UNIVERSITY OF LJUBLJANA
FACULTY OF ECONOMICS

Anže Burger

DYNAMIC EFFECTS OF INTERNATIONAL FRAGMENTATION OF PRODUCTION: EMPIRICAL ANALYSIS OF SLOVENIAN MANUFACTURING FIRMS

Doctoral Dissertation

Ljubljana, 2009

IZJAVA

Študent Anže Burger izjavljam, da sem avtor te doktorske disertacije, ki sem jo napisal pod mentorstvom doc. dr. Andreje Jaklič in somentorstvom izr. prof. dr. Jožeta Pavliča Damijana in skladno s 1. odstavkom 21. člena Zakona o avtorskih in sorodnih pravicah dovolim objavo doktorske disertacije na fakultetnih spletnih straneh.

V Ljubljani, dne 29. januarja 2009

Podpis:________________________

DINAMIČNI UČINKI MEDNARODNE FRAGMENTACIJE PROIZVODNEGA PROCESA: EMPIRIČNA ANALIZA PODJETIJ SLOVENSKE PREDELOVALNE INDUSTRIJE

Povzetek

Vedno večje število podjetij se odloča za zunanje izvajanje neključnih funkcij z namenom osredotočanja na ključne kompetence. Pričujoča disertacija prispeva k omejenemu naboru teoretične in empirične literature na temo povezanosti čezmejnega zunanjega izvajanja proizvodnje vmesnih dobrin in produktivnostjo podjetja. Osrednji namen disertacije je proučiti učinke vertikalne fragmentacije proizvodnega procesa na produktivnost. V tesni povezavi s primarnim namenom doktorskega dela želim dokazati tudi prisotnost učinka osredotočanja na osrednje kompetence podjetja kot enega izmed transmisijskih kanalov, preko katerega uvoz vmesnih dobrin povečuje produktivnost. Temeljna hipoteza doktorske disertacije namreč trdi, da lahko podjetja uporabijo mednarodno zunanje izvajanje procesov ne le kot učinkovit način zniževanja stroškov in izboljševanja kvalitete vstopnih inputov, pač pa tudi kot vzvod, s pomočjo katerega lahko redke vire preusmerijo v ključne poslovne kompetence. Z izdvajanjem standardiziranih, perifernih komponent in procesov se lahko podjetja bolje osredotočijo na aktivnosti kot so raziskave in razvoj, marketing in odnosi s strankami, s tem pa usmerijo vire na stvari, ki neposredno oblikujejo njihov konkurenčni položaj.

Z vidika prispevka k teoriji v disertaciji oblikujem teoretični model, v katerem se podjetja odločajo o organiziranosti svojega proizvodnega procesa v mednarodnem in dinamičnem tržnem okolju. Ogrodje modela je zasnovano na prispevkih Antrasa (2005a) in Antrasa in Helpmana (2004), vendar podjetja soočim z dinamičnim okoljem neehnega tekmovanja v produktivnosti. Predstavim model parcialnega ravnotežja, v katerem se heterogena monopolistično konkurenčna podjetja odločajo med vertikalno integracijo ali zunanjim izvajanjem dela proizvodnega procesa, ter med opravljanjem le-tega doma ali v tujini. Poleg tega podjetja lahko vsako obdobje investirajo tudi v izboljšanje svojih osrednjih kompetenc. Model uspe razložiti povezanost med mednarodnim zunanjim izvajanjem dela proizvodnega procesa in osredotočanjem na osrednje kompetence. Pokaže namreč, da vertikalna fragmentacija proizvodnega procesa v tujino omogoči podjetju povečati obseg investicij in s tem doseči višjo rast produktivnosti.

Namen empiričnega dela disertacije je preveriti prisotnost pozitivnega učinka mednarodnega zunanjega izvajanja del na produktivnost podjetij, obenem pa tudi identificirati in opredeliti tisti del učinka fokusiranja na osrednje kompetence, ki se izraža kot povečana inovacijska aktivnost na novo fragmentiranih podjetij. V ta namen uporabim panelno podatkovno bazo slovenskih podjetij iz predelovalne industrije v obdobju 1994-2005 s podrobnimi računovodskimi informacijami, podatki o mednarodni trgovini na ravni podjetij, podatki o neposrednih tujih investicijah in inovacijski aktivnosti. Z uporabo testov stohastične dominance (Kolmogorv-Smirnov in Mann-Whitney testa) potrdim hipotezo o samoizbiri boljših podjetij v mednarodno vertikalno fragmentacijo proizvodne verige, medtem ko rezultati ocenjevanja proizvodnih funkcij podkrepijo pozitivno povezanost med uvozom vmesnih dobrin in produktivnostjo podjetja. Z ekonometričnimi tehnikami paritve (angl. propensity score matching) nadalje testiram, ali podjetja, ki začnejo uvažati inpute, kasneje postanejo bolj produktivna. Analiza potrdi kavzalnost med uvozom in dvigom produktivnosti,

saj novi uvozniki vmesnih proizvodov postanejo statistično značilno bolj produtivni od primerljivih kontrolnih podjetij. Učinek za prvo leto uvažanja dela vstopnih inputov iz tujine je povečanje produktivnosti dela v višini 550 tisoč SIT dodane vrednosti na zaposlenega. Glede na povprečje v predelovalni industriji v obdobju 1994-2005 (2.680 tisoč SIT) ta prirast predstavlja 20% rast dodane vrednosti na zaposlenega. Učinek se zmanjša, vendar ostane značilen tudi v naslednjem letu po začetku uvažanja inputov iz tujine, vendar izgine v kasnejših obdobjih. Kljub kratkoročnemu učinku na povečanje rasti produktivnosti pa razlika v produktivnosti med novimi uvozniki vmesnih proizvodov in primerljivimi, na domači trg omejenimi podjetji raste v času še naprej: po štirih letih uvažanja je dodana vrednost na zaposlenega za približno 1 milijon SIT višja kot v kontrolnih podjetjih. To predstavlja 35-40% povečanje glede na povprečno produktivnost dela v opazovanem obdobju. Tudi z vidika skupne faktorske produktivnosti je dodatna dosežena rast produktivnosti v prvem letu uvoza vmesnih dobrin impresivna: v povprečju se produktivnost v novih uvoznikih poveča za 20 odstotnih točk hitreje kot v kontrolnih neuvoznikih. V drugem letu po začetku uvažanja dela inputov iz tujine se premija v rasti skupne faktorske produktivnosti zniža na 5%, zatem pa novi uvozniki ne povečujejo svoje produktivnosti več značilno hitreje kot podobna domača podjetja. Do konca četrtega leta uvažanja vmesnih proizvodov znaša kumulativno povečanje produktivnosti nad tisto v kontrolni skupini podjetij okrog 35 odstotnih točk. Dodatne regresije na podlagi razlik v razlikah pokažejo, da uvozniki vmesnih proizvodov z neposrednimi naložbami v tujini ne povečujejo produktivnosti značilno hitreje kot uvozniki brez naložb v tujini, vendar pa podjetja v tuji lasti v povprečju rastejo hitreje kot novi uvozniki v domači lasti.

V zadnjem delu empiričnega dela potrdim hipotezo o pozitivnem učinku osredotočanja na osrednje kompetence. Hipoteza trdi, da podjetja lahko povečajo fokus na svoje ključne kompetence in posledično povečajo produktivnost, tako da delegirajo proizvodnjo dela vmesnih dobrin zunanjim izvajalcem v tujini. Rezultati kažejo na vzročno-posledično razmerje, ki teče od mednarodnega zuanjega izvajanja proizvodnje vmesnih proizvodov do povečanja proizvodne in procesne inovativnosti. Podjetja, ki so prešla iz izključno domače nabave vmesnih dobrin na vsaj delni uvoz tovrstnih proizvodov, so se prelevila iz povprečnih v nadpovprečno uspešne inovatorje proizvodov. Učinek na proizvodno inovativnost ostaja statistično značilen precej daljše obdobje kot učinek na rast produktivnosti. Za razliko od proizvodnih inovacij pa so procesne inovacije v bodočih uvoznikih bolj pogoste že v obdobju pred samim začetkom uvažanja vmesnih dobrin. Po začetku uvažanja to prednost tudi ohranijo.

Rezultati empirične analize podjetij slovenske predelovalne industrije torej kažejo, da mednarodna fragmentacija proizvodnega procesa v smislu nabave vmesnih proizvodov iz tujine povečuje rast produktivnosti v prvih nekaj letih po začetku uvažanja. Poleg tega nivo produktivnosti v novih uvoznikih naraste glede na produktivnost v podjetij z izključno domačo nabavo inputov in ostane statistično značilno višji tudi srednjeročno. Zlasti pomembna ugotovitev pa je, da uvoz vmesnih proizvodov poveča proizvodno in procesno inovativnost, kar vodi do dolgoročnega izboljšanja konkurenčnosti podjetij.

Ključne besede: zunanje izvajanje del, produktivnost, ključne kompetence, fragmentacija proizvodnega procesa

DYNAMIC EFFECTS OF INTERNATIONAL FRAGMENTATION OF PRODUCTION: EMPIRICAL ANALYSIS OF SLOVENIAN MANUFACTURING FIRMS

Abstract

An increasing number of firms outsource peripheral functions in order to stay focused on their core capabilities. This dissertation contributes to a limited body of theoretical and empirical research on the relationship between intermediate inputs offshoring and firm productivity. The main aim of the dissertation is to study the effects of vertical fragmentation on firm productivity. 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 dissertation 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 activities, firms can better concentrate on activities such as research, innovation, sales and marketing, and increase their energies on matters that directly affect competitive positioning.

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. 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.

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. 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 stochastic dominance tests (Kolmogorov-Smirnov and Mann-Whitney tests) I confirm the self-selection into foreign sourcing hypothesis, while the estimates of production functions substantiate positive relationship between importing intermediate inputs and firm productivity. Using propensity score matching techniques to analyze whether firms that start importing intermediate inputs become more productive, I find causal evidence that new importers become more productive once they start sourcing their inputs abroad. The average treatment effect for the first year of importing 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. Compared to manufacturing average over the entire period 1994-2005 (2,680

thousand tolars), this amount represents a 20% increase of value added per employee. The effect, though smaller, remains significant in the following year but vanishes thereafter. Nevertheless, the productivity gap between importers and their domestically-oriented counterparts increases further over time: after four years of intermediate inputs importing, value added per employee in new importers increases by 1 million Slovene tolars more than it does in non-importing control firms. This represents a 35-40% increase relative to average labour productivity in the observed period. In terms of total factor productivity, the extra growth rate of productivity in the first year of importing is also impressive: the average productivity of new importers increases by as much as 20 percentage points faster than in non-importing firms. In the second year after import initiation, the growth premium decreases to around 5 percentage points but remains significant only at 90% significance level. In the following periods new importers do not experience any significantly higher productivity growth in comparison to similar non-importers. By the end of the fourth year of importing, their four-year cumulative productivity growth is around 35 percentage points higher than the growth rate in control firms. Additional difference-in-differences based regressions suggest that importers with outward direct investment do not increase labour productivity and TFP significantly differently than non-multinational new importers, but foreign-owned firms on average do grow faster than domestic new importers.

In addition, I find support for the 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. The results suggest 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. In contrast to product innovation, process innovation is more common in prospective importers already prior to import start. 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.

To conclude, 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.

Keywords: offshoring, outsourcing, productivity, core competences, fragmentation of production

Contents

List of tables

List of figures

List of abbreviations

ATT	Average treatment effect on the treated
CIS	Community Innovation Survey
DID	Difference in differences
EU	European Union
FDI	Foreign direct investment
GMM	Generalized method of moments
ICT	Information and communications technology
KS	Kolmogorov-Smirnov
MW	Mann-Whitney
NACE	Classification of economic activities in the European Community
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary least squares
R&D	Research and development
TFP	Total factor productivity

1 INTRODUCTION

1.1 Basis for Research

Globally, fragmentation of production has become increasingly widespread in recent years as barriers to international trade and investment have decreased and as global competition has driven producers to cross national borders in order to lower costs. Improved legal and business environment, proliferation of internet and improvements in information and communications technology (ICT) have made the splitting of production processes and the coordination in the resulting activities possible. Particularly noteworthy was the spread of offshore outsourcing – international sourcing of intermediate goods and services based on contractual, arm's length relationship between a producer and an input provider.[1] Three features of this development present a challenge to the standard trade models and have triggered research designed to better explain the changes. First, the World has featured an impressive growth in intermediate goods and the share of imported intermediates in total inputs increased strikingly over the last three decades (Kleinert, 2003). Second, a striking feature of this growth has been an unprecedented expansion of input trade that takes place across the boundaries of the firm, as an arm's length trade (see Feenstra, 1998 and Borga & Zeile, 2004). Third, these trends have been widespread across sectors and types of inputs (Helpman, 2006). These processes triggered a new generation of theoretical approaches to modelling alternative forms of involvement of business firms in cross-border endeavours and corresponding changes in international trade and investment patterns. Furthermore, the growing importance of international procurement of intermediate inputs either through offshore outsourcing or within the boundaries of a multinational firm, through foreign direct investment, could not be adequately explained by traditional trade theories that alienate from vertical fragmentation of production process and the make-or-buy question.

On the organizational and managerial level, reorganization of production across national borders raised new issues as well. Towards the end of the twentieth century, the idea of outsourcing processes and capabilities began to gain currency as a means to achieve more rapid benefits. Companies may have previously outsourced a few ancillary activities like basic components production, maintenance or specialized legal work, but now they were beginning to outsource major capabilities involving thousands of people, sensitive knowledge, and firm-specific technology. At first, the pioneers of offshoring were drawn to the idea of farming out processes largely because of the potential for lower costs and leaner balance sheets, but they achieved greater flexibility and access to specialized expertise as well (Davenport, 2005, p. 102). Growing number of companies is leveraging world-class capabilities from another company in order to improve the total value they can provide to

[1] Even though taxonomy is explained thoroughly in chapter 2.1, a brief description of the most important terms is in order already at this stage. Following the broad definition of the term, outsourcing is defined as the acquisition of an input or a service from an unaffiliated company. On the other hand, offshoring is the sourcing of input goods or services from a foreign country (WTO (2008, p. 99)).

their customers and clients. Increasingly, successful companies focus on enabling their best people to execute and raise productivity in core areas, and outsource everything else to best-in class providers. Follow-up interviews and several case studies suggest that offshoring allows companies to increase the number of researchers and engineers while keeping constant the cost of product development as a percentage of sales (Lewin & Peeters, 2006, p. 24). The result is more focus on firm's core competences and better subsequent performance.

The dissertation belongs to the subfield of international trade that studies international fragmentation, the process of splitting the production process into ever smaller activities produced in different locations. However, international production sharing transcends the question of location of input production as it increasingly deals with the make-or-buy dilemma: should a process be kept in-house or purchased from an outside supplier. A growing body of literature is attempting to clarify the trade-offs involved in the simultaneous choice about the location and internalization of production process. Yet the first attempts to explain the growing trade in intermediate inputs ignored the question of organization of input production. Traditional models of international trade have been modified by Jones (2000), Arndt (1997, 1998), Deardorff (2001a, b) and others to deal with trade in intermediate inputs, but they focused on macro implications of international multi-stage production on wages, trade flows, and welfare. Doing that, they ignored an important empirical fact, that much of the growth in intermediate inputs was generated through arm's length relationships. In response, there is now a general trend to develop a deeper understanding of the organization of production, focusing on the individual firm, its boundaries, internationalization decisions, and sourcing strategies. The analysis of firm boundaries, summarized in the make-or-buy decision, entailed merging traditional trade theories with the theory of the firm and concepts of industrial organization. As a reflection of several strains of the theory of the firm, a number of different approaches emerged that provided new explanations for alternative organizational structures, firm's sourcing strategies and its inner workings. Among working horses of these theories, the most notable include contractual incompleteness, relation-specific investments, asymmetry of information, imperfect monitoring, costly search and matching, thickness of the market, and the quality of institutions in enforcing contracts.

Some of the models have embraced another important empirical finding besides rapid growth of trade in intermediate goods and proliferation of contractual business relationships. The fact I refer to is a sizeable and persistent heterogeneity of establishments inside narrowly defined industries and regions. New theoretical advances explained why some firms, depending on ex-ante productivity differences, organize their production process within national borders or choose to serve only domestic markets while some of them source production inputs from abroad. Up till the end of the 20th century, the theory of international trade and foreign direct investment assumed symmetric firms within the same industry, implying symmetric productivities, size, international activity, or, at best, arbitrary and ambiguous asymmetry of organizational forms (see Helpman and Krugman 1985, chapters 7 and 12). Empirical findings on firm- and plant-level data uncovered the pattern in which only a small fraction of firms operate internationally and are generally more productive, larger and more capital intensive than domestic counterparts. To reconcile the theory with the prevailing empirical evidence, Melitz (2003) developed a model of monopolistic competition with heterogeneous firms, while at the same time similar theoretical attempts emerged (e.g. Montagna, 2001 and Jean, 2002), some of which based on alternative market structures (for example Bernard, Redding & Schott, 2007). Melitz's (2003) concept of heterogeneity was soon integrated into models of international sourcing, producing realistic models of industry with heterogeneous firms, simultaneous existence of different organizational forms, relative prevalence of firm types in accord with empirical evidence, and equilibrium market structures determined by realistic exogenous parameters.

These advances in international trade theory, however, do not question the validity of traditional theories of international trade. Ricardo's theory of comparative advantages and Heckscher-Ohlin theorem are still relevant in explaining a large portion of inter-industry trade with homogeneous goods between developed and developing countries, while new trade theories based on imperfect competition, internal and external economies of scale, vertically and horizontally differentiated goods, and trade costs, successfully explain the existence of intra-industry flows of goods among similarly developed and endowed countries. What the new generation of models contributes to rich and extensive theory of international trade and factor movements is a valuable account for the recent growth of trade in intermediate goods and enhanced heterogeneity of organizational forms in international business. In addition, it provides valuable insights into the processes and relations inside the firm, which generate interesting theoretical results at the level of industries and nations.

Another basis for research comes from the fact that only a small number of empirical studies so far examined the link between offshoring and firm productivity. Namely, most of the research focused on the aggregate effects of shifting output fragments to low-cost countries since the issues such as job losses and wage depression were high on the political agenda. However, little is known about the causal effects of cross-border vertical specialization on firm productivity and even less on the particular mechanisms through which they affect one another interchangeably. My thesis aims to provide an important piece in this puzzle.

1.2 Research Objectives

The main aim of the dissertation is to study the effects of vertical fragmentation on firm productivity. Vertical fragmentation will be measured by imports of intermediate goods, so the thesis 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 dissertation 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 activities, 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. The most important motivating facts are presented in turn.

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 & Kierzkowski, 1990, 2001; Arndt, 2001; Deardorff, 2001a, 2001b; and Kohler, 2004). 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. In line with this, the subject of the thesis is a theoretical and empirical analysis of international fragmentation of production. Specifically, it is concerned with that part of international sourcing that is revealed through increased imports of intermediate goods as inputs in the production process.

Second, increased availability of firm- and plant-level data has driven advances in empirical research, overwhelmingly substantiating the existence of large and persistent productivity differences among firms in the same narrowly defined industries. Furthermore, empirical studies on the organization of firms have given evidence on considerably diverse mixture of business forms coexisting in the same industry. Heterogeneity thus plays a key role in two ways.[2] First, there is heterogeneity as a result of productivity differences across establishments within industries because some firms have intrinsically different aptitudes, either as a result of technological supremacy, better management, greater efficiency, and other factors. Second, there is heterogeneity in organizational form: some firms serve only domestic market, some export, some source inputs from a local independent provider, some from a foreign one, and some firms carry out captive offshoring. The two dimensions of heterogeneity are related in both directions. Concerning the first direction of the relationship, evidence shows that productivity differences induce different choices for the organization of production (e.g. Görg and Hanley 2004, Criscuolo and Leaver 2006) and sales (e.g. Bernard

[2] There is also substantial heterogeneity in entry and exit patterns across industries (see for example Dunne, Roberts & Samuelson, 1988 and 1989), but I do not explore this issue in my dissertation.

and Jensen 1995, 1999, 2004). This empirical evidence on firm heterogeneity provides further motivation and focus to the subject of my research. Instead of studying the aggregate implication of international fragmentation, I will focus on a single firm and analyze the determinants and effects of cross-border input sourcing.

Finally, a defining characteristic of international fragmentation is that it allows firms to utilize cheaper foreign factors for some fragments of their value-added chain. Outsourcing such fragments internationally makes production less costly and should, therefore, release resources that could be directed elsewhere. By outsourcing standardized, peripheral activities, firms can direct scarce resources on their core business activities, further enhancing competitive advantages and boosting productivity. Numerous case studies and surveys on firms performing international outsourcing confirm this claim. Therefore, apart from the previously mentioned causality going from productivity to sourcing strategies, my doctoral dissertation aims to provide theoretical rationale and empirical evidence for the inverse causation. In my theoretical model, sourcing and integration patterns will be determined by firm's productivity level and other exogenous factors, but the choice of organizational structure will have backward positive effects on subsequent evolution of productivity. The mechanism that will provide such backward causality will be modelled as productivity enhancing investment, endogenously determined by firm's optimization based on its own characteristics and the state of the industry.

On the theoretical ground, the dissertation's objective is to 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 will be build upon the theoretical models of Antras (2005a) and Antras and Helpman (2004) but will put firms in a dynamic environment of constant productivity race. I will build 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 will be governed by incomplete contracts while vertically integrated firms will face relatively higher cost of governance. In addition, firms will be allowed to make productivity improving investments in their core capabilities. The model will rationalize the relation between international sourcing of intermediate inputs and focusing on the core business, as it will show that firms can increase the level of investments and boost productivity growth by fragmenting the production process across borders.

The model is about to explain some relevant empirical facts about internationalization process, industry structure, and firm-level productivity. First, allowing for firm heterogeneity will yield a rich array of different location-ownership types of firms corresponding to individual firm productivity levels. Second, it will explain why only the most productive firms internationalize their production process while the least productive companies retain all the production in-house. Because firms' profits are proportional to productivity, only the most productive among them can compensate higher fixed organizational costs and the distortions caused by incomplete contracts with lower unit labour costs abroad. Third, the fact that different industries in terms of the product standardization have different prevalent forms of production modes will also be rationalized. The youngest industries are the least internationalized, while in the most mature ones the prevalent form is offshore outsourcing and foreign direct investment. It will also be shown that as the industry matures, outsourcing (national and cross-border) becomes more and more common relative to vertical integration (in-house production or FDI). Fourth, it will be shown that delegating part of the production process to an outside principal, be it vertically integrated foreign subsidiary or an independent contractor, leads to productivity gains, because firms are able to devote more resources to enhance their core capabilities. Finally, the model aims to show why internationalization is a stepwise process. Firms need time and knowledge capacity to shift to more complex organizational mode because they entail higher organizational costs and riskier B2B relationships.

Theoretical predictions derived from the model will be tested on a panel of Slovenian manufacturing firm-level data for the period 1994-2005. Slovenia may be considered an interesting case study, given that Hummels, Ishii and Yi (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 aggregate and international trade dimensions 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. The latter will be examined by testing the effects of foreign input sourcing on the degree of product and process innovation. 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.

1.3 Theoretical bases and Research Methods

The choice of methodology and research methods employed in the thesis closely follows its structure. The first part of the thesis provides an exposition of past and current developments of international fragmentation and gives a literature review of theoretical models of outsourcing and offshoring. This is followed by a survey of previous empirical work on the relationship between international sourcing of intermediate inputs and productivity. This part features less formal approaches such as literature survey, critical analysis of theoretical and empirical evidence, and the methods of induction and deduction.

The second part provides a formal model of monopolistically competitive industry with heterogeneous firms in the manner of Melitz (2003) where firms choose among four alternative forms of organizing intermediate input production and operate in an environment of incomplete contracts and relationship-specific investments. Building on Antras (2003), Antras in Helpman (2004), Antras (2005a), and Grossman, Helpman in Szeidl (2005), basic static model will be enriched by putting firms in a dynamics environment of constant productivity race. By modelling individual firm's decision to invest in productivity enhancing activities, I attempt to rationalize the concept of focusing on core competence and analyze the effect of international fragmentation on firm productivity. Following modern international trade theory, methodology employed in this part of the dissertation will be neoclassical, building on two defining elements: inductivism and methodological individualism (Boland, 1982).[3] Methods or techniques employed in this part will come from different fields of economics and mathematical economics, such as maximization methods, game theoretical approaches, comparative statics, and dynamic optimization.

The third part embraces a variety of empirical tests of theoretical predictions regarding the prevalence of different types of international sourcing of inputs, productivity responses of firms that start shifting input production across borders and the effect of international fragmentation on firm's R&D activity. While the methodology stays in the realm of neoclassical economics, the methods employed in this part correspond to the specifics of panel data and several econometric issues involved in estimating econometric specifications. In case of estimation of firm productivity the issues include sample selection bias (due to the fact that firm exit depends, in part, on the firm's expectation of its future productivity and, given serial correlation, its current productivity), simultaneity bias (because of the correlation between unobserved productivity shocks and variable inputs), and endogeneity of import status (stemming from the assumption that importing improves productivity and is correlated with inputs. To alleviate these, I will employ semiparametric approaches proposed by Olley and Pakes (1996), Levinsohn and Petrin (2003), and Kasahara and Rodrigue (2008). To estimate the effects of international sourcing of components on firm productivity and R&D intensity, we will use propensity score matching (e.g. Heckman et al., 1997, 1998) that is based on constructing a counterfactual to be compared to new importers. The method gives us the causal effect of importing for every period following the decision to internationalize input production. Combining different matching techniques with difference-in-differences (Blundell and Costa Dias 2000) will further improve the quality of evaluation and give us more accurate estimate and significance of the effect of import status on productivity and R&D performance.

[3] The latter, more relevant in the context of theoretical model formation, assumes that economic phenomena can be explained by aggregating over the behaviour of agents. In the context of the theoretical model in this dissertation, this implies that only individual firms, or more precisely individual agents inside the firms, are decision makers whose actions explain all the market institutions (e.g. prices, aggregate output, distribution of different firm types).

1.4 Scientific Contribution

The main contribution of my research is firm-level data analysis of the relationship between firm's outsourcing mode and its subsequent productivity. My main hypothesis is that firms can leverage their productivity by delegating some of the input production to external contractors/subsidiaries, which gives them the opportunity to devote more resources to their core competencies. In the theoretical part, the dissertation aims to combine three strains of literature into a common framework by bringing together the theory of a firm, internationalization theory and the growth theory. To this end, I will build 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. In addition, every period each firm decides upon the level of investment in productivity enhancing R&D. The model is about to explain some relevant empirical facts about internationalization process, industry structure, firm-level productivity, and most importantly, the effect of internationalization of input production on focusing on core capabilities.

In the empirical part, the dissertation's main contribution will be to identify and quantify productivity gains that appear as a direct consequence of relocated input production. Improved TFP calculation technique and the choice of matching methodology will give us greater assurance that we are not only capturing spurious correlations but pure causality from import status towards productivity improvements. By explicitly examining the effect of international intermediate inputs sourcing on firm innovation activity as one of the possible workings of focusing on core capabilities effect, I will be able to test whether international fragmentation of production enables strategic restructuring that transcends traditional production cost reduction. In addition, the use of econometric techniques and the quality of empirical data is also unique. To my knowledge, this will be the first empirical study on the relationship between international input sourcing and productivity that employs propensity score matching technique and the first one to use firm-level accounting data linked with detailed trade information and a series of Community Innovation Surveys.

1.5 Organization of Doctoral Dissertation

The remainder of the doctoral thesis is organized as follows. The second chapter introduces terminology and lists the most important reasons for intensification of the globalization as manifested through increased international production sharing. This is followed by presentation of the development of trade in intermediate inputs and foreign direct investment, increasingly important features of global economic integration associated with the fragmentation of production across borders. The extent of offshoring activities is assessed on three scales: global, European and Slovenian. Chapter three gives an overview of theoretical and empirical literature on outsourcing and offshoring. The first part of the chapter examines the traditional and new-generation theoretical literature on international outsourcing. An overview of the theory of the firm is presented in the next part in order to provide theoretical foundations for the recent theoretical models of international vertical fragmentation that delve into the black box of the firm. Special attention is given to the property-rights theory of the firm as my theoretical model builds upon this approach to modelling the boundaries of the firm. Next subsection briefly presents the growth theory which is the third line of economic literature brought together in my theoretical model. An overview of the empirical literature on the relationship between offshoring and productivity completes the third chapter. The model of multinational production with the choice of organizational form under firm heterogeneity is constructed in the fourth chapter. This part of the thesis provides the theoretical justification of the focusing on core competencies effect, where it is shown that the choice of cross-border dispersion of component production brings about productivity improvements by freeing up resources for efficiency-enhancing investments. In methodological part of my thesis (Chapter five), I first present research hypotheses that derive from the theoretical model. This is followed by specification of the econometric model and the description of econometric methods that justify the relevant econometric issues. The final part of chapter five gives a description of the data set employed in the estimations. Chapter six begins with descriptive statistics and proceeds with the presentation of results of the empirical analysis. Chapter seven concludes by presenting a short summary of theoretical and empirical contributions of the thesis, listing its advantages and possible limitations, providing policy implications, and proposing future avenues of research.

2 RECENT TRENDS IN INTERNATIONAL FRAGMENTATION

This section describes historical context and recent developments of international fragmentation of production. To clarify the terms used in the remainder of the dissertation, the first subsection introduces terminology and taxonomy. After listing the most important reasons for increased internationalization of production in recent decades, the chapter proceeds with presenting basic statistics on trade in intermediate inputs and foreign direct investment data – proxy measures for the evolution of economy-wide offshoring. Both types of data are first presented on a global scale, followed by EU15 and Slovenian figures. The aim is to substantiate the relevance of the topic of the dissertation by arguing that international fragmentation of production and related trade in part and components account for a large part of the superior growth of trade compared with GDP over the last half century.

2.1 Terminology and taxonomy

Few concepts in international economics have had so much media and research attention than offshoring in recent years. During the 2004 presidential campaign in the USA, offshore outsourcing was in the limelight of economic issues debates. Although the attention to offshoring was increasing throughout 2003, the mentions of the word “outsourcing” in four major American newspapers in the period 2002-2005 revealed that it bears a highly political connotation. The references to the term first spiked after the release of the 2004 Economic Report for the President and again in the height of the presidential elections in November 2004 (Mankiw and Swagel (2006, p. 6); see also Amiti and Wei (2005) for a longer period of analysis). Google search engine, for example, found almost 60 million hits for “outsourcing” (6 million for “offshoring”) which is a surprisingly high figure in comparison to well-established terms like “globalization” (28 million hits), “foreign direct investment” (25 million hits), and “tariff” (21 million hits). On the other hand, offshoring and related concepts have only recently been given thorough scientific research attention and are empirically poorly investigated. These facts illustrate the wide chasm between media attention and solid empirical evidence on offshoring.

Notwithstanding the lack of empirical evidence, there seems to be a lot of confusion in the use of terms on this subject. In media and scientific press, several terms are used interchangeably and often there is more than one definition of a particular concept. To avoid misunderstandings, I next provide the most widely-used definitions of the terms used in my thesis. For this reason I rely on the taxonomy developed by the UNCTAD in its World Investment Report 2004. This is a non-exhaustive taxonomy that reduces the reality to minimal number of relevant dimensions: location and ownership type (Table 1).

Table 1: Schematic representation of outsourcing and offshoring

<table>
<tr><td colspan="2"></td><td colspan="2">location</td></tr>
<tr><td colspan="2"></td><td>home country</td><td>foreign country (offshoring)</td></tr>
<tr><td rowspan="2">ownership</td><td>internalized</td><td>domestic vertical integration (in-house production, captive onshore outsourcing)</td><td>vertical FDI (captive offshoring)</td></tr>
<tr><td>externalized (outsourcing)</td><td>domestic external production (domestic onshore outsourcing)</td><td>production outsourced to unaffiliated foreign provider (offshore outsourