and Andrews 1944).

Next, there is a problem of self-selection due to endogenous exit of firms. A firm will continue operations, if and only if current realization of productivity shock is no smaller than the threshold productivity value that induces exit. If the profit function is increasing in capital stock (k) and import status (d), the value function must be increasing and the threshold productivity value decreasing in k and d. Firms with larger capital stocks and positive imports of intermediate inputs can expect larger future returns for any given level of current productivity and will therefore continue in operation at lower realizations of productivity shocks. The self-selection process generated by exit behaviour will hence lead to attrition bias: negative bias on capital and import status coefficients. This is because firms that exit (and thus remain omitted from the sample) are on average smaller in terms of capital and likelier to be non-importers.

The third estimation problem, endogeneity of import status, will be corrected by incorporating past import status as an additional state variable. If importing in fact improves productivity and is correlated with inputs it belongs in the first stage production function. Otherwise, the estimated coefficients would suffer from omitted variables bias. Material demand function will therefore be augmented with current import status as an additional argument. There are two justifications for this. First, if there exist a sunk start-up cost of importing materials, then the current import choice is not freely variable and hence should be included in the material demand function. Second, if plants using imported materials face different material input market than those using only domestic materials, the material's demand function must be not only time-dependent but also import-status dependent (Kasahara and Rodrigue (2008)).

In order to manage the issues of simultaneity, self-selection, and endogeneity of import decision, I apply Kasahara and Rodrigue (2008) (KR hereafter) estimation framework that proposes a semi-parametric estimation of production function, building on Olley and Pakes (1996) and Levinsohn and Petrin (2003). In addition to current capital and productivity shock, import status (d_{it}) serves as an additional state variable. Furthermore, it is assumed that import status has a positive dynamic effect on productivity as predicted by my theoretical model.

Once the parameters of production function are estimated, I construct total factor productivity measures in the traditional way: $tfp_{it} = y_{it} - \hat{\beta}_L l_{it} - \hat{\beta}_K k_{it}$. This productivity measure is expressed in logarithmic terms, which means that time differentiation directly yields the growth rate of productivity, the fact I will use later on.[3] Estimated TFP will then be use to test my hypothesis whether the use of imported intermediate inputs leads to higher productivity

[3] Taking the exponential over TFP would allow me to present the productivity in monetary terms, but I will skip this exercise.

growth. For that reason I will use propensity score matching, a method used extensively in labour economics to evaluate the impact of different social programmes.[4]

The first step in the propensity score matching method is to estimate a probability to start importing. This will be carried out by running a probit model with a dependent variable *D* equal to 1 if a firm started importing and zero otherwise on a set of lagged observables:

$$\Pr(D_{it}=1)=\Phi\left[h(\omega_{it-1},rk_{it-1},rl_{it-1},ex_{it-1},a_{it},iFDI_{t-1},oFDI_{t-1})\right]. \quad (14)$$

$\Phi(\cdot)$ is the normal cumulative distribution function, ω_{it-1}, k_{it-1}, and ex_{it-1} are lagged productivity measure, relative capital, relative labour, and export status, and a_{it} represents firm *i*'s age at time *t*. Because firm age is known only for firms that entered the industry after 1994, I also include a left censoring dummy for the age as a regressor. This variable has value 1 if a firm was operational already in 1994 and is hence most probably older than (*t*-1994) years. I use a third order polynomial in the elements of *h* in order to improve the fit of the model. As a dependent variable I use an indicator for the *start* of importing intermediate inputs instead of a dummy that signifies the importing status. In the latter case, I would have to include a lagged import status among the regressors and would thus in fact estimate the probability to continue importing instead of the probability to start importing. Firms that import throughout the entire sample period are excluded from the analysis as they do not provide the necessary dynamics and are neither useful for the following matching stages. Two right-hand side variables, ω and k are the firm's state variables from the theoretical part of TFP estimation procedure. Productivity is also the most important decision variable in the theoretical model. I also include export status since one can expect that having established business relationship with export markets helps firms in their pursuit of internationalization of production chain. Age variable is used to proxy for unobserved ability, managerial experience, organizational knowledge, and survival probability.[5] I furthermore include a set of year and industry dummy variables to control for the common aggregate shocks and specific industry characteristics. I will denote the predicted probability to start importing, i.e. the propensity score, with P_{it}.

I match denovo importers with appropriate control firms within the same 2-digit NACE industries and in within the same year. Consequently, I create a control group of similar firms from the same sector that are exposed to common temporal aggregate supply and demand shocks. The group of treated firms to be matched consists of only those firms that start importing intermediate inputs somewhere during the sample period and remain importers ever since, which means that I exclude permanent importers. Potential control group consists only of nonimporting firms so that the possibility of a denovo importer being matched with a forthcoming importer (i.e. an importer-to-become but not yet importing at the time of

[4] For matching techniques in general see Heckman et al. 1997 and 1998; for propensity score matching in particular refer to Rosenbaum and Rubin 1983 and 1984.

[5] It is a well established stylized fact that younger firms have a higher probability of exiting (Klette and Kortum 2004, pp. 990).

matching) is excluded. This way I assure that subsequent import status changes in the matched control group/firm does not enter the estimation of the average effect. Matching is performed in the year in which a firm starts importing (τ_0) and the same control group/firm is used for comparison in all the other periods used (τ_{-2}, τ_{-1}, τ_1, τ_2, τ_3). To provide more confidence with the results, average treatment effect on the treated is estimated using several matching methods. Among traditional matching estimators, I use nearest neighbour matching within caliper and K-nearest neighbour matching within caliper. In addition, I also perform a more complex mahalanobis matching estimator. In order to make sure that matches are as similar in productivity levels as possible, mahalanobis matching allows me to fit the treated units with controls not only on propensity score but also on productivity level at the time of import decision (a year before import start).

Relatively long time dimension of my panel data enables me to track the effects of importing on firm performance several years after the foreign sourcing of intermediate inputs has begun. In addition, the post-programme effects will be compared to the differences between prospective new importers and control firms in the years prior to import start by observing the average diff-in-diffs as defined by equation (11) from τ_{-2} to τ_3. This will allow me to check the validity of matching procedure[6], structural shift between the pre- and post-transformation period, the size of the effect and its temporal persistence. The average treatment effect for a period *s* will be calculated according to the following expression:

$$\hat{\alpha}_s^{DID} = \sum_{i \in M} \left(\left(Y_{i\tau_s} - Y_{i\tau_{s-1}} \right) - \sum_{j \in C} W_{ij} \left(Y_{j\tau_s} - Y_{j\tau_{s-1}} \right) \right) w_i \text{ for } s = -2, -1, 0, 1, 2, 3. \quad (12)$$

In case of *Y* denoting TFP, the value of $\hat{\alpha}_s$ will tell me by how many percentage points on average the growth rate of new importers *s* years after (prior to) the import initiation exceeded the growth rate of corresponding control non-importing firms from the same industry and in the same year. In other words, the value of the effect will represent the extra productivity growth that can be attributed to firm's decision to procure intermediate inputs abroad.

In order to explore a different yet tightly related aspect of productivity effects of importing, I will also observe how the decision of starting to import impacts the productivity trajectory. Therefore, I estimate the average cumulative treatment effect or the productivity gain gathered over *S* years after the decision to start sourcing inputs abroad. The estimator $\hat{\alpha}_S^{CUM}$ is given by

$$\hat{\alpha}_S^{CUM} = \sum_{i \in M} \left(\left(Y_{i\tau_S} - Y_{i\tau_{-1}} \right) - \sum_{j \in C} W_{ij} \left(Y_{j\tau_S} - Y_{j\tau_{-1}} \right) \right) w_i \text{ for } S = 0, 1, 2, 3. \quad (13)$$

The above estimate will provide me with an average productivity gain since the period before the import initiation (*S*=-1). In other words, the estimate in (13) gives me the productivity

[6] If the matching was correct, future importers would have to exhibit similar productivity growth rates as the matched control firms in the years just before international fragmentation of production.

premium new importers have gathered over time. My theoretical model predicts that the productivity growth rate will increase in the periods after the switch to foreign input sourcing, but this extra growth will eventually wane. The model therefore predicts significantly higher growth rates of productivity only in the first years after the decision to start importing intermediate inputs whereas the level of productivity in new importers shifts above the level of non-importers and remains significantly higher even in the periods in which growth rates return to normal. In reality, long-term above average growth rates are uncommon, yet firms become and remain more productive than domestically oriented competitors with respect to their pre-internationalization productivity level, the pattern observed in several studies on the effect of starting to export (e.g. De Loecker 2007, Damijan and Kostevc 2006). To test whether new importers become more productive despite not growing significantly faster each year after the switch to foreign sourcing, I therefore estimate cumulative effects in addition to the effect on the year-to-year productivity growth.

Once the matching is completed and difference-in-differences values assigned to all the matched denovo importers for the periods $\tau_{-1} - \tau_3$, I estimate the following equation proposed by Damijan and Kostevc (2006):

$$\Delta_{it} = \beta_0 + \beta_1 \Delta_{it-1} + \beta_2 r\kappa_{it-1} + \sum_{\tau=\tau_0}^{\tau_3} \beta_3 D_\tau + \sum \beta_4 X_{it} + \beta_5 \theta_t + \varepsilon_{it}\,, \qquad (16)$$

where Δ represents the productivity growth differential between denovo importer and its control group and is defined as the difference between the productivity growth rate of an importer $\left(\omega_{it}^{M} - \omega_{it-1}^{M}\right)$ and a nonimporting control firm/group $\left(\omega_{it}^{C} - \omega_{it-1}^{C}\right)$. Letter *r* in front of a variable denotes relative firm-to-sector figures derived by expressing the nominal values of firms characteristics relative to the corresponding 3-digit NACE industry averages. Explanatory variables include the lagged productivity (Δ_{t-1}) and lagged relative capital intensity ($r\kappa_{t-1}$) in terms of the difference between the treatment and control group. My interest lies in the values of coefficients $ß_3$ which will reveal whether there are any productivity gains attributable to import status. Dummy variable D_{τ_s} is equals 1 if firm *i* started importing $s \in [0,3]$ years ago and is set to zero otherwise. Positive and statistically significant values of the coefficients $ß_3$ will confirm that international fragmentation of production chain brought about notably higher productivity growth rates of importers compared to the pre-outsourcing periods. The vector of variables in *X* includes the share of imported inputs in the total material costs (*m*), an indicator variable for firms with outward foreign direct investment (*oFDI*), and the foreign ownership dummy (iFDI). θ_t is time dummy that captures the temporal shocks common to all firms.

4.3. Data description

The data set is created by linking four different sources of firm-level data: financial statements collected by Agency of the Republic of Slovenia for Public Legal Records and Related Services (AJPES), information on FDI status provided by Bank of Slovenia, Community innovation surveys prepared by Slovenian Statistical Office, and trade data from Slovenian Customs Office. Financial statements include data from balance sheet and income statement for every firm in Slovenia and are collected annually, regardless of the establishment size and ownership. Reporting is obligatory for all the firms, so the resulting unbalanced panel includes information on exit and entry. Among other, this data source provides information on gross revenue, the number of workers employed, stock of fixed assets, value of exports, material costs, and labour costs. The period covered is from 1994 to 2005. FDI related information is provided by Bank of Slovenia through its annual mandatory survey of firms with foreign ownership and/or foreign direct investments abroad. Unfortunately, from otherwise rich survey data, only the indicators of inward and outward foreign direct investment were made available to me by Bank of Slovenia. The time span of this data source is 1994-2003 period. Community Innovation Survey (CIS) was executed for the first time in 1996 as a pilot study. By now, four CIS were implemented by Slovenian Statistical Office biannually from 1998 to 2004 (CIS1, CIS2, CIS3, CIS4). In contrast to other three sources, this data source is a survey that covers a pre-selected fraction of manufacturing and non-manufacturing firms with at least 10 employees, regardless of the actual R&D activity. The latter fact is important, because the surveys allow me to create a reasonably random sample of firms with enough variability in innovation activity and determinants of innovation. Trade data comes from Customs Office of the Republic of Slovenia and includes information on every import and export shipment of goods to and from Slovenia in the period 1994-2003. Among other, the information include the id of the reporting firm, 6-digit TARIC code of the goods being shipped, the value in Slovene tolars and US dollars, country of origin and country of destination, physical quantity, and date of the dispatch. All value data are in Slovene tolars[7] and are deflated with corresponding 2-digit NACE industry producer price indices, while the capital stock was deflated by consumer price index.

5. Results

In this section I perform empirical analysis in which I test the hypotheses that follow from my theoretical model. The rest of this chapter is organized as follows. The first subsection provides a basic description of the data set and collects several stylized facts about importers in Slovenian manufacturing sector. The focus is on presenting the pertinent characteristics of importers in relation to non-importers, examining the dynamics of firm sourcing operations, proving the existence of stochastic dominance of importers over non-importers, and

[7] On 1st of January 2007, when euro was adopted in Slovenia, the conversion rate between Slovene tolars (SIT) and euro was 239,64 SIT/€.

identifying the issue of self selection into foreign sourcing of intermediate inputs. Next subsection considers denovo importers – the firms that switched form domestic input sourcing to offshoring. It explores the context and outcome of firm's decision to commence intermediate goods importing in order to gain preliminary evidence on productivity growth effect of foreign sourcing and to provide the motivation for more careful analysis. In the last subsection, I test the main predictions of the theoretical model about the productivity effect of offshoring and the focus on core competence effect as one of the possible transmission mechanisms. The hypotheses are tested using propensity score evaluation methods according to Blundell and Costa Dias (2000) and Smith and Todd (2001).

5.1. Behaviour of importing firms and importing behaviour of firms

I now turn to document some basic empirical facts about firms that procure intermediate inputs abroad. Because the data for the smallest micro firms is unreliable, especially when operating with relative quantities such as value added per employee and tangible fixed assets per employee, I use only observations with firms having at least 5 employees. This leaves me with a sample of 4,197 firms and 22,041 observations over the period 1994-2003.

Table 5-1: Descriptive statistics in 1994-2003.

	Sales	VA/L	Labour	Capital	Mtotshare	Minpshare	Obs / N firms
All firms	887,716.0	2,531.1	97.3	356,737.2	0.241	0.150	22,041
	(27,920.8)	(14.72)	(1.78)	(9,140.5)	(0.002)	(0.001)	4,197
Continuous importers	1,267,127.0	2,802.5	137.2	511,693.6	0.351	0.220	13,301
	(42,636.1)	(19.33)	(2.65)	(13,832.7)	(0.002)	(0.002)	2,182
Non-importers	82,690.4	1,528.9	20.9	30,725.9			1,368
	(5,949.8)	(25.74)	(1.05)	(4,805.3)			480
Switchers	352,546.2	2,227.3	39.5	137,652.6	0.098	0.054	7,372
	(30,977.3)	(25.33)	(2.12)	(10,397.9)	(0.002)	(0.002)	1,535
Survivors	947,645.0	2,749.7	97.7	371,796.2	0.248	0.159	16,417
	(35,322.4)	(17.11)	(2.13)	(10,817.5)	(0.002)	(0.002)	2,746
Quitters	712,777.5	1,892.9	96.1	312,778.5	0.221	0.125	5,624
	(36,539.9)	(27.14)	(3.14)	(16,902.9)	(0.004)	(0.002)	1,451

Notes: Standard errors are in parentheses. The statistics are based on the restricted sample that excludes firms with less than 5 employees. *Continuous importers* are firms that imported every period. *Non-importers* are firms that never imported in the sample period. *Switchers* are firms that switched their import status at least once. *Survivors* are plants that did not exit during the sample period (until 2005), while *Quitters* exit sometime before 2005. *Sales*, value added per employee (*VA/L*), and *capital* are measured in 1000 Slovene tolars. *Labour* is the number of workers. Total import ratio (*Mtotshare*) and intermediate inputs import ratio (*Minpshare*) are the ratios of imports to total material cost. *Obs* is the number of observations (firm-year units) and *N firms* is the number of firms in the 1994-2003 period.
Source: author's own calculations

Figure 5-1Figure 5-1: The relationship between firm productivity and intensity of international input sourcing, 1994-2003. reports descriptive statistics for variables in the period 1994-2003. The comparison between continuous importers, switchers and non-importers reveals the substantial differences between the three types of firms. The largest firms as indicated by sales, employment, and capital stock are firms that imported throughout the sample period. In addition, they have substantially higher labour productivity than the other two groups of firms. Non-importing firms, in contrast, are inferior in each of the selected performance measures, although the direction of causality is not clear from these simple descriptive statistics. On average, switchers are three to four times less import intensive than their continuously importing counterparts. On the other hand, as shown in the last two rows of Figure 5-1, firms that survive until 2005 are larger, more productive and have higher import shares than firms that exit within the sample period 1994-2005. In order to explore the relationship between exit and import behaviour further, I present transition dynamics across import status and exit (see Table 5-2).

Table 5-2: Transition probability of import status and exit

Year t status	Importer			Non-importer		
Year t+1 status	Importer	Non-importer	Exit	Importer	Non-importer	Exit
94-96 average	87.0%	7.3%	5.7%	25.3%	67.3%	7.4%
97-99 average	90.7%	5.5%	3.9%	22.2%	71.2%	6.6%
00-02 average	91.0%	5.7%	3.3%	20.7%	73.6%	5.7%
94-03 average	89.7%	6.1%	4.2%	22.3%	71.2%	6.4%

Note: The statistics are based on the restricted sample that excludes firms with less than 5 employees.
Source: author's own calculations

The above table exhibits two important features of firm and industry dynamics. First, there is a strong persistence of import status in time. Among the firms that imported in year *t*, 90% of them also imported in year *t*+1, while among the firms that did not import in year *t*, 71% of them neither imported in the subsequent year. Between-firm variation of import status will thus be an important source of identification of the import variable coefficient. Nevertheless, there is a significant fraction of firms that switch from domestic to foreign sourcing, so that there is also variability of import status within firms ready to be exploited in the estimations. The second stylized fact concerns survival probability. Comparing firms across import status in year *t*, we can observe importers having higher chances of survival than non-importers, although one cannot say that it is the importing status and not some other omitted factors correlated with the import decision that cause the observed difference in survival rates. Nevertheless, the results above suggest that adding import status as an additional explanatory variably in the exit decision rule in Kasahara-Rodrigue estimation was a reasonable extension of OP procedure.

Next, I further disentangle the differences in performance and firm characteristics regarding the mode of intermediate inputs sourcing (Table 5-3). As expected, domestic input sourcing firms are much smaller with regards to total sales, while importers with direct investments

abroad outperform offshore outsourcing firms. Domestic firms and importers without outward FDI have experienced the revenue growth of similar magnitude over the observed period, whereas importers with outward investments have expanded even faster. The other indicator of size –number of employees – exhibits the same ranking: offshore outsourcers are three- to four-times larger than domestic firms, yet the premium of multinationals is more than an order of magnitude. Due to transitional restructuring of large enterprises and the entry of smaller firms, the average size of the firm in terms of employment decreased steadily in all three groups. Both groups of foreign sourcing firms are more capital intensive than domestic sourcers, corroborating the well known empirical fact that internationalized firms employ better technology and more complex production techniques. However, contrary to expectations, average capital intensity within groups has not changed much or even decreased in domestic firms and multinationals. This is probably due to the fact that capital intensive socialist firms replaced excessive and technologically inferior technology with modern and leaner productive assets.[8] In terms of labour productivity, foreign sourcing firms outperform their domestic competitors and the difference tends to increase in time. In 2003, offshoring firms with outward FDI were 70% and 20% more productive than offshore outsourcers and domestic firms, respectively. In short, the same ranking pertains to all the features of firms analysed: multinational firms dominate foreign sourcing firms and the latter are superior to domestically-oriented counterparts.

Table 5-3: Average sales, labour productivity, employment and capital-labour ratio by intermediate input sourcing mode, 1994-2003.

	Domestic sourcing only					Importers without oFDI					Importers with oFDI				
	sales	val	l	kl	N	sales	val	l	kl	N	sales	val	l	kl	N
1994	106,749.4	1,485.8	26.1	2,234.7	310	631,777.0	1,685.1	111.9	3,107.3	1,231	4,029,864.0	2,439.6	604.5	5,642.2	142
1995	87,544.1	1,518.5	29.5	2,159.6	381	617,205.8	1,817.4	96.6	2,936.4	1,413	4,041,256.0	2,408.1	609.9	4,883.2	146
1996	109,921.5	1,549.1	23.2	2,315.5	489	644,367.1	2,049.5	90.0	2,926.5	1,391	4,230,202.0	2,774.6	572.2	5,031.2	148
1997	223,467.3	1,873.9	29.1	2,183.4	502	680,305.3	2,448.8	80.9	3,394.8	1,452	4,439,200.0	3,162.6	524.5	6,281.2	149
1998	141,110.2	1,906.5	21.4	2,267.6	548	759,163.0	2,516.8	79.5	3,325.7	1,524	3,890,823.0	3,132.2	453.4	6,018.3	165
1999	103,739.3	1,957.0	18.9	1,848.2	577	743,326.3	2,862.6	76.0	3,419.8	1,564	4,453,162.0	3,186.5	470.8	5,478.0	162
2000	101,845.9	2,024.4	16.2	1,896.2	551	780,982.0	2,981.0	72.0	3,510.8	1,604	4,749,133.0	3,450.0	435.2	4,547.0	189
2001	109,615.1	2,150.1	18.8	2,071.2	583	756,902.6	3,129.7	67.5	3,421.4	1,586	4,603,162.0	3,661.4	389.4	4,503.1	229
2002	114,721.6	2,157.5	21.3	2,152.5	624	754,984.7	3,166.3	63.9	3,250.0	1,568	4,180,884.0	3,557.8	344.4	4,349.9	287
2003	125,499.6	2,287.2	21.2	2,101.5	601	728,309.3	3,343.1	61.2	3,363.1	1,671	4,950,057.0	3,951.5	355.6	4,556.4	254

Note: The statistics are based on the restricted sample that excludes firms with less than 5 employees. The variables included are: *sales* – total revenue; *val* – value added per employee; *l* – number of employees; *kl* – tangible fixed assets per employee; *N* – number of firms. *Sales*, *val* and *kl* are deflated with the corresponding deflators and expressed in 1000 Slovene tolars. *oFDI* denotes outward foreign direct investment.
Source: author's own calculations

Table 5-4 provides a comparison between the three modes of input sourcing in terms of average relative values of firm characteristics with respect to the current average in the corresponding 3-digit NACE industries. Relative to the average firm in the same sector, domestic firms were only 30-40% as large in terms of employment and 20-30% of the average

[8] Polanec (2004, p. 25-28) also finds that capital intensity as measured by total fixed assets per employee hardly changed in the period 1994-2003 and thus could not explain a significant increase in labour productivity.

size in terms of total revenue. Relative capital intensity of offshore outsourcers increased slightly in the 1994-2003 period, but decreased relative to the industry average in the remaining two groups of firms. Relative productivity of domestic firms remained fairly constant in time while that of importers with outward FDI decreased by as much as 10 percentage points. The reason is that the growth of average labour productivity in offshore outsourcers was considerably higher than in the other two groups of firms. However, since offshore outsourcers represent the majority of firms in Slovene manufacturing, their average relative productivity improves only marginally in the analysed time interval.

Table 5-4: Average relative sales, labour productivity, employment and capital-labour ratio by intermediate input sourcing mode, 1994-2003.

	Domestic sourcing only					Importers without oFDI					Importers with oFDI				
	rsales	rval	rl	rkl	N	rsales	rval	rl	rkl	N	rsales	rval	rl	rkl	N
1994	0.25	0.83	0.31	0.75	310	0.89	1.01	0.92	1.01	1,231	3.57	1.26	3.22	1.45	142
1995	0.19	0.81	0.32	0.77	381	0.92	1.03	0.92	1.03	1,413	3.87	1.19	3.57	1.34	146
1996	0.27	0.81	0.34	0.80	489	0.93	1.07	0.93	1.03	1,391	4.12	1.15	3.83	1.42	148
1997	0.27	0.80	0.34	0.67	502	0.92	1.04	0.91	1.05	1,452	4.27	1.30	4.07	1.66	149
1998	0.28	0.84	0.35	0.70	548	0.94	1.04	0.94	1.04	1,524	3.96	1.21	3.71	1.65	165
1999	0.23	0.78	0.31	0.65	577	0.97	1.07	0.97	1.09	1,564	4.04	1.13	3.80	1.41	162
2000	0.22	0.76	0.29	0.63	551	0.89	1.06	0.89	1.09	1,604	4.22	1.19	4.02	1.29	189
2001	0.24	0.78	0.36	0.67	583	0.87	1.05	0.86	1.08	1,586	3.83	1.21	3.61	1.29	229
2002	0.26	0.80	0.39	0.71	624	0.84	1.05	0.83	1.06	1,568	3.49	1.18	3.26	1.32	287
2003	0.27	0.81	0.41	0.68	601	0.86	1.04	0.84	1.07	1,671	3.68	1.16	3.45	1.30	254

Note: The statistics are based on the restricted sample that excludes firms with less than 5 employees. The variables included are: *rsales* – relative total revenue; *rval* – relative value added per employee; *rl* – relative number of employees; *rkl* – relative tangible fixed assets per employee; *N* – number of firms.
Source: author's own calculations

Because of the heterogeneity of manufacturing industries, one could argue that the differences between domestic and foreign sourcing firms may arise due to the compositional effect. In order to refute the hypothetical claim, I present the same characteristics of importing firms (both groups of foreign input sourcers) expressed in relative terms by 2-digit NACE industry classification.

Table 5-5 shows that the above concerns were redundant as importing firms remain more productive even in more narrowly defined sectors. In all but one industry (Other transport equipment), foreign sourcing firms are on average 1-15% more productive than the average firm in a given 3-digit NACE industry. In 15 out of 22 industries, importers improved their relative position in terms of labour productivity compared with the initial relative value added per employee. The distinctive feature observable from

Table 5-5 is that, as argued above, importing firms are on average more productive, larger and more capital intensive than domestic firms.

Table 5-5: Relative sales, labour productivity, employment and capital-labour ratio of foreign sourcing firms by 2-digit NACE industry, 1994-2003 average.

nace2	rval	rkl	rl	rsales	N	$rval_{1994}$	$rval_{2003}$
15	1.145	1.231	1.474	1.527	1,021	1.069	1.159
17	1.054	1.093	1.117	1.138	917	1.068	1.092
18	1.096	1.235	1.377	1.427	734	1.080	1.042
19	1.063	1.079	1.194	1.209	269	1.129	1.047
20	1.069	1.101	1.309	1.363	954	1.043	1.075
21	1.093	1.112	1.170	1.194	347	1.037	1.047
22	1.106	1.158	1.592	1.634	905	1.063	1.083
23	1.023	1.007	0.956	0.959	27	1.000	1.015
24	1.019	1.008	1.034	1.036	625	1.000	1.016
25	1.042	1.028	1.113	1.125	1,174	1.011	1.060
26	1.047	1.058	1.134	1.152	791	0.940	1.074
27	1.036	1.007	1.128	1.128	337	1.006	1.015
28	1.084	1.165	1.193	1.245	2,569	1.070	1.090
29	1.035	1.034	1.105	1.130	1,789	1.027	1.014
30	1.129	1.049	1.201	1.269	268	1.087	1.163
31	1.044	1.071	1.095	1.110	1,001	1.050	1.047
32	1.014	0.962	1.061	1.071	515	0.995	1.007
33	1.043	1.046	1.107	1.112	728	1.053	1.047
34	1.012	0.935	1.057	1.082	447	0.921	1.030
35	0.946	1.019	1.076	1.083	155	1.041	0.762
36	1.055	1.092	1.216	1.228	1,194	1.045	1.050
37	1.129	1.200	1.445	1.415	92	1.155	0.985

Note: The statistics are based on the restricted sample that excludes firms with less than 5 employees. The variables included are: *rsales* – relative total revenue; *rval* – relative value added per employee; *rl* – relative number of employees; *rkl* – relative tangible fixed assets per employee; *N* – number of firms; $rval_{1994(2003)}$ – relative productivity in 1994 (2003).
Source: author's own calculations

Interesting finding from the above analysis of relative labour productivity worth exploring further is that in the majority of industries importing firms were not only initially more productive than their domestic counterparts but managed to additionally increase the productivity lead within the sector. Up to now, I have only explored the dichotomous classification of firms regarding the geographical aspects of their intermediate input sourcing. Next, I turn to the quantitative aspects by exploring the relationship between the intensity of firms' involvement in foreign market sourcing and their performance. Table 5-6 attempts to reveal the association between the extent of foreign inputs sourcing and relevant firm characteristics in Slovene manufacturing firms. The figures reveal a clear positive link between the intensity of foreign input sourcing and relative labour productivity. Contrary to export intensity (see Damijan and Kostevc 2006 and Blalock and Gertler 2004), higher intermediate inputs import intensity is associated with higher productivity. The same can be said for capital intensity and total revenue. Only in terms of size as measured by the number of employees, the most import intensive firms are dominated by firms with intermediate involvement in foreign input sourcing. In short, higher share of foreign inputs in total material

costs appears to demand and/or cause higher productivity, capital intensity and size of importing firms.

Table 5-6: Relative labour productivity, capital-labour ratio, employment and sales with respect to the share of imported intermediate inputs in total material costs, 1994-2003 average.

Import share (m)	rval	rkl	rl	rsales	N
m=0	0.801	0.697	0.339	0.250	5,159
m>0	1.065	1.092	1.206	1.238	16,626
0<m<0.30	1.041	1.086	1.050	1.037	12,393
0.30<m<0.50	1.103	1.093	1.727	1.819	2,511
0.50<m<1	1.179	1.130	1.563	1.839	1,722

Note: The statistics are based on the restricted sample that excludes firms with less than 5 employees. The variables included are: *rsales* – relative total revenue; *rval* – relative value added per employee; *rl* – relative number of employees; *rkl* – relative tangible fixed assets per employee; *N* – number of firms.
Source: author's own calculations

In order to check whether the observed regularity holds at the finer aggregation level as well, I present a more detailed scrutiny of the relative productivity of importing firms at the 2-digit NACE division (Table 5-7). As it turns out, only one third of the industries conform fully to the pattern of monotonically positive relationship between import intensity and firm productivity. Apparently, there is a substantial inter-industry heterogeneity within manufacturing sector and perhaps other factors, not taken into account in this simple descriptive analysis, shape the examined association. Nevertheless, importing is positively correlated with the relative productivity of importing firms, but the correspondence between the intensity of foreign input sourcing and productivity levels does not follow the predicted pattern in every single industry. Despite some irregularities, there is hardly any industry in clear contrast to theoretical predictions.

Table 5-7: Relative labour productivity of manufacturing firms with respect to their share of intermediate inputs imports in total material costs by sector, 1994-2003 average.

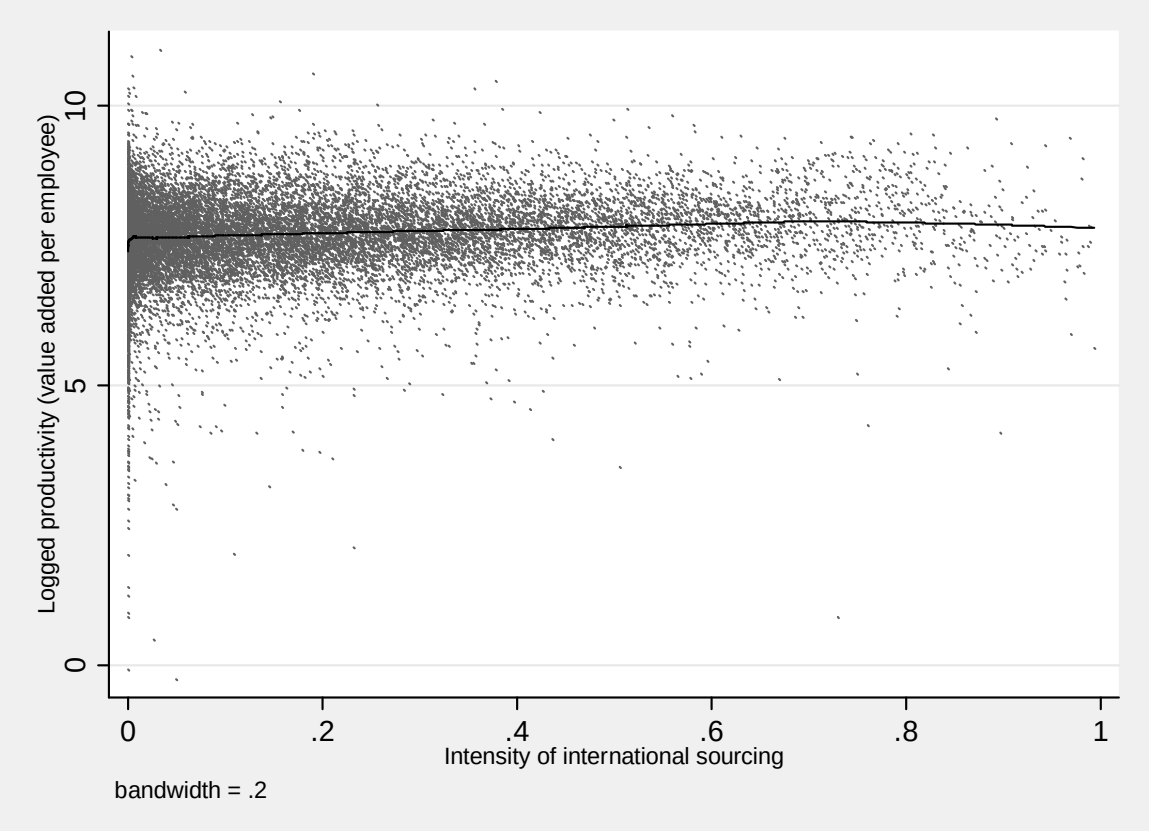
nace2	m=0	N	0<m<0.30	N	0.30<m<0.50	N	0.50<m<1	N
15	0.789	700	1.147	998	1.110	22	-0.546	1
16			1.000	10				
17	0.646	139	0.922	446	1.225	233	1.165	216
18	0.814	369	1.086	600	1.214	92	1.059	33
19*	0.719	60	1.022	205	1.182	32	1.284	24
20	0.878	538	1.057	841	1.237	79	0.869	25
21	0.581	77	0.977	231	0.900	56	1.754	56
22*	0.931	835	1.070	857	1.428	23	2.035	25
23*	0.683	2	1.023	27				
24	0.514	24	1.003	318	1.063	184	1.010	119
25*	0.703	168	1.014	587	1.047	282	1.126	287
26	0.762	157	1.077	573	0.994	114	0.967	96
27	0.742	47	0.891	227	1.231	42	1.122	60
28*	0.762	904	1.028	1,866	1.158	359	1.365	290
29*	0.791	295	1.001	1,361	1.093	318	1.331	101
30	0.625	92	1.135	258	1.093	8		

31*	0.648	123	1.034	668	1.048	222	1.174	86
32	0.847	48	1.046	316	1.025	105	0.951	81
33	0.698	104	1.055	563	1.027	93	1.039	61
34*	0.738	58	0.973	264	1.046	102	1.140	71
35	1.555	15	1.037	92	0.832	28	0.743	25
36	0.795	319	1.048	995	1.167	115	1.033	65
37	0.861	85	1.145	90	0.390	2		

Note: The statistics are based on the restricted sample that excludes firms with less than 5 employees. *m* denotes import share. * denotes the industries that fully conform to the theoretical predictions of positive correlation between productivity and import share.
Source: author's own calculations

The relationship between firm productivity and intensity of foreign input sourcing may be nonmonotonic, in which case the arbitrarily determined import share intervals in Table 5-6 and Table 5-7 can conceal the true pattern. For this reason, I present the scatterplot of productivity and import intensity together with the locally weighted regression line with relatively little smoothing (Figure 5-1). Indeed, the relationship between the variables appears to be concave with the maximum productivity level achieved at around 75% share of imported inputs.

Figure 5-1: The relationship between firm productivity and intensity of international input sourcing, 1994-2003.



Note: The scatterplot is based on the restricted sample that excludes firms with less than 5 employees. Solid line is the LOWESS fit to the data at the bandwith 0.2.
Source: author's own calculations

The intensity of foreign input sourcing can either come about as a consequence of a larger number of imported varieties (extensive margin) or higher import values of existing range of imported varieties (intensive margin). If the former is at work, I should identify positive relationship between the number of imported varieties and productivity similar to the link between the extent of foreign sourcing and firm productivity. The association can easily be rationalized within my theoretical framework by extending the model to many intermediate inputs. Because each foreign intermediate entails bearing some fixed cost, importing a broader range of inputs demands a firm to have higher productivity in order to cover all the fixed costs. Table 5-8 reveals that the productivity is uniformly increasing in the number of imported varieties of intermediate inputs. Firms that import more than 100 varieties are on average almost 20% more productive than the average firm in a corresponding 3-digit industry, while the productivity of firms with more than ten inputs is only 2% above the average. Because of high collinearity between productivity and capital intensity, revenues and employment, the relationship between the latter three performance measures and the number of imported varieties exhibits the same robust pattern as with productivity.

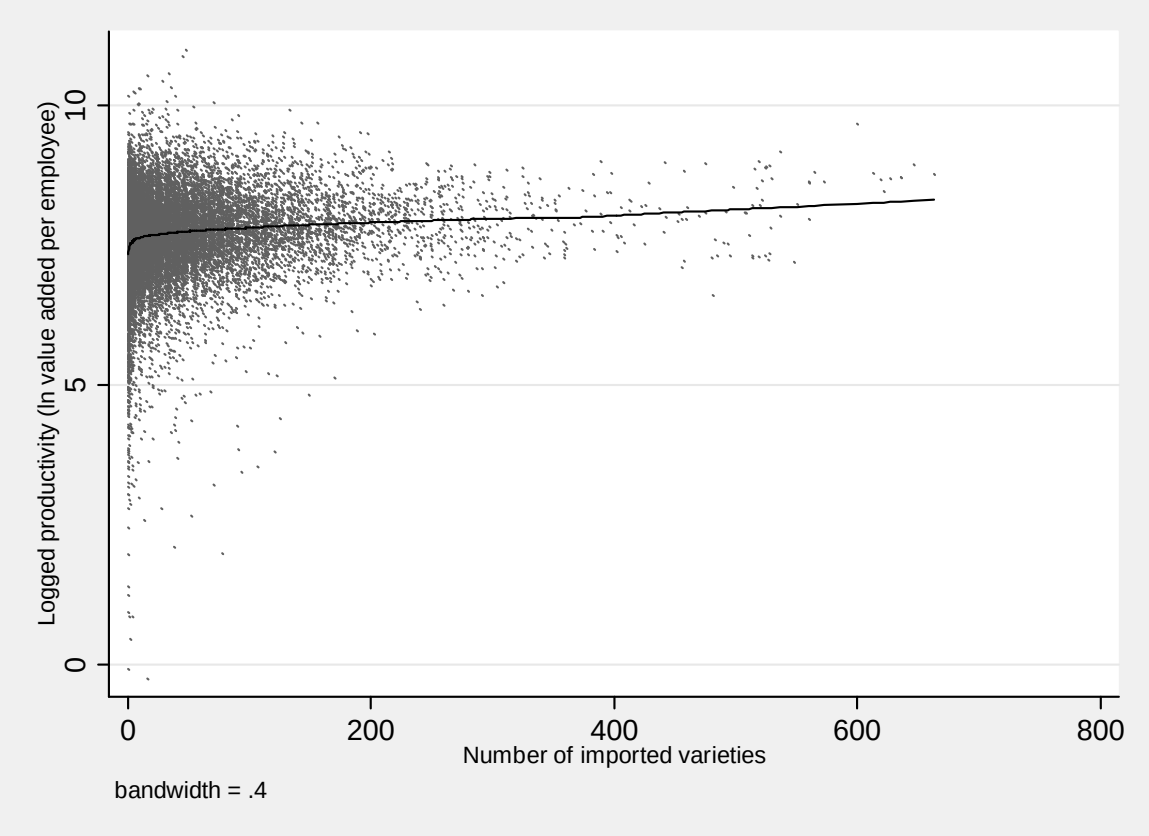
Table 5-8: Relative labour productivity, capital-labour ratio, employment and sales with respect to the number of imported varieties, 1994-2003 average.

No. of imported varieties (v)	rval	rkl	rl	rsales	N
v=0	0.779	0.660	0.337	0.234	4,034
0<v<5	0.917	0.911	0.404	0.358	3,432
5≤v<10	1.009	1.031	0.504	0.483	2,017
10≤v<20	1.018	1.068	0.577	0.542	2,670
20≤v<30	1.053	1.114	0.695	0.685	1,878
30≤v<50	1.097	1.085	0.965	0.944	2,730
50≤v<100	1.113	1.129	1.454	1.505	3,079
v≥100	1.194	1.272	3.790	4.075	2,194

Note: The statistics are based on the restricted sample that excludes firms with less than 5 employees. The variables included are: *rsales* – relative total revenue; *rval* – relative value added per employee; *rl* – relative number of employees; *rkl* – relative tangible fixed assets per employee; *N* – number of firms. Number of imported varieties is defined as the number of distinct 6-digit tariff products imported by a firm in a given year.
Source: author's own calculations

Figure 5-2 confirms the finding from Table 8 as the lowess line reveals monotonically positive relationship between firm productivity and the number of imported varieties. Halpern, Koren, and Szeidl (2006) also find that the number of imported varieties is positively associated with firm productivity and size. In addition, they estimate that about two thirds of the increases in total factor productivity comes from the increased variety.

Figure 5-2: The relationship between firm productivity and the number of imported input varieties, 1994-2003.



Note: The scatterplot is based on the restricted sample that excludes firms with less than 5 employees. Number of imported varieties is defined as the number of distinct 6-digit tariff products imported by a firm in a given year. Solid line is the LOWESS fit to the data at the bandwith 0.2.
Source: author's own calculations

Heterogeneity in importing behaviour is also reflected in the relationship between the number of import markets and firm characteristics (

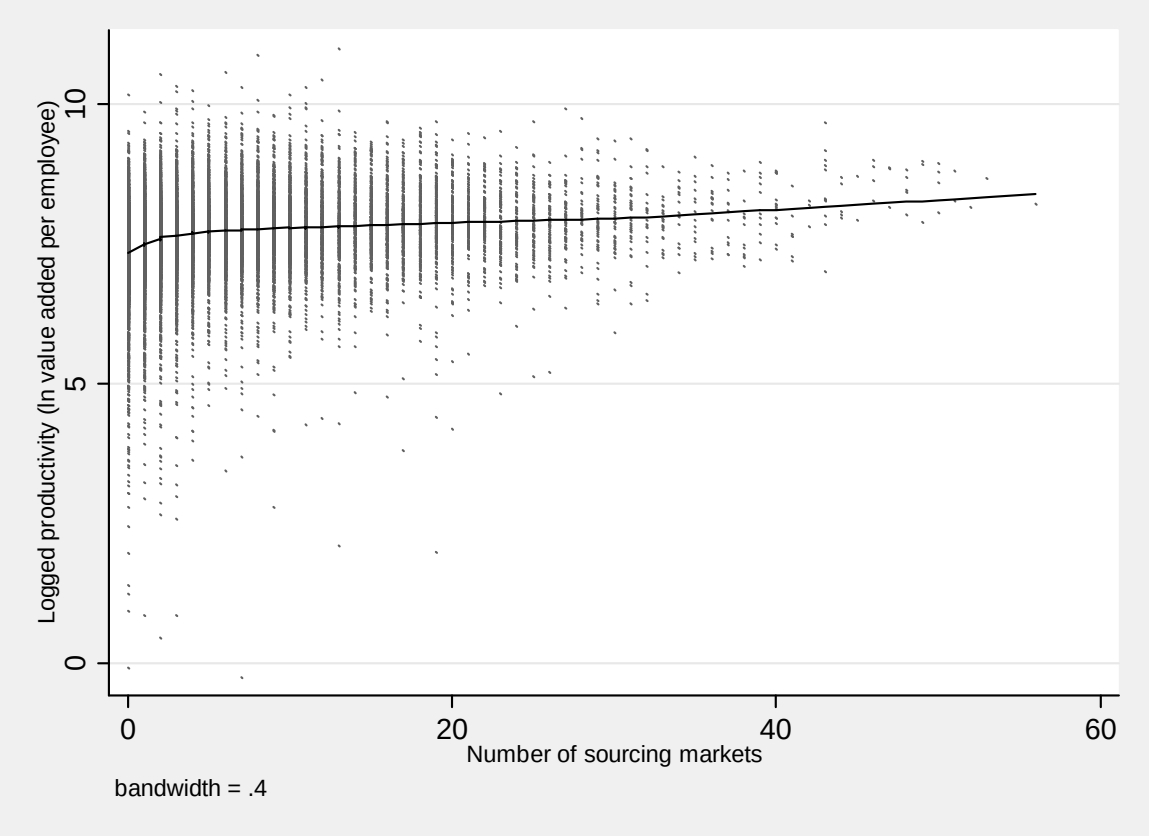
Table 5-9). As in the case of import intensity, relative productivity increases stepwise with the number of import markets. Firms that buy intermediates from more than 9 countries are on average 15% more productive than the average firm in the same narrowly defined industry. Except for minor irregularity in relative capital intensity, capital-labour ratio and the firm size as measured by the number of employees and total revenue increase monotonically with the number of import markets. This is consistent with my model where entry in import market entails a fixed cost, for example because it requires establishing and maintaining costly business connections and other transaction costs. Spreading the procurement network to a larger number and more distant countries entails higher fixed costs and thus demands higher productivity.

Table 5-9: Relative labour productivity, capital-labour ratio, employment and sales with respect to the number of import markets, 1994-2003 average.

No. of import markets (n)	rval	rkl	rl	rsales	N
n=0	0.779	0.660	0.337	0.234	4,034
n=1	0.891	0.848	0.368	0.306	2,933
n=2	0.972	0.977	0.449	0.402	2,222
n=3	1.015	1.098	0.546	0.522	1,916
4≤n<6	1.079	1.146	0.697	0.704	2,799
6≤n<8	1.078	1.081	0.906	0.911	1,993
8≤n<10	1.119	1.159	1.159	1.187	1,436
n≥10	1.154	1.188	2.581	2.724	4,701

Note: The statistics are based on the restricted sample that excludes firms with less than 5 employees. The variables included are: *rsales* – relative total revenue; *rval* – relative value added per employee; *rl* – relative number of employees; *rkl* – relative tangible fixed assets per employee; *N* – number of firms.
Source: author's own calculations

Figure 5-3: The relationship between firm productivity and the number of import countries, 1994-2003.



Note: The scatterplot is based on the restricted sample that excludes firms with less than 5 employees. Solid line is the LOWESS fit to the data at the bandwith 0.2.
Source: author's own calculations

In Figure 5-3, the relationship between firm productivity and the number of countries from which intermediate inputs are imported is presented graphically. The line that corresponds to nonparametric estimate of the association is increasing in the entire domain, corroborating the positive relationship. More productive and larger firms are more likely to overcome the fixed

costs associated with increased geographical dispersion of their input sourcing because they have more resources and because they profit more from offshoring inputs than their smaller and less productive counterparts.

Finally, I present the dynamics of entry and exit in and out of import market (Table 5-10). The second column reveals that the number of manufacturing firms with at least 5 employees persistently increased from 1,683 in 1994 to 2,526 firms in 2003. Among these, around three quarters of firms purchased part of their intermediate inputs from abroad, confirming the well established fact that Slovenian economy is heavily engaged in international markets. The fraction of importers decreased slightly due to the entry of new firms that predominately sourced inputs domestically (column 3). Although erratic, entry into importing on average stayed constant at around 110-120 firms per year and was (with the exception of the year 1996) always higher than the exit from importing. As a consequence, the number of importers increased by 552 from 1994 to 2003 which represents 33% (22%) of the total number of firms in 1994 (2003). The entry rate into importing in the observed period moves between 4.2% and 6.7% per annum. Compared to export dynamics, import entry is more stable and lower since Damijan et al. (2004) report the entry rates into exporting being as high as 17% at the beginning of the period and afterwards falling to 4%. The exit rate out of importing of around 4% is on the other hand comparable to the rate of exit from export markets as stated in Damijan et al. (2004).

Table 5-10: Entry to and exit from import markets, 1994-2003.

Year	All	Non-importers	Importers	% Importers	Enter [a]	Exit [a]	Net
1994	1683	310	1373	81.6			
1995	1940	381	1559	80.4	110	81	29
1996	2028	489	1539	75.9	85	156	-71
1997	2103	502	1601	76.1	135	104	31
1998	2237	548	1689	75.5	115	96	19
1999	2303	577	1726	74.9	114	93	21
2000	2344	551	1793	76.5	121	78	43
2001	2398	583	1815	75.7	128	113	15
2002	2479	624	1855	74.8	101	86	15
2003	2526	601	1925	76.2	148	87	61

Note: The statistics are based on the restricted sample that excludes firms with less than 5 employees. [a] Entry and exit figures denote the number of firms that started and ceased importing intermediate inputs from the previous year.
Source: author's own calculations

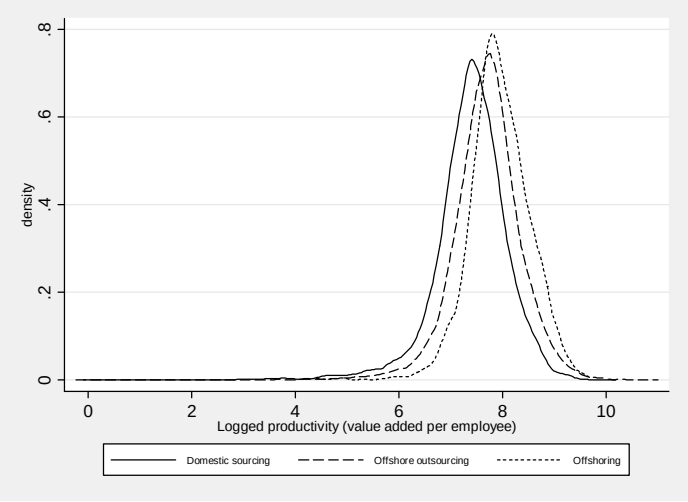
5.2. Are importers of intermediate inputs more productive than non-importers?

One of the implications of several models of international fragmentation including the one introduced in this thesis is that firms arrange themselves into alternative production modes according to their productivity levels. Only the more productive firms are able to profit form

organizing their vertical production chain across national borders, while according to my theoretical model, the most productive of them are involved in captive offshoring. In order to test these predictions, I will apply the Kolmogorov-Smirnov stochastic dominance test and Wilcoxon signed rank (Mann-Whitney) non-parametric test to gain an extra evidence for the differences between domestic and foreign sourcers, as well as between domestically-oriented firms, offshore outsourcers and captive offshorers.

Before turning to the results of the two non-parametric tests for stochastic dominance, let me first present graphically the distributions to be tested. Figure 5-4 displays the distribution of firms according to their productivity (as measured by the logarithm of value added per employee) for three different sourcing types: domestic sourcing, offshore outsourcing and captive offshoring (intermediate input importers with outward FDI). The figure reveals the notable dissimilarity of the distributions and the compliance with the proposed hypotheses about the dominance of foreign sourcing firms over domestically-bound companies. The distribution of offshoring firms with outward FDI is to the right of the distribution of offshore outsourcers, which itself is to the right of the distribution of domestic firms.

Figure 5-4: Distribution of productivity according to input sourcing mode, 1994-2003.



Note: The figure is based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

To test whether the observed differences in Figure 5-4 are indeed statistically significant, I now turn to the results of the Kolmogorov-Smirnov and Mann-Whitney tests of stochastic dominance. Instead of using logged value added per employee as in the Figure 5-4, I will draw the inference on relative value added per employee (relative to 3-digit NACE industry average). Employing the relative measure of productivity corrects for differences in productivity levels across manufacturing sectors that might otherwise disturb the results. First, I present the results of the test of Hypothesis III that non-importers have significantly different productivity distribution function than importers of intermediate inputs. Next, I turn to testing the difference between domestically-oriented firms and offshore outsourcers (Hypothesis IV), followed by the results of the tests on the Hypothesis V which states that

foreign sourcers with outward FDI stochastically dominate the distribution function of firms performing cross-border outsourcing of intermediate inputs.

Table 5-11-Table 5-14 undoubtedly confirm the Hypothesis I that importers of intermediate inputs stochastically dominate non-importers in terms of the productivity distribution. Both pooled (Table 5-11) and year-by-year KS-tests confirm the theoretical predictions as the combined KS statistic confirms at the negligible level of risk the differences between the two cumulative distribution functions (CDF). Positive values of the D-statisctics reported in both tables indicate that the normalized maximum vertical difference between the two CDFs is positive or, in other words, that the CDF of importers is to the right of the CDF of domestic firms. The robustness of the evidence given in Table 5-11 is further confirmed in the year-by-year KS-tests, since in every single year the distribution of importers stochastically dominates the distribution of domestic firms.

Table 5-11: Kolmogorov-Smirnov test of stochastic dominance for Hypothesis III over the entire period of observation, 1994-2003.

Smaller group	D	P-value	Corrected
Non-importers	0.2044	0.000	
Importers	-0.0022	0.964	
Combined K-S:	0.2044	0.000	0.000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

Table 5-12: Kolmogorov-Smirnov test of stochastic dominance for Hypothesis III annually for each year in the period 1994-2003.

Year	D	P-value	Corrected
1994	0.202	0.000	0.000
1995	0.212	0.000	0.000
1996	0.188	0.000	0.000
1997	0.204	0.000	0.000
1998	0.194	0.000	0.000
1999	0.221	0.000	0.000
2000	0.257	0.000	0.000
2001	0.230	0.000	0.000
2002	0.218	0.000	0.000
2003	0.235	0.000	0.000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

Table 5-13 and Table 5-14 present the results of the Mann-Whitney test of Hypothesis III and substantiate the previous results from the KS-tests. At a negligible level of risk, MV-test on the pooled sample of firms rejects the null hypothesis that the two samples come from the same distribution of labour productivity. Above all, the observed rank sum of importers (non-importers) is higher (lower) than what would be expected given the null hypothesis, which means that the ranks of importing firms' relative productivity levels are on average higher

than the ranks of non-importers. Performed for each year separately, the results of the MW-test systematically confirm Hypothesis III at a very high level of significance, leading to the conclusion that both tests reveal significant differences in the distribution of firms according to relative labour productivity in favour of intermediate inputs importers.

Table 5-13: Two sample Mann-Whitney test on Hypothesis III that importing firms are relatively more productive than domestic sourcing firms over the entire period of observation, 1994-2003.

Firm type	Obs	Rank sum	Expected
Non-importers	5,165	44,585,485	56,905,388
Importers	16,869	1.98e+08	1.86e+08
Combined	22,034	2.43e+08	2.43e+08
unadjusted variance			1.60e+11
adjustment for ties			-4,914.35
adjusted variance			1.60e+11
Ho: rval(DMinputs=0) = rval(DMinputs=1)			
z = -30.801			
Prob > z = 0.0000			

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

Table 5-14: Year-by-year results of the two sample Mann-Whitney test on Hypothesis III that importing firms are relatively more productive than domestic sourcing firms.

Year	Prob > |z|	Obs
1994	0.0000	1,683
1995	0.0000	1,940
1996	0.0000	2,021
1997	0.0000	2,103
1998	0.0000	2,237
1999	0.0000	2,303
2000	0.0000	2,344
2001	0.0000	2,398
2002	0.0000	2,479
2003	0.0000	2,526

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

Next, I split the importers into those that purchase intermediate inputs abroad but have no foreign subsidiaries and those importers that have an investment abroad. Hypothesis IV compares the distribution of non-importers to that of non-multinational foreign sourcers and the results of the tests are reported in Table 5-15-Table 5-18. As before, I first present KS-tests (pooled and year-by-year) and after that the MW-tests (pooled and year-by-year). All four groups of tests establish a strong confirmation of the hypothesis as they show that the distribution functions differ significantly. Furthermore, offshore outsourcers stochastically dominate non-importers since the D-statistics from the KS-tests are systematically positive and the rank sum of offshore outsourcers constantly exceed the expected values under the null

hypothesis. Using domestic intermediate inputs enables companies to avoid numerous problems, including those connected with long distances, lengthy supply lines, complex transportation channels, language differences, exchange-rate fluctuations, inventory levels, tariffs, strikes, and political risks. In order to cover for these extra fixed and/or sunk costs, firms need to be on average more productive and larger to gain enough through cheaper or more advanced input sourcing from abroad.

Table 5-15: Kolmogorov-Smirnov test of stochastic dominance for hypothesis IV over the entire period of observation, 1994-2003.

Smaller group	D	P-value	Corrected
Non-importers	0.1875	0.000	
Offshore outsourcers	-0.0020	0.970	
Combined K-S:	0.1875	0.000	0.000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

Table 5-16: Kolmogorov-Smirnov test of stochastic dominance for hypothesis IV annually for each year in the period 1994-2003.

Year	D	P-value	Corrected
1994	0.1817	0.000	0.000
1995	0.1934	0.000	0.000
1996	0.1738	0.000	0.000
1997	0.1847	0.000	0.000
1998	0.1793	0.000	0.000
1999	0.2051	0.000	0.000
2000	0.2401	0.000	0.000
2001	0.2120	0.000	0.000
2002	0.2005	0.000	0.000
2003	0.2209	0.000	0.000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

Table 5-17: Two sample Mann-Whitney test on Hypothesis IV that offshore outsourcing firms are relatively more productive than domestic sourcing firms over the entire period of observation, 1994-2003.

Firm type	Obs	Rank sum	Expected
Non-importers	5,165	41,918,349	52,073,530
Offshore outsourcing	14,998	1.61e+08	1.51e+08
Combined	20,163	2.03e+08	2.03e+08

unadjusted variance	1.30e+11
adjustment for ties	-1,757.18
adjusted variance	1.30e+11

Ho: rval(dom_outs=0) = rval(dom_outs=1)
z = -28.147
Prob > z = 0.0000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

Table 5-18: Year-by-year results of the two sample Mann-Whitney test on Hypothesis IV that offshore outsourcing firms are relatively more productive than domestic sourcing firms.

Year	Prob > |z|	Obs
1994	0.0000	1,541
1995	0.0000	1,794
1996	0.0000	1,873
1997	0.0000	1,954
1998	0.0000	2,072
1999	0.0000	2,141
2000	0.0000	2,155
2001	0.0000	2,169
2002	0.0000	2,192
2003	0.0000	2,272

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

Testing for the validity of Hypothesis V results in equally strong confirmation as the tests for the previous two hypotheses (Table 5-19-Table 5-22). All the null hypotheses of equal distributions between offshore outsourcers and offshorers with outward FDI are rejected at a negligible level of risk and D-statistics and rank sum values imply that the productivity distribution of captive offshorers is significantly to the right of the distribution of offshore outsourcers. Obviously, only the most productive importers of intermediate inputs choose to establish corporate presence abroad since running a foreign subsidiary involves extra cost to the business. Offshorers are (and become) more productive because they not only have to cover higher transaction and organizational cost involved in managing foreign sourcing strategy but also because multinational operations demand some offsetting advantages to make up for extra costs associated with multinational production.[9] These include – apart from higher marginal costs already compensated by lower production costs abroad – fixed costs of coordination, communication, control, management, and transportation.

Table 5-19: Kolmogorov-Smirnov test of stochastic dominance for hypothesis V over the entire period of observation, 1994-2003.

Smaller group	D	P-value	Corrected
Offshore outsourcers	0.1635	0.000	
Captive offshorers	-0.0029	0.973	
Combined K-S:	0.1635	0.000	0.000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

[9] A limited but very useful organizing framework for inquiring into the nature of these advantages was proposed by Dunning (1977, 1981). He proposed that there are three conditions needed for firms to have a strong incentive to undertake direct foreign investments. First, the ownership advantage: the firm must have a product or a production process such that the firm enjoys some market power advantage in foreign markets. Second, the location advantage: the firm must have a reason to want to locate production abroad rather than concentrate it in the home country, especially if there are scale economies at the plant level. Third, internalization advantage: the firm must have a reason to want to exploit its ownership advantage internally, rather than license its product/process to a foreign firm. The productivity advantage belongs to the first set of advantages.

Table 5-20: Kolmogorov-Smirnov test of stochastic dominance for hypothesis V annually for each year in the period 1994-2003.

Year	D	P-value	Corrected
1994	0.3005	0.000	0.000
1995	0.2163	0.000	0.000
1996	0.1741	0.001	0.000
1997	0.2204	0.000	0.000
1998	0.1795	0.000	0.000
1999	0.1701	0.000	0.000
2000	0.1674	0.000	0.000
2001	0.1550	0.000	0.000
2002	0.1538	0.000	0.000
2003	0.1317	0.001	0.001

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

Table 5-21: Two sample Mann-Whitney test on Hypothesis V that captive offshoring firms are relatively more productive than offshore outsourcing firms over the entire period of observation, 1994-2003.

Firm type	Obs	Rank sum	Expected
Offshore outsourcing	14,998	1.24e+08	1.27e+08
Captive offshoring	1,871	18,436,426	15,781,885
Combined	16,869	1.42e+08	1.42e+08
unadjusted variance			3.95e+10
adjustment for ties			-2,154.25
adjusted variance			3.95e+10
Ho: rval(outs_off =0) = rval(outs_off =1)			
z = -13.365			
Prob > z = 0.0000			

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

Table 5-22: Year-by-year results of the two sample Mann-Whitney test on Hypothesis V that captive offsoring firms are relatively more productive than offshore outsourcing firms.

Year	Prob > |z|	Obs
1994	0.0000	1,373
1995	0.0000	1,559
1996	0.0001	1,533
1997	0.0000	1,601
1998	0.0000	1,689
1999	0.0020	1,726
2000	0.0001	1,793
2001	0.0000	1,815
2002	0.0000	1,855
2003	0.0002	1,925

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

To sum up, this section attempted to test the validity of four related hypotheses with a common denominator in claiming that there are significant differences in the distributions of domestic and foreign sourcing firms in terms of the relative value added per employee. All four hypotheses were confirmed and I furthermore showed that the distribution of multinational offshorers stochastically dominates the distribution of offshore outsourcers, which in turn dominates the distribution of domestic firms. The ranking of different production modes from the theoretical model is thus confirmed in the actual data.

However, being static in their nature, the results of these tests say nothing concrete about the sources of the differences between alternative forms of vertical fragmentation. It is impossible to tell at this point whether the supremacy of internationalized firms is caused by benevolent effects of importing or do initially more productive firms simply self-select into foreign sourcing operations without being further enhanced through offshoring. In the next section, I will test the hypothesis of self selection into foreign sourcing, leaving the question of backward causality to the last part of the empirical analysis.

5.3. Do firms self-select into offshore outsourcing and captive offshoring?

Self-selection hypothesis is embedded in my theoretical model as an ordering of firms into different vertical fragmentation regimes according to their productivity levels. The choice and timing of production mode is endogenous in that it results from a firm's optimization strategy, based on comparing costs, productivity level and prospects about future state of the industry and own productivity improvements. For the self-selection to hold as predicted by the model, firms on the brink of switching to foreign sourcing, be it vertically integrated or arms-length relationship, would have to be more productive than the rest of the non-exporters. To test the validity of the hypothesis, I will again employ Kolmogorov-Smirnov and Mann-Whitney tests of stochastic dominance with which I will compare the distribution of non-importers to the distribution of firms one year before the start of foreign sourcing. To determine whether more productive offshore outsourcers choose to establish outward foreign direct investment, I will further compare the distribution of outsourcing firms with the distribution of soon-to-become multinational importers of intermediate inputs.

As

Table 5-23 shows, the expectation that prospective importers are more productive than domestic firms that will not start importing inputs next year is confirmed on the pooled sample KS-test. The results reveal that the distribution of non-importers is to the left of the distribution of future importers in terms of their relative value added per employee.

Table 5-23: Kolmogorov-Smirnov test of stochastic dominance for self-selection into foreign sourcing hypothesis over the entire period of observation, 1994-2002.

Smaller group	D	P-value	Corrected
Non-importers	0.1238	0.000	
Prospective importers	-0.0216	0.775	
Combined K-S:	0.1238	0.000	0.000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

The results of the Mann-Whitney test of stochastic dominance for self-selection into foreign sourcing (Table 5-24) confirm the findings of the KS-test for the entire period 1994-2002. D-statistics and rank sum values are both speaking in favour of prospective importers being more productive than non-importers that stay confined to domestic market. Despite weaker results in the year-by-year analysis (not reported here) and in view of the data shortage, the hypothesis of self-selection into foreign sourcing can be confirmed.

Table 5-24: Mann-Whitney test of stochastic dominance for self-selection into foreign sourcing hypothesis over the entire period of observation, 1994-2002.

Firm type	Obs	Rank sum	Expected
Non-importers	4,875	12,509,876	12,592,125
Prospective importers	290	831,319	749,070
Combined	5,165	13,341,195	13,341,195

unadjusted variance	6.09e+08
adjustment for ties	-0.87458
adjusted variance	6.09e+08

Ho: rval(selfsel1==0) = rval(selfsel1==1)
z = -3.334
Prob > z = 0.0009

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

Finally, I test the hypothesis that importing firms self-select into captive offshoring as they become productive enough. Now, Kolmogorov-Smirnov and Mann-Whitney tests will compare the relative productivity of established importers with the relative productivity of those importers that will engage in foreign direct investment in the following period. If the second variant of the self-selection hypothesis is correct, I would observe prospective multinational importers being more productive than importers that will not invest abroad.

Table 5-25-Table 5-26 present the results of the KS-tests and MW-test of stochastic dominance of prospective captive offshorers' distribution over the distribution of regular intermediate input importers.

Table 5-25: Kolmogorov-Smirnov test of stochastic dominance for self selection into captive offshoring hypothesis over the entire period of observation, 1994-2002.

Smaller group	D	P-value	Corrected
Offshore outsourcing	0.1693	0.000	
Captive offshoring	-0.0094	0.963	
Combined K-S:	0.1693	0.000	0.000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

As seen from

Table 5-25, KS-test for the entire period strongly confirms the hypothesis that prospective investors abroad were more productive than the rest of importers already one year before the establishment of the first foreign subsidiary. Unlike before, even year-by-year analysis gives stronger evidence in favour of the second self-selection hypothesis as the KS-test turns out significant in four of the seven years of observation (not reported here). Even in the three remaining insignificant years, KS-statistic is positive which means that the distribution of would-be investors is to the right of the distribution of importers. MW-test for the entire period of observation clearly confirms the findings of the KS-tests. Importers that engage in outward foreign direct investment in the next period are more productive than the rest of their importing counterparts.

Table 5-26: Mann-Whitney test of stochastic dominance for self selection into captive offshoring hypothesis over the entire period of observation, 1994-2002.

Firm type	Obs	Rank sum	Expected
Offshore outsourcing	14,785	1.11e+08	1.11e+08
Captive offshoring	214	1,912,018	1,605,000
Combined	14,999	1.13e+08	1.13e+08

unadjusted variance	3.96e+09
adjustment for ties	-93.1735
adjusted variance	3.96e+09

Ho: rval(selfsel2==0) = rval(selfsel2==1)
z = -4.882
Prob > z = 0.0000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.
Source: author's own calculations

The evidence at hand leads me to confirm the second self-selection hypothesis with even greater confidence than the first one. I can therefore attest the predictions of my theoretical model that more productive firms choose to purchase intermediate inputs abroad and that the most productive of intermediate inputs importers commence with multinational production. Having established the existence of positive relationship between productivity and international fragmentation of production chain in the direction from the former to the latter, I now turn to exploring the other possible direction of causality. The next section therefore aims to reveal whether foreign sourcing of intermediate inputs enhances productivity in the firms that switched from domestic to cross-border sourcing, and whether the potentially identified import-led productivity growth works via firms focusing on their core competence.

5.4. What happens to the firms that switch to foreign sourcing of intermediate inputs?

Up to this point, I have only analyzed static differences between importers of intermediate inputs and domestic firms. Although highly informative, the above findings do not establish

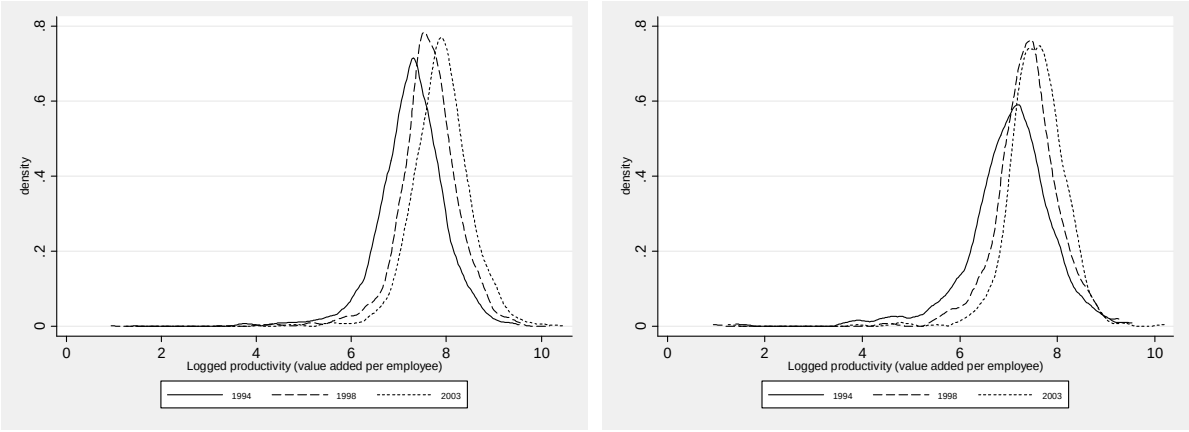
any unambiguous causality from importing to various performance measures. In addition, importers are heterogeneous along many dimensions and differ not only from their domestically-oriented competitors but from their importing counterparts as well. The previous section also proved that would-be importers differ significantly from non-importers already before they start importing. To disentangle the effects of intermediate inputs importing from the self-selection effect, it is therefore not enough to compare the means of importers and non-importers but to focus on firms that switched from domestic to foreign input sourcing and impose even starker methodological restrictions. Having the privilege to work with firm-level longitudinal data, I can delve deeper into the dynamics of importing decision and its effect on various firm characteristics. This section turns its focus from static to dynamic analysis and from importers in general to new importers – firms that made a permanent change from domestic to foreign input sourcing sometime in the observed period 1994-2003. Despite bringing me one step closer to the evaluation of the true effects of importing, the following analysis will by no means provide definite and methodologically appropriate estimates. My aim in this section is to provide an idea of what is going on in new importers before, at and after the beginning of foreign sourcing. The reader has to bear in mind, however, that here I only compare new importers with the entire pool non-importers, disregarding important (prior) differences between the two groups of firms.

Productivity changes in new importers, one of the key issues of my empirical analysis, can be graphically represented by shifts in productivity distribution of firms in time.
Figure 5-5a-
Figure 5-5d hence represent the movements in distribution of the logarithm of value added per employee in 1994, 1998, and 2003. As a benchmark, I first present the evolution of productivity distribution for the whole sample of manufacturing firms, followed by the figures for non-importers and importers. These distributions can then be compared to the shifts in productivity distributions in new importers, where points of particular interest will be the position and shape of distribution functions.

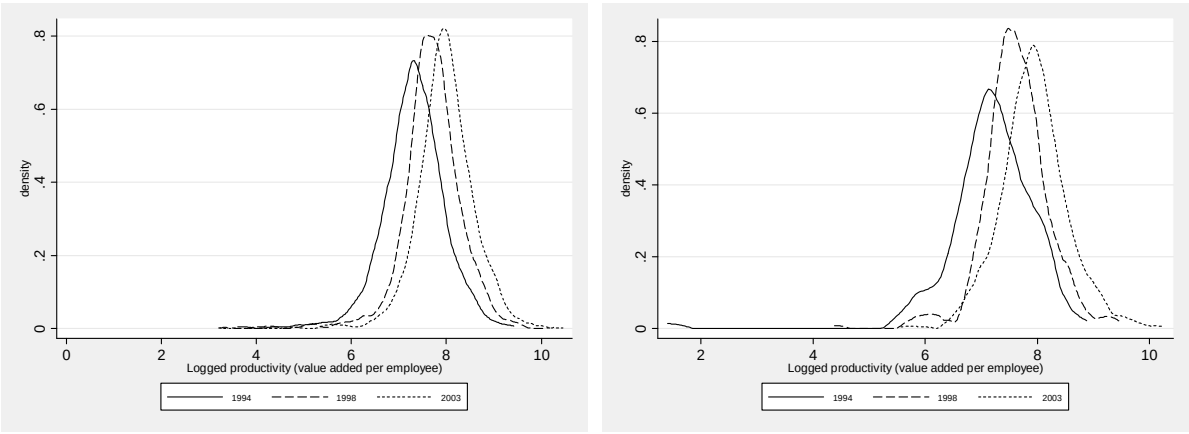
Figure 5-5a reveals that there has been a significant improvement in average productivity of Slovenian manufacturing firms as represented by stepwise shifts of productivity distributions in each of the three cross-section years. Alongside average productivity improvements, the changing shape of distribution functions reveals the reduction in the variance of productivity between firms as the distributions become more condensed. In the beginning of transition, market conditions allowed even relatively less productive firms to survive in the business, but as the environment became more competitive, less deviation from the average productivity was sustainable.

Figure 5-5a-d: Distribution of a) Slovenian manufacturing firms, b) non-importing firms, c) importing firms, and d) new importers according to their productivity in 1994, 1998, and 2003.

a) all firms **b) non-importers**



c) importers **d) new importers**



Note: The figures are based on the restricted sample that excludes firms with less than 5 employees. Lines represent univariate kernel density estimates of the distribution of logged productivity.
Source: author's own calculations

Figure 5-5b and
Figure 5-5c uncover some interesting facts about the differences in size, variance and dynamics of firm productivity between non-importers and importers. First, initial distribution of non-importers was substantially more spread and had a lower mean than that of intermediate input importers. Second, while non-importers experienced a positive shift and concentration of productivity in the earlier stage of transition period (1994-1998) and hardly any significant change from 1998 onwards, the group of importing firms increased their productivity substantially throughout the entire time interval. Third, the position of productivity distribution of importers was always to the right of the corresponding distribution of non-importers, while the productivity variance of importers remained lower than that of non-importers (see also column 2 of Table 5-1 for a similar finding).

Finally,
Figure 5-5d depicts the evolution of productivity distribution of new importers. Unlike
Figure 5-5b and
Figure 5-5c, where only observations without and with positive imports are present, respectively,

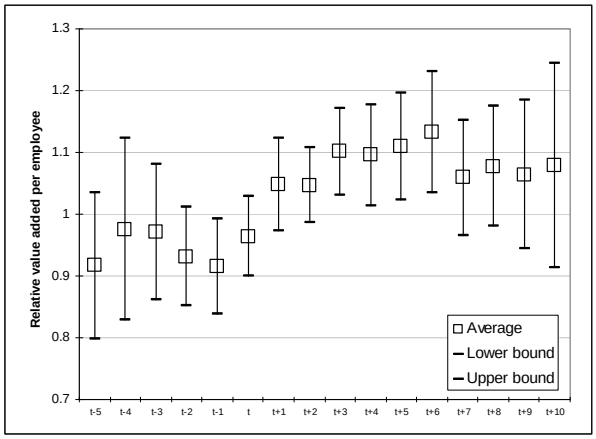
Figure 5-5d includes the observations of new importers regardless of their current import status. In other words, I include observations of new importers' productivity levels even before they actually started importing. The 1994 line therefore, by construction, shows the distribution of productivity levels of non-importing firms that will switch to importing anytime by 2003. On the other hand, by construction, the 2003 line shows importing firms that switched from domestic to foreign sourcing of intermediate inputs anytime in the 1995-2002 period. Compared to non-importers, new importers exhibit even stronger positive shifts in productivity distribution leading to the assumption that it was importing status that accelerated productivity growth in these firms. At the end of the period the shape of the distribution of new importers is almost identical to that of importers, while the distribution of non-importers remains more dispersed and positioned significantly to the left.

So far, I have presented some rather suggestive findings on the positive impact of intermediate inputs import initiation on firm productivity. In the remaining part of this section, I will inspect the effects of importing even more thoroughly by tracing the movement of various firm characteristics prior and after the starting year of foreign sourcing. New importers will be pooled and synchronized to the common technical timeline, so that year t will denote the first year of importing, t+1 the year after and so forth. Various performance indicators will then be observed for the group of new importers and averaged together. Figure 5-6a-Figure 5-6g present the progress of eight performance measures in 917 new importers available in our sample. A firm is be tagged as new importer if it switched from zero imports of intermediate inputs to a positive value and continued importing uninterruptedly until the last observation available (2003 or the closure). This definition excludes firms that started importing inputs in the first year of their market presence. Because the foreign trade data is available only for the period 1994-2003, new importers will be identified from this period. Performance measures unrelated to trade flow information, however, will be tracked over the longer period between 1994 and 2005, for which the accounting data is available.

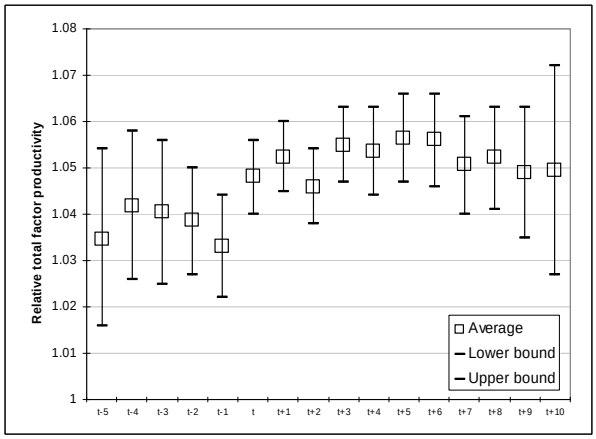
Figure 5-6a and Figure 5-6b depict the development of relative productivity as measured by value added per employee and total factor productivity, respectively. Both measures experience very similar movement in time, but they differ in the relative position. While average relative labour productivity of future importers is below industry average, their relative total factor productivity outstrips the industry average already before the beginning of importing. It should be stressed, however, that both productivity measures are still higher than the averages for non-importing firms, because both variables are expressed relative to industry average and not relative to non-importers. Bearing in mind this consideration, the self-selection into importing hypothesis remains valid also in this context. Both indicators of productivity increase substantially after the first year of importing and slightly decline in the last four periods ((t+7) – (t+10)). Nevertheless, even at the end of the 10th year of importing, relative productivity of the remaining new importers stays above the levels prior to import initiation.

Figure 5-6a-g: Performance of new importers before, at, and after the beginning of foreign input sourcing as measured by relative labour productivity (a), relative total factor productivity (b), relative sales (c), relative employment (d), relative capital intensity (e), number of imported varieties (f), number of imported markets (g), and share of imported intermediate inputs in total material costs, 1994-2005.

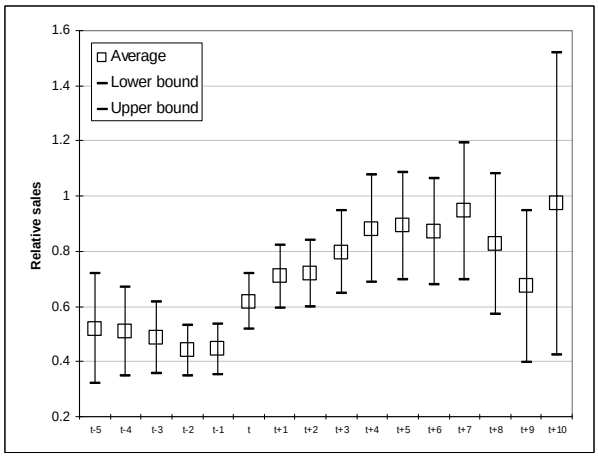
a)



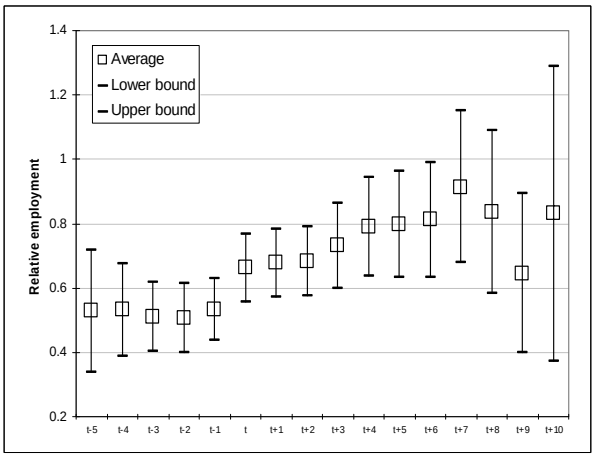
b)



c)

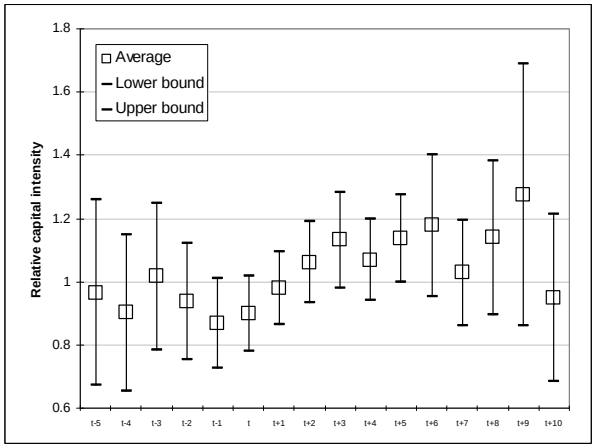


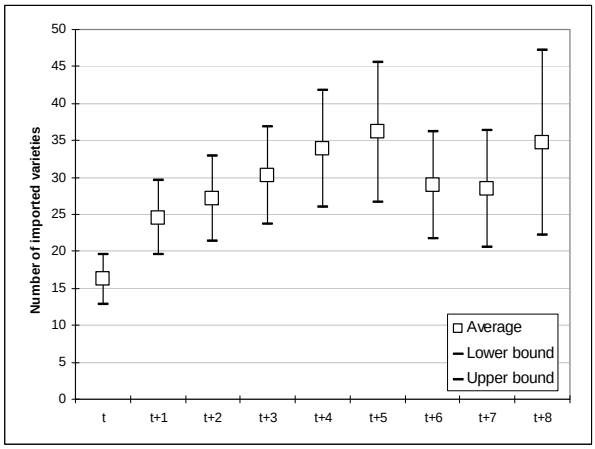
d)



e)

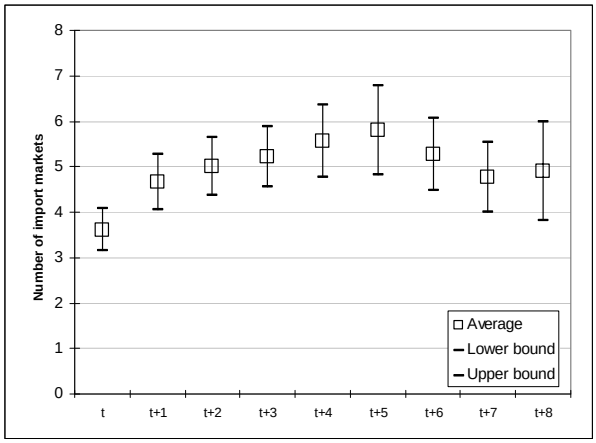
f)

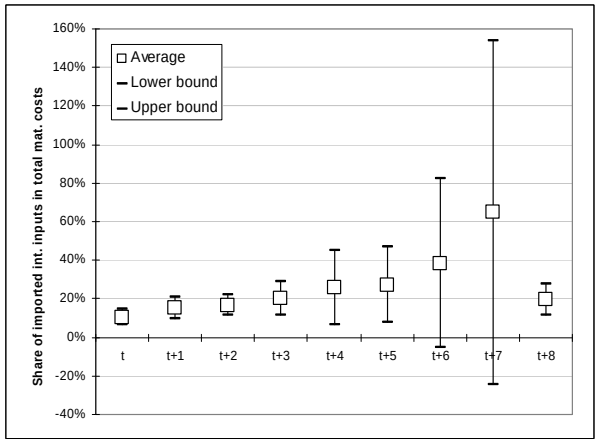




g)

h)





Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees. New importers are firms that switched from non-importing to permanent foreign sourcing somewhere in the period 1995-2003. Performance measures for these new importers cover the period 1994-2005. Lower and upper bounds represent the 95% confidence interval for the average value of performance measure. Time *t* denotes technical time and is set in the way that *t*+*k* represents *k* years after the beginning of intermediates importing.
Source: author's own calculations

Figure 5-6a and Figure 5-6b reveal another interesting finding that casts light on the possible weakness of value added per employee as a measure of productivity. If we compare the biannual upward shift in both productivity indicators from *t*-1 to *t*+1, we observe that relative labour productivity increased by 13 percentage points (or by 14.4%), while the increase for TFP amounts to only 1.9 percentage points (or 1.87% growth rate). The difference lies in the fact that labour productivity accounts for the changes in only one production factor (labour), while TFP considers the adjustment of firm capital stock in addition to labour input. The explanation for substantial difference can therefore be found by looking at the changes in relative capital-labour ratio during the same period (Figure 5-6e). It turns out that new importers not only increased the number of employees relative to the industry average (Figure 5-6f), but augmented to an even larger degree their capital stocks as suggested by the increase of relative capital intensity by 11 percentage points (or by 13%). Due to the observed stickiness of labour relative to capital input, the productivity measured by value added per employee overstates the actual productivity gains of importing as it assigns all the output growth to labour.

Figure 5-6c uncovers the fact that the largest improvement of performance in the period of importing comes in the form of significantly larger relative sales that escalate from less than 50% of the industry average a year before import start to roughly the industry average by the 7^{th} or 10^{th} subsequent year. In the years prior to import launch, the would-be importers were actually losing their relative market position. From this perspective, offshoring appears to be a deliberate strategic decision by which a firm is to be pulled out of the flagging condition.
The evolution of employment in new importers closely relates to the movement in total revenue, although the shifts appear more moderate and even (Figure 5-6d). Unlike total

revenue, employment in new importers never reaches the industry average but evens out at around 85% of the industry average.

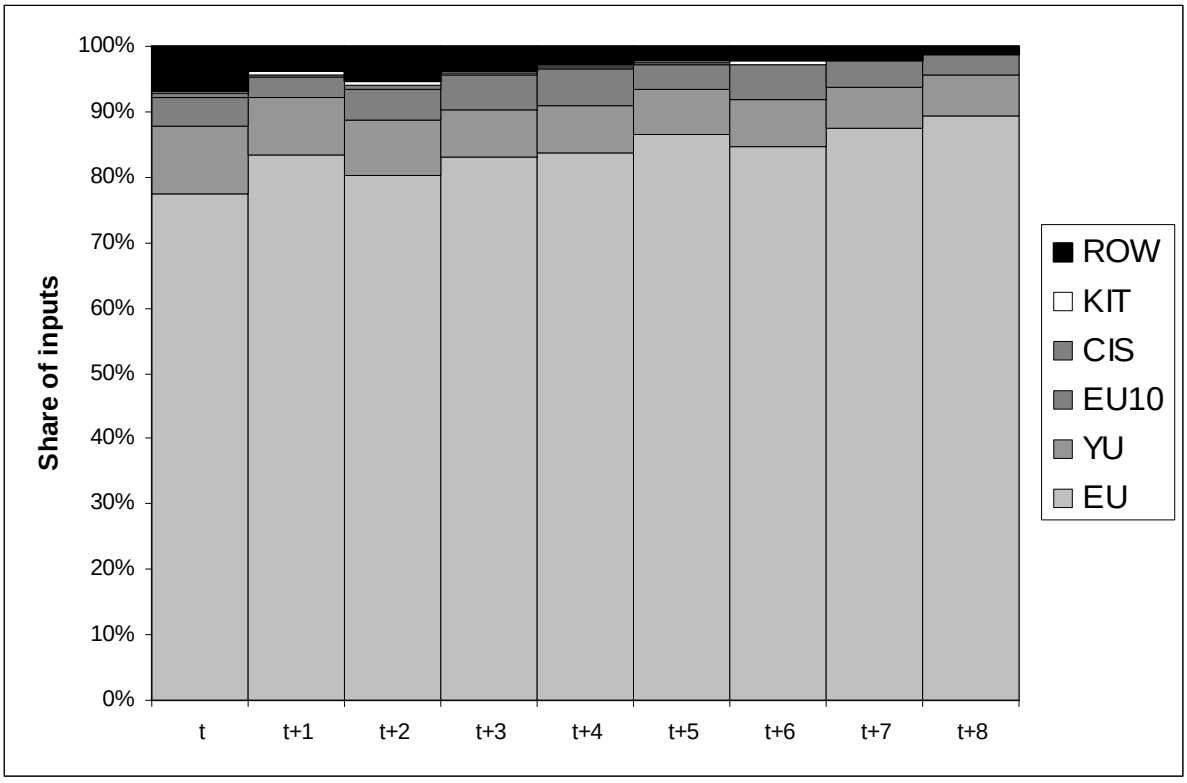
The evidence in the previous sections revealed that more productive importers source broader range of distinct intermediate inputs from a larger number of countries and exhibit a larger share of foreign intermediates in the total material costs. Besides, the last figures also showed that new importers notably increase relative productivity after they start importing, so I examine whether these productivity gains influence the extent of involvement in foreign sourcing also in new importers. Figure 5-6f trails the number of imported varieties in an average new importer through time. The number of varieties starts at 16 in the firts year and gradually increases to 35 in the 8th year. Comparing the latter figure with the average number of varieties for the entire population of importers (48 varieties) reveals that broadening the range of imported intermediate inputs is a lengthy and demanding process Apparently, firms need to gain experience, efficiency, absorptive capacity, and business networks as they carry out foreign sourcing in order to advance to broader range of foreign inputs.

Figure 5-6g follows the average number of countries from which new importers source their inputs. In the first six years of importing, additional import market is added every two years. After the ninth year, average new importer sources from 5 countries, up from 3.6 in the starting year. It appears that expanding to an additional import market requires a lot of resources since new importers are much faster at extending the range of intermediate inputs from abroad than spreading the upstream vertical chain geographically. However, given that the average number of import countries for the entire population of importers is 7.5, it can be observed that after nine years of importing denovo importers still lag significantly in the number of imported inputs and the number of countries from which these are procured. Finally, Figure 5-6h depicts the share of foreign inputs in new importers' material cost. Starting small, the share gradually increases from 10% to around 20% (the industry average) in the 9th year of importing. The doubling of the share in the period of 9 years is consistent with the doubling the number of imported input varieties, whereas the increase in the number of origin countries is much more modest.

Positive relationship between the switch to foreign sourcing and subsequent productivity gains can theoretically influence the geographical pattern of input sourcing. More productive firms are expected to be more adept to use increasingly more sophisticated inputs. These inputs can in the earlier stages be too demanding in terms of sunk implementation costs and firm's technological absorption capacity. As firms learn how to manage cross-border sourcing relationships more efficiently, establish B-2-B networks, realize all the potential that foreign suppliers offer, and become themselves more efficient, their demand and the capability to advance to more technologically sophisticated intermediate inputs and more complex business relationships increases. One of the possible outcomes of this process could be the shift to more developed sourcing markets, the hypothesis I examine now. Figure 5-7 reveals a few interesting empirical facts regarding the geographical composition of new importer's input

sourcing. First, from the inception, denovo importers acquire inputs predominantly from industrialized European countries. Second, despite geographical and cultural proximity, the share of Western Balkan countries in total intermediate input sourcing is small and has in fact decreased from 10% in 1994 to 6.4% in 2003. This is somehow in contrast to theoretical expectations and the fact that the series of Balkan wars and their resolution made the business environment more, not less friendly. The other fact that should speak in favour to increased involvement of Slovenian manufacturing firms offshoring to this region is an extensive wage gap between the two regions due to lower productivity in the Balkan countries, which could be used to reduce production cost through wage arbitrage. Third, new member states, CIS countries and China play a negligible and diminishing role in Slovenian manufacturing inputs sourcing. Finally, the share of imports from developed European countries was increasing in time (from 77% in 1994 to 90% in 2003), which is supportive to the hypothesis that new importers switch to technologically more advanced inputs as they gain experience and improve their efficiency.

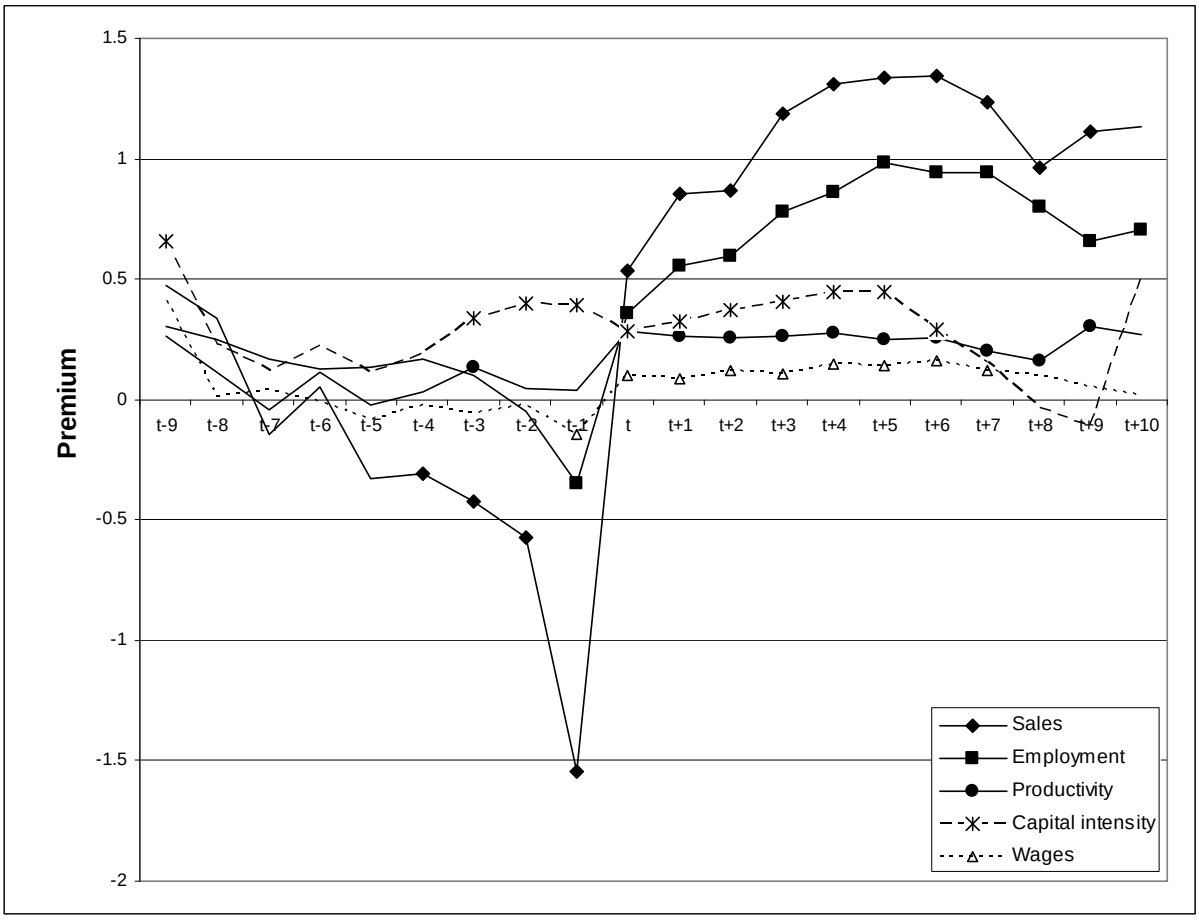
Figure 5-7: Geographical composition of intermediate input imports of new importers, 1994-2003.



Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees. New importers are firms that switched from non-importing to permanent foreign sourcing somewhere in the period 1995-2003. Time *t* denotes technical time and is set in the way that *t+k* represents *k* years after the beginning of intermediates importing. EU include all the developed European countries, YU former republics of Yugoslavia and Albania, EU10 new EU member states from the last two enlargements, CIS are the countries from the former Soviet bloc, KIT is China, and ROW is rest of the world.
Source: author's own calculations

Since the majority of manufacturing firms are already importing intermediate inputs, which questions the validity of using the relative-to-industry-average performance measures, I now present the results of the regression analysis where I estimate the percentage premium of new importers compared to non-importers only. Like in Bernard and Jensen (1999), I also control for firm size, time and industry effects. To control for the effects of exporting, foreign ownership and multinationality I also include the corresponding dummy variables. In this setting, significance and size of the premium is identified with the coefficient on the dummy variable that distinguishes new importers from non-importing firms. Figure 5-8 presents the results of the regression analysis for five performance measures: total revenues, employment, labour productivity, capital intensity, and average wages.

Figure 5-8: Premium of new importers relative to non-importers, 1994-2005.



Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees. New importers are firms that switched from non-importing to permanent foreign sourcing somewhere in the period 1995-2003. Time *t* denotes technical time and is set in the way that *t+k* represents *k* years after the beginning of intermediates importing. Premium is the value of coefficient on the new importer dummy. Statistically significant premiums (to 5%) are indicated by markers.
Source: author's own calculations

In most of the performance indicators upcoming new importers do not significantly differ form other non-importing firms in the years before the start of importing. Notable exception is total revenue where future new importers display significantly lower output than control

firms, especially one year before the start of importing. This is most probably due to the fact that the majority of new importers start importing already in the second year of existence, the fact that I further explore below. Capital intensity, on the other hand, is the only characteristic that does not undergo any significant shift after the import initiation. New importers are from 40-50% more capital intensive than non-importers already prior to the switch to foreign sourcing and remain so afterwards as well.

Before intermediate inputs sourcing from abroad, firms pay wages that do not differ from average wages in non-importing firms, but increase employee compensation afterwards. In the periods of foreign sourcing, new importers pay on average 9-17% higher wages than domestically-oriented competitors. Again, the largest improvement comes in the form of total revenue where new importers exhibit 70% higher sales than non-importers already in the year of import initiation. The premium then escalates to as much as 280% and calms down somewhat afterwards. The revenue boost is tightly related to employment growth in new importers, although the latter is less pronounced and more smooth. In the fifth year after the start of offshoring, employment in new importers is 165% higher than non-importers', a hefty increase from the first year's 45% premium. Productivity of new importers increases from the level of other non-importers to 33% premium in the first year of foreign sourcing and remains significant as long as 10 years after, slowly declining to 23% in t+8. Compared with Figure 6a, productivity movement relative to non-importers exhibits different pattern than in the comparison to the industry average. In the first case, the premium first overshoots and then levels off at somewhat lower, yet still significantly positive level, whereas in the case of relative-to-industry-average productivity, new importers gradually increase their average productivity and finally settle down after a minor downward correction. The overall gain relative to the year before import start, however, is similar in both cases and amounts to around 20%. It should be noted that the estimated premia for new importers are robust to major omitted variable bias as I control for some other factors (export, foreign ownership, and multinationality status) that might influence the difference between new importers and non-importers and are highly correlated with the import status.

Even the last regression analysis, where I compared new importers with non-importers, is methodologically inappropriate for evaluating the effect of foreign sourcing of intermediate inputs on firm performance. Let me take age of a firm for example: it could be that new importers are on average younger than non-importing firms. According to the well-established empirical fact (e.g. Klette and Kortum 2004, p. 990), incipient firms grow faster than indigenous counterparts, which would imply that I am assigning too much of the measured improvements in various performance indicators to the importing status, where in fact a significant part of the gains are due to the systematically different age structure. Table 5-27 substantiates this concern as it shows that new importers indeed start importing very early in their existence: most of the firms start sourcing some intermediate inputs from abroad already in the first year ("born-importers"). In addition, the incidence of switching from domestic to foreign sourcing declines rapidly with age so that 90% of new importers start importing

already by their third year on the market. Observing only the subsample of firms that I use in the following empirical analysis (new importers without "born-importers") does not significantly change the skewness of the age distribution and the message that follows.

Table 5-27: Age of firms at the beginning of foreign sourcing of intermediate inputs, 1995-2003.

Age	Frequency	Share	Share w/o born importers	rval
1	1001	64.3%		0.88
2	286	18.4%	51.4%	0.85
3	104	6.7%	18.7%	1.03
4	52	3.3%	9.4%	1.02
5	37	2.4%	6.7%	0.91
6	34	2.2%	6.1%	0.87
7	19	1.2%	3.4%	0.86
8	12	0.8%	2.2%	1.46
≥9	12	0.8%	2.2%	1.21

Note: The statistics are based on the restricted sample that excludes firms with less than 5 employees. The data covers the period for which firms' age is known, hence the omission of the year 1994. New importers of intermediate inputs with age equal to 1 are so called born importers – firms that start importing inputs in the first year of operation. Because they are excluded from the analysis in the empirical part, I also present the share without them

Source: author's own calculations

The last column in Table 5-27 aims to verify the theoretical prediction of my model that a firm needs to enhance its productivity before it can profitably commence intermediate inputs offshoring, which is a lengthy process. Despite the fact that all age cohorts of new importers outstrip non-importers at the time of the change, there is no clear pattern between the relative productivity and the age of the firm at the beginning of importing. The most productive new importers relative to the corresponding industry average are those that start importing at the age of 3-4 and 8-9, whereas in the younger and intermediate ages new importers exhibit somewhat lower relative productivity. Nevertheless, the figures suggest that by the age firms start importing, they gain above average productivity relative to non-importing firms.

In short, the examination of firm age at the beginning of importing has reminded us that the naïve comparison of new importers with the broad sample of non-importers is conceptually misleading and econometrically inappropriate. In other words, all non-importers are a poor control group for identification of the true effect of importing. Moreover, apart from firm age there are several other dimensions over which new importers and non-importers differ substantially. As confirmed in the previous sections, firms self-select into foreign sourcing according to productivity and other characteristics that are correlated with it, such as capital intensity, size, export status, and multinationality status. In order to resolve the endogeneity issues just described, I now turn to methodologically more appropriate identification techniques. In the following section, I will present the results of the non-parametric propensity score estimation. My aim is to identify and estimate the size of the effect of importing on productivity growth and cumulative productivity increase, as well as to test the second core hypothesis of the article that foreign sourcing allows a firm to focus on its core competence.

The latter will be tested using propensity score matching applied to the data on firm innovation activities from five Community Innovation Surveys. By matching new importers with similar non-importing firms, I will be able to compare the actual performance outcome in new importers with the effect the entrants in import markets would have experienced, on average, had they not started to import. The estimated average effect of importing on the population of denovo importers will thus provide me with the causal impact of importing on productivity and innovation performance.

5.5. Results from propensity score matching

I now turn to the main results as shown in

Table 5-28-

Table 5-31 where I present the average treatment effects and cumulative effects of foreign sourcing of intermediate inputs on firm productivity.

Table 5-28 presents the results for labour productivity where new importers' productivity growth rates[10] are tracked from the two years before to the end of the third year after the beginning of importing. As explained in the methodological section, average treatment effect is calculated as the average of the difference in (time) differences between new importers and the corresponding control group. The estimate gives the productivity growth premium new exporters have experienced in each of the observed period. In other words, I estimate the excess (relative to that of a comparable group of non-importing firms) year-on-year increase in labour productivity before, at, and after the start of foreign sourcing.

The results reveal that prior to the switch from domestic to foreign sourcing, prospective importers on average grew at the same rate as the control group since average DID_{-2} and DID_{-1} are not significantly different from zero. Already in the first year of importing, however, new importers significantly improved their labour productivity growth relative to control group of non-exporters. The average treatment effect is highly significant in all four variants of propensity score matching and can be interpreted as an additional increase of labour productivity in the amount of 550 thousand Slovene tolars of value added per employee. The effect remains significant in the following year but falls to roughly 220 thousand tolars in the case of nearest neighbour matching techniques. Next two periods' growth rates of new importers in excess of the growth rates in control firms drop further towards zero and become insignificant. Apparently, the effect of intermediate inputs imports on productivity growth is short lasting since new importers improve their productivity on the year-to-year basis significantly more than similar non-exporters only in the first two years of importing, whereas in the following years the growth premium dissipates.

[10] In case of value added per employee the use of the term growth rate is actually not exactly appropriate, since I am referring to the time differential of labour productivity ($y_{it} - y_{it-1}$). For the sake of brevity, however, I use the term growth rate. In case of total factor productivity, on the other hand, the use of the term is exact since TFP enters in logarithms, so that the time differential is an acceptable proxy for growth rate ($\ln y_{it} - \ln y_{it-1} \approx dy/dt$).

Table 5-28: Average treatment effect of importing intermediate inputs on the growth of labour productivity (measured by value added per employee), 1994-2005.

Time span	Matchning type	ATT	SE[a]	Pr	Obs
DID_{-2}	nearest neighbour	37.663	123.930	0.3805	267
	k-nearest neighbours	84.850	110.390	0.2210	267
	mahalanobis	-188.602	106.033	0.9625	109
	mahalanobis w caliper	-152.940	125.392	0.8885	103
DID_{-1}	nearest neighbour	-240.215	112.779	0.9000	369
	k-nearest neighbours	-239.937*	175.733	0.9140	369
	mahalanobis	-45.055	116.344	0.6505	154
	mahalanobis w caliper	30.388	108.807	0.3900	142
DID_{0}	nearest neighbour	546.653***	116.840	0.0000	517
	k-nearest neighbours	578.616***	95.965	0.0000	517
	mahalanobis	548.401***	92.174	0.0000	247
	mahalanobis w caliper	514.248***	95.013	0.0000	233
DID_{+1}	nearest neighbour	236.173**	111.999	0.0175	469
	k-nearest neighbours	199.094***	75.270	0.0040	469
	mahalanobis	70.079	111.881	0.2655	208
	mahalanobis w caliper	104.914	174.282	0.2735	197
DID_{+2}	nearest neighbour	134.399*	96.998	0.0830	434
	k-nearest neighbours	66.125	73.269	0.1835	434
	mahalanobis	99.136	108.901	0.1815	186
	mahalanobis w caliper	99.168	159.117	0.2665	175
DID_{+3}	nearest neighbour	10.365	137.642	0.4700	284
	k-nearest neighbours	8.863	112.987	0.4685	284
	mahalanobis	25.431	171.368	0.4410	104
	mahalanobis w caliper	69.960	195.605	0.3605	102

Notes: DID_t denotes $\Delta y_{it}^{Newimporter} - \Delta y_{it}^{Control}$, where y is value added per employee (in 1,000 Slovene tolars). [a] bootstrapped standard errors (100 repetitions). For nearest neighbour matching sub-sampling based standard errors (100 repetitions) are reported. *, **, *** indicate significance at 10%, 5% and 1% level, respectively.

However, the lack of significance in the average treatment effect in the second and the third year after import initiation should not be interpreted as the absence of productivity effect of importing. Even though the productivity of new importers stops growing significantly faster than that of non-exporters, the former can still experience higher year-on-year growth rates of productivity, leading to higher, increasing and persistently significant productivity level differential. To test for the existence of cumulative productivity gains in the absence of significant year-to-year growth rate differentials, I observe the entire productivity path of import entrants and compare it to that of the control group by estimating the productivity gain after *s* years of importing.

Table 5-29 reports the results of the average cumulative effect of foreign sourcing on labour productivity. In all four years after the import initiation, the productivity gains (relative to the year before importing) are higher in new importers than in control non-importers. The results are highly significant in each estimation technique and highly comparable in values. At the

end of the third year after the beginning of importing, labour productivity in denovo importers is 1 million tolars per employee higher than would be had they not started importing intermediate inputs. This means that in each of the four years of importing, new importers increased their productivity on average by 250 thousand tolars per employee more than their competitors from the control group.

Table 5-29: Cumulative effect of importing intermediate inputs on the growth of labour productivity (measured by value added per employee), 1994-2005.

Time span	Matchning type	ATT	SE[a]	Pr	Obs
CUM_0	nearest neighbour	546.653***	116.840	0.0000	517
	k-nearest neighbours	578.616***	95.965	0.0000	517
	mahalanobis	548.401***	92.174	0.0000	247
	mahalanobis w caliper	514.248***	95.013	0.0000	233
CUM_1	nearest neighbour	692.892***	120.825	0.0000	469
	k-nearest neighbours	694.063***	93.110	0.0000	469
	mahalanobis	769.523***	175.554	0.0000	213
	mahalanobis w caliper	762.706***	197.771	0.0000	199
CUM_2	nearest neighbour	827.364***	137.518	0.0000	436
	k-nearest neighbours	798.025***	116.096	0.0000	436
	mahalanobis	888.347***	144.549	0.0000	186
	mahalanobis w caliper	869.714***	145.444	0.0000	174
CUM_3	nearest neighbour	999.305***	196.175	0.0000	288
	k-nearest neighbours	945.410***	156.949	0.0000	288
	mahalanobis	1034.032***	219.338	0.0000	107
	mahalanobis w caliper	1102.297***	228.316	0.0000	105

Notes: CUM_t denotes $\left(y_{i,s=t} - y_{i,s=-1}\right)^{Newimporter} - \left(y_{i,s=t} - y_{i,s=-1}\right)^{Control}$, where y is value added per employee (in 1,000 Slovene tolars). [a] bootstrapped standard errors (100 repetitions). For nearest neighbour matching sub-sampling based standard errors (100 repetitions) are reported. *, **, *** indicate significance at 10%, 5% and 1% level, respectively.

The use of value added per employee is a useful variable to estimate the effects of importing in that it offers the value of the effect in monetary terms. As I have showed, however, its methodological weaknesses as a measure for productivity stem from the fact that only labour input is involved in productivity calculation, leaving aside other important inputs that significantly determine the level of output and productivity. This is especially important in an environment where input adjustment takes place in suboptimal factor markets and asymmetric adjustment costs between the inputs. In light of these shortcomings, I present the results for analogous propensity score matching analysis on the total factor productivity estimated in the previous section by Kasahara-Rodrigue estimator.[11] Table 5-30 first presents the effects of importing on annual productivity growth rates, while Table 5-29 lists the results for the cumulative effects of importing.

[11] The use of OLS estimates of production function does not change the results because the alternative TFP measures appear to be robust to time differencing. In other words, different coefficients in production function affect the levels of measured productivity but hardly the time changes – exactly what enters in my matching analysis.

Table 5-30: Average treatment effect of importing intermediate inputs on the growth of productivity (measured by total factor productivity), 1994-2005.

Time span	Matchning type	ATT	SE[a]	Pr	Obs
DID_{-2}	nearest neighbour	-0.057	0.065	0.8080	218
	k-nearest neighbours	-0.049	0.054	0.8210	218
	mahalanobis	-0.060	0.067	0.8145	91
	mahalanobis w caliper	-0.070	0.080	0.8085	85
DID_{-1}	nearest neighbour	-0.058	0.057	0.8456	295
	k-nearest neighbours	-0.053	0.039	0.9120	295
	mahalanobis	-0.051	0.068	0.7730	132
	mahalanobis w caliper	-0.032	0.067	0.6815	116
DID_{0}	nearest neighbour	0.198***	0.048	0.0000	453
	k-nearest neighbours	0.222***	0.037	0.0000	453
	mahalanobis	0.208***	0.048	0.0000	206
	mahalanobis w caliper	0.189***	0.045	0.0000	198
DID_{+1}	nearest neighbour	0.061*	0.046	0.0885	425
	k-nearest neighbours	0.042*	0.029	0.0770	425
	mahalanobis	0.101*	0.066	0.0615	174
	mahalanobis w caliper	0.057	0.072	0.2165	161
DID_{+2}	nearest neighbour	0.060*	0.042	0.0785	398
	k-nearest neighbours	-0.004	0.028	0.5525	398
	mahalanobis	-0.055	0.053	0.8529	157
	mahalanobis w caliper	-0.044	0.054	0.7929	148
DID_{+3}	nearest neighbour	0.002	0.047	0.4830	256
	k-nearest neighbours	0.001	0.031	0.4855	257
	mahalanobis	0.117**	0.063	0.0315	81
	mahalanobis w caliper	0.077	0.082	0.1760	78

Notes: DID_t denotes $\Delta y_{it}^{Newimporter} - \Delta y_{it}^{Control}$, where y is total factor productivity. [a] bootstrapped standard errors (100 repetitions). For nearest neighbour matching sub-sampling based standard errors (100 repetitions) are reported. *, **, *** indicate significance at 10%, 5% and 1% level, respectively.

As before, new importers grow significantly faster tan non-importers only in the first and conditionally the second year (Table 5-30). The extra growth rate of productivity in the first year of importing is impressive: the average productivity of new importers increases by as much as 20 percentage points faster than faster than in non-importing firms. Compared to similar analysis of new exporters on the same data set, De Loecker (2007) and Damijan et. al. (2004) find significant but lower effects of exporting on productivity growth in the first year: 8 and 14 percentage points, respectively. In the second year after import initiation, the growth premium decreases to around 5 percentage points but remains significant only at 10% significance level. In the following periods new importers do not experience any significantly higher productivity growth in comparison to similar non-importers.

Table 5-31: Cumulative effect of importing intermediate inputs on the growth of productivity (measured by total factor productivity), 1994-2005.

Time span	Matchning type	ATT	SE[a]	Pr	Obs
CUM_0	nearest neighbour	0.198***	0.048	0.0000	453
	k-nearest neighbours	0.222***	0.037	0.0000	453
	mahalanobis	0.208***	0.048	0.0000	206
	mahalanobis w caliper	0.189***	0.045	0.0000	198
CUM_1	nearest neighbour	0.243***	0.062	0.0000	411
	k-nearest neighbours	0.275***	0.042	0.0000	411
	mahalanobis	0.327***	0.061	0.0000	179
	mahalanobis w caliper	0.287***	0.080	0.0000	164
CUM_2	nearest neighbour	0.265***	0.067	0.0000	378
	k-nearest neighbours	0.247***	0.049	0.0000	378
	mahalanobis	0.206***	0.057	0.0000	162
	mahalanobis w caliper	0.166***	0.070	0.0090	153
CUM_3	nearest neighbour	0.344***	0.074	0.0000	240
	k-nearest neighbours	0.345***	0.063	0.0000	240
	mahalanobis	0.414***	0.070	0.0000	83
	mahalanobis w caliper	0.332***	0.101	0.0005	80

Notes: CUM_t denotes $\left(y_{i,s=t} - y_{i,s=-1}\right)^{Newimporter} - \left(y_{i,s=t} - y_{i,s=-1}\right)^{Control}$, where y is total factor productivity. [a] bootstrapped standard errors (100 repetitions). For nearest neighbour matching sub-sampling based standard errors (100 repetitions) are reported. *, **, *** indicate significance at 10%, 5% and 1% level, respectively.

Despite the short-lived year-to-year growth effects of importing, firms that switched from domestic to foreign sourcing of intermediate inputs achieve significantly higher cumulative productivity improvements relative to the year prior to the change (

Table 5-31). Cumulative effects are highly significant in all the years and matching approaches and, above all, increase steadily in time. After initial 20 percentage point hike, new importers later on gain additional 15 percentage points, so that by the end of the fourth year of importing, their four-year productivity growth is around 35 percentage points higher than the growth rate in control firms. The reassuring feature of

Table 5-28-

Table 5-31 is that the estimated effects are robust across different estimation techniques and number of observations. In addition, in the year prior to import initiation, prospective importers and their control counterparts experience equal productivity changes. Insignificant in any case, the difference in productivity growth between new importers and non-importers in this period is negative rebutting possible claims that the productivity trend is higher already prior to the change.

In order to further substantiate the positive shift of productivity growth in the first years of offshoring compared to the periods before, I run the regression as specified in equation (16), where I compare productivity growth rates (*DIDs*) in the periods after the switch to foreign sourcing with those prior to import initiation. I additionally control for other factors that might influence the excess growth rate of new importers, such as capital intensity, imported inputs share, foreign ownership, multinationality status, and common time-specific industry-wide shocks. The emphasis in these regressions will be given to the temporal effects of import status expressed by the size and significance of a series of dummy variables ($start_s$). These will tell by how much, controlling for other factors, import of intermediate inputs increases productivity growth relative to non-importing firms and relative to periods before import start. Difference-in-differences in the importing periods will thus be compared to the difference-in-differences prior to foreign sourcing initiation and this will identify the duration and significance of the perceived benefits from importing.

Table 5-32: Productivity improvements of new importers relative to domestic sourcers of intermediate inputs (difference-in-differences matching using value added per employee), 1994-2005.

	nearest neighbor		k-nearest neighbours		mahalanobis		mahalanobis w caliper	
$rval_{t-1}$	-471.349***		-497.595***		-215.955**		-236.929**	
	(-7.06)		(-8.72)		(-2.50)		(-2.19)	
rkl_{t-1}	36.640	-38.756	43.346*	-36.248*	37.767	28.361	56.087	46.611
	(1.36)	(-1.55)	(1.88)	(-1.68)	(0.91)	(0.68)	(1.10)	(0.91)
start0	775.319***	793.926***	775.817***	795.460***	594.494***	632.200***	534.235***	578.999***
	(4.92)	(4.98)	(5.76)	(5.79)	(4.36)	(4.65)	(3.11)	(3.38)
start1	613.799***	524.118***	536.047***	441.372***	225.627	199.666	173.863	147.172
	(3.46)	(2.92)	(3.53)	(2.86)	(1.42)	(1.25)	(0.87)	(0.74)
start2	621.081***	502.587**	499.877***	374.785**	280.000	254.787	334.870	310.729
	(3.15)	(2.53)	(2.97)	(2.19)	(1.51)	(1.37)	(1.43)	(1.33)
start3	339.537	217.236	315.236*	186.125	249.233	230.388	293.676	273.693
	(1.58)	(1.00)	(1.72)	(1.00)	(1.15)	(1.06)	(1.10)	(1.02)
$Minpshare_t$	165.464	291.869	48.369	181.813	195.438	228.908	187.730	220.906
	(0.54)	(0.95)	(0.19)	(0.69)	(0.97)	(1.14)	(0.76)	(0.90)
$oFDI_t$	-170.771	-239.386	-22.909	-95.345	-383.805	-481.614	-554.017	-661.908
	(-0.29)	(-0.40)	(-0.05)	(-0.18)	(-0.47)	(-0.58)	(-0.55)	(-0.66)
$iFDI_t$	-20.093	-130.505	310.188	193.627	866.634**	774.368**	908.285**	805.217*
	(-0.05)	(-0.34)	(0.95)	(0.58)	(2.30)	(2.06)	(1.97)	(1.75)
Ind. dummies	no	no	no	no	no	no	no	no
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes

N	1847	1847	1847	1847	760	760	719	719
adj. R^2	0.0378	0.0121	0.0559	0.0172	0.0489	0.0422	0.0351	0.0298

Notes: the dependent variable is $\Delta y_{it}^{Newimporter} - \Delta y_{it}^{Control}$, where y is value added per employee (in 1,000 Slovene tolars); t-statistics are in parentheses. *, **, *** indicate significance at 10%, 5% and 1% level, respectively.

Table 5-32 reports the results for the difference-in-differences regression using value added per employee as a productivity measure. In contrast to

Table 5-28 where the average treatment effect was significant only in the first two periods, the regressions above indicate that also the third year of importing brings about significantly higher productivity increases relative to control non-importers. Lagged dependent variable is also significant and negatively signed, meaning that high productivity growth in the previous period implies lower productivity growth in the present. Outward FDI (*oFDI*) is insignificant in all specifications which indicates that the effects of foreign sourcing does not differ between multinational and non-multinational new importers. In other words, captive offshoring does not seem to result in higher gains from international fragmentation of production chain. Where significant, the coefficient on foreign ownership (*iFDI*) is positive and of significant size with respect to other coefficients. Sourcing within foreign multinational network thus seem to be more beneficial for firm productivity growth. The reasons could be leaner supply chain, more sophisticated intermediate inputs, better control over the quality of inputs, superior on-time delivery, better cooperation and support services, and better management. Capital intensity and the intensity of input sourcing do not seem to have any significant effects although the coefficients are positive.

Table 5-33: Productivity improvements of new importers relative to domestic sourcers of intermediate inputs (difference-in-differences matching using total factor productivity), 1994-2005.

	nearest neighbor		k-nearest neighbours		mahalanobis		mahalanobis w caliper	
$rtfp_{t-1}$	-2.670***		-2.686***		-3.248***		-3.388***	
	(-14.26)		(-18.96)		(-10.64)		(-10.13)	
rkl_{t-1}	0.002	-0.012	0.003	-0.011	0.000	-0.009	0.002	-0.007
	(0.24)	(-1.37)	(0.53)	(-1.57)	(-0.01)	(-0.66)	(0.13)	(-0.51)
start0	0.270***	0.274***	0.300***	0.304***	0.258***	0.316***	0.241***	0.295***
	(4.84)	(4.63)	(7.10)	(6.52)	(3.44)	(3.90)	(2.96)	(3.35)
start1	0.262***	0.192***	0.207***	0.136***	0.255***	0.206**	0.193**	0.137
	(4.17)	(2.89)	(4.35)	(2.61)	(2.88)	(2.15)	(2.00)	(1.31)
start2	0.243***	0.149**	0.174***	0.080	-0.008	-0.062	0.074	0.005
	(3.52)	(2.05)	(3.33)	(1.39)	(-0.08)	(-0.57)	(0.66)	(0.04)
start3	0.122	0.008	0.180***	0.065	0.339***	0.233*	0.270*	0.162
	(1.59)	(0.09)	(3.12)	(1.03)	(2.64)	(1.68)	(1.94)	(1.08)
$Minpshare_t$	0.062	0.182	-0.002	0.120	-0.069	0.013	-0.150	-0.051
	(0.45)	(1.25)	(-0.02)	(1.04)	(-0.42)	(0.07)	(-0.84)	(-0.27)
$oFDI_t$	-0.216	-0.295	-0.058	-0.138	-0.394	-0.383	-0.562	-0.524
	(-1.02)	(-1.32)	(-0.36)	(-0.78)	(-0.92)	(-0.82)	(-1.24)	(-1.07)
$iFDI_t$	0.292**	0.171	0.289***	0.168	0.276	0.249	0.525*	0.395
	(2.19)	(1.22)	(2.87)	(1.51)	(1.05)	(0.87)	(1.77)	(1.23)
Ind. dummies	no	no	no	no	no	no	no	no
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes
N	1673	1673	1673	1673	659	659	615	615
adj. R^2	0.1224	0.0152	0.1992	0.0258	0.1655	0.0197	0.1632	0.0209

Notes: the dependent variable is $\Delta y_{it}^{Newimporter} - \Delta y_{it}^{Control}$, where *y* is total factor productivity; t-statistics are in parentheses. *, **, *** indicate significance at 10%, 5% and 1% level, respectively.

Similarly, Table 5-33 reports results for the impact of importing on productivity growth as measured by total factor productivity. As before, I find evidence of significantly higher productivity growth in the first two years of importing, yet in some specifications the third and the fourth year are significant as well. Lagged productivity enters significantly negative, while imported input share and lagged relative capital intensity do not affect current productivity growth rates. Importers with outward direct investment do not increase TFP significantly different than non-multinational new importers, but foreign-owned firms on average do grow faster than domestic new importers.

Reve (1990) points out that strategic core is a dynamic concept, with three key issues of theoretical and managerial concern related to strategic core: (1) the creation of the strategic core (theories of entrepreneurship or innovation), (2) the question of how to protect the strategic core to maintain a competitive advantage, and (3) the question of how the strategic core is continuously developed and renewed as environmental requirements change. In a changing world a strategic core which in the past provided a competitive advantage may be of little value today. Strategic core needs to be continually redefined as market and competitive forces change. The key hypothesis in my paper is that international fragmentation of production chain enables firms to focus on strategic core by delegating out peripheral functions to foreign providers. The result is that more attention and resources can be allocated to firm's core competence, leading potentially to higher product and process innovation. Linking Community Innovation Survey data with the accounting data from annual financial statements and firm-level foreign trade data allows me to test verify the hypothesis that the focus effect is at work and that one of its particular transmission channels operates through product and process innovation.

If the hypothesis of focusing on core hypothesis is correct, firms that undertook an offshoring initiative would experience significantly more frequent introduction of new products to the market. Table 5-34 presents the results of propensity score matching of importing initiation on product innovation. Because of small sample and larger data requirements of mahalanobis matching, only nearest neighbour matching is performed. For each period, I first match on each industry and each year separately which produces pairs (groups) of new importers and control firms from the same 2-digit NACE sector and operating in the same year. To gain some more observations, I then match only within the 2-digit industries regardless of the year the observation is from. In this way I assign to each new importer a control firm (group of firms) from the same industries but not necessarily in the same year, allowing for possible time variant industry-wide shocks influence the estimate of treatment effect. Finally, I perform matching over the entire manufacturing and time period, gaining some additional observations at the account of more biased estimates. Due to the scarcity of the data, I also do not follow the difference-in-differences approach but only compute the usual average treatment effect based on the current difference between new importers and control group.
The results reported in Table 5-34 present the effect of foreign sourcing on the intensity of product innovation. Two years prior to import start, prospective importers do not differ from

their non-importing competitors in the rate at which they deliver new products on the market. Already in the year of import initiation, however, denovo importers introduce product innovations with around 7-11% higher rate than non-importing counterparts. The difference between the two groups becomes even larger and more significant in the next two years as the importers are by 11-15% more likely to launch new products on the market. The effect persists even after four and six years after the switch from domestic to foreign sourcing of intermediate inputs although the small number of remaining observations in the (*s*+6) period puts some doubt on the validity of the ATT estimate. Nevertheless, the evidence suggests that new importers transform themselves form the average (relative to non-importing firms) to the above average product innovators in the periods after the import initiation. Unlike the effect on annual productivity growth rates, the effect on product innovation exhibits much longer persistency. I now turn from product to process innovation to test whether imported inputs enable firms to increase innovation across their processes.

Table 5-34: Average treatment effects of importing intermediate inputs on product innovation, 1996-2004.

Time span		Matchning type	ATT	SE	Pr	Obs
D_{-2}	by industry & by time	nearest neighbour	0.0526	0.1203	0.3334	19
		k-nearest neighbours	0.0395	0.1151	0.3678	19
	by industry	nearest neighbour	-0.0541	0.0862	0.7328	37
		k-nearest neighbours	-0.0446	0.0699	0.7362	37
	pooled	nearest neighbour	0.0506	0.0473	0.1440	79
		k-nearest neighbours	0.0279	0.0410	0.2490	79
D_0	by industry & by time	nearest neighbour	0.0952*	0.0571	0.0515	42
		k-nearest neighbours	0.1135**	0.0555	0.0238	42
	by industry	nearest neighbour	0.0595	0.0518	0.1269	84
		k-nearest neighbours	0.0518	0.0473	0.1383	84
	pooled	nearest neighbour	0.0672**	0.0399	0.0474	134
		k-nearest neighbours	0.0576*	0.0352	0.0522	134
D_{+2}	by industry & by time	nearest neighbour	0.1429*	0.0847	0.0517	28
		k-nearest neighbours	0.1161*	0.0848	0.0912	28
	by industry	nearest neighbour	0.0588	0.0652	0.1855	51
		k-nearest neighbours	0.1118**	0.0546	0.0230	51
	pooled	nearest neighbour	0.1359***	0.0391	0.0004	103
		k-nearest neighbours	0.1451***	0.0373	0.0001	103
D_{+4}	by industry & by time	nearest neighbour	0.1053*	0.0723	0.0814	19
		k-nearest neighbours	0.1053*	0.0723	0.0814	19
	by industry	nearest neighbour	0.0833**	0.0467	0.0416	36
		k-nearest neighbours	0.0787**	0.0443	0.0421	36
	pooled	nearest neighbour	0.0690*	0.0483	0.0795	58
		k-nearest neighbours	0.1038**	0.0458	0.0135	58
D_{+6}	by industry & by time	nearest neighbour	0.3750**	0.1830	0.0398	8
		k-nearest neighbours	0.3750**	0.1830	0.0398	8
	by industry	nearest neighbour	0.3077**	0.1332	0.0198	13
		k-nearest neighbours	0.2308*	0.1342	0.0555	13
	pooled	nearest neighbour	0.1765*	0.1282	0.0938	17
		k-nearest neighbours	0.1522**	0.0876	0.0482	17

Notes: D_t denotes $y_{it}^{Newimporter} - y_{it}^{Control}$, where y is dummy for product innovation. [a] bootstrapped standard errors (100 repetitions). For nearest neighbour matching sub-sampling based standard errors (100 repetitions) are reported. *, **, *** indicate significance at 10%, 5% and 1% level, respectively.

Table 5-35 presents the estimates of the average treatment effect of import initiation on the propensity to introduce process innovations in the period from (*s*-2) to (*s*+6). In contrast to product innovation, process innovation is more common in prospective importers already prior to import start. It appears that firms considering fragmenting their production processes introduce improvements in management and execution of internal processes, eventually leading to foreign sourcing of inputs. In case of matching within the same industry and year, the effect drops from 16% to 12% in the year of transformation and stays at around 10% until the end of the fifth year of importing.

Table 5-35: Average treatment effects of importing intermediate inputs on process innovation, 1996-2004.

Time span		Matchning type	ATT	SE	Pr	Obs
D_{-2}	by industry & by time	nearest neighbour	0.1579**	0.0859	0.0414	19
		k-nearest neighbours	0.1579**	0.0859	0.0414	19
	by industry	nearest neighbour	0.0270	0.0724	0.3555	37
		k-nearest neighbours	0.0613	0.0612	0.1619	37
	pooled	nearest neighbour	0.0759**	0.0350	0.0165	79
		k-nearest neighbours	0.0771**	0.0357	0.0169	79
D_0	by industry & by time	nearest neighbour	0.1190**	0.0506	0.0117	42
		k-nearest neighbours	0.1190**	0.0506	0.0117	42
	by industry	nearest neighbour	0.0476	0.0533	0.1871	84
		k-nearest neighbours	0.0571	0.0497	0.1269	84
	pooled	nearest neighbour	0.1269***	0.0373	0.0004	134
		k-nearest neighbours	0.1162***	0.0342	0.0004	134
D_{+2}	by industry & by time	nearest neighbour	0.1071*	0.0787	0.0922	28
		k-nearest neighbours	0.1131*	0.0728	0.0659	28
	by industry	nearest neighbour	0.1176**	0.0535	0.0162	51
		k-nearest neighbours	0.1052**	0.0526	0.0255	51
	pooled	nearest neighbour	0.1748***	0.0376	0.0000	103
		k-nearest neighbours	0.1883***	0.0387	0.0000	103
D_{+4}	by industry & by time	nearest neighbour	0.1053	0.1053	0.1653	19
		k-nearest neighbours	0.0877	0.1077	0.2129	19
	by industry	nearest neighbour	0.0833	0.0732	0.1313	36
		k-nearest neighbours	0.0787	0.0688	0.1303	36
	pooled	nearest neighbour	0.1207***	0.0497	0.0091	58
		k-nearest neighbours	0.1366***	0.0500	0.0041	58
D_{+6}	by industry & by time	nearest neighbour	0.3750**	0.1830	0.0398	8
		k-nearest neighbours	0.3750**	0.1830	0.0398	8
	by industry	nearest neighbour	0.2308**	0.1216	0.0410	13
		k-nearest neighbours	0.2308**	0.1216	0.0410	13
	pooled	nearest neighbour	0.2353**	0.1060	0.0207	17
		k-nearest neighbours	0.1449*	0.0860	0.0530	17

Notes: D_t denotes $y_{it}^{Newimporter} - y_{it}^{Control}$, where y is dummy for process innovation. [a] bootstrapped standard errors (100 repetitions). For nearest neighbour matching sub-sampling based standard errors (100 repetitions) are reported. *, **, *** indicate significance at 10%, 5% and 1% level, respectively.

Within-industry matching produces somewhat lower and insignificant results in the periods prior and at the beginning of importing, yet in the second year denovo importers introduce process innovations at around 10% higher rate than non-importers. The effect turns insignificant next two years but returns even more pronounced in the sixth year. When new importers were allowed to be matched with firms in any industry and any year, the estimates of the average effect remain in line with the other two matching approaches in the periods of importing: new importers are on average by 12% more innovative in the year of import initiation, by 18% two years after and by 13% four years after the switch to foreign sourcing. Although positive and significant, the estimates for the sixth year after import initiation are based on small sample and thus cannot be considered as representative.

The results of the product and process innovation activity revealed that new importers are better in both types of innovations in the periods after the beginning of foreign sourcing. Comparing the average effects across the two types of innovations reveals that offshoring of intermediate inputs incites the process innovation even more intensively than the product innovations. However, given that the intensity of product innovation in prospective importers roughly equals that in the control non-importing firms prior to import initiation, while the former are already better process innovators then the latter, the subsequent improvement of new importers in the field of product innovations represents a far more important contribution of cross-border vertical fragmentation. Whereas new importers are already better process innovators than non-importers prior to import start and retain the supremacy also in the years of importing, the switch to foreign sourcing of components seems to ignite product innovation in the first place.

6. Conclusions

In order to survive in an increasingly competitive global market, firms need to focus their valuable resources on what they do best in order to innovate on their core competencies. The results above provide evidence that starting to import intermediate inputs indeed contributes to more successful product and process innovation. However, firms also need partners who can continue to innovate on the non-core inputs and processes that they outsource. Sourcing partners can help a company to focus on its core, balance risk and opportunity, lower costs, increase innovation across all of its value chain and finally, put in place attitudes to optimize all of these factors, socially and politically. Outsourcing and offshoring are essential components of this but only if they pave the way for firms to free up resources so they can focus on core competencies that lead to greater innovation. Quinn and Hillmer (1995) list four benefits of offshoring as a leverage to enhance company's core competence. First,

international fragmentation of production maximizes returns on internal resources by channelling investments and energies on what the enterprise does best. Second, well-developed core competencies provide formidable barriers against present and future competitors that seek to expand into the company's business, thus facilitating and protecting the strategic advantages of market share. Third, perhaps the greatest leverage of all is the full utilization of specialized external suppliers, investments, innovations, and professional capabilities that would otherwise be prohibitively expensive or even impossible to duplicate internally. Fourth, in rapidly changing marketplace and technological situations, the buyer-supplier joint strategy decreases risks, shortens cycle times, lowers investments, and creates better responsiveness to customer needs.

The results of the empirical analysis of Slovenian manufacturing firms indicate that foreign sourcing of intermediate inputs increases productivity growth in the first couple of years after the switch from domestic to cross-border procurement of inputs. Furthermore, productivity level of new importers shifts upward relative to domestic counterparts and remains significantly higher over a medium term. Most importantly, the evidence at hand implies that importing of intermediate inputs enhances firm's product and process innovation, leading to long-term improvement of competitiveness and market position.

In manufacturing, those industries that delayed or simply ignored the move to strategic offshoring paid and continue to pay a heavy price. Change in any industry is painful, especially when the industry is accustomed to premier stature. The only thing more painful, in the long run, is ignoring the change. For those individuals, organizations and nations who resist, the future will be uncompromising in passing judgment on their inability to innovate and keep pace.

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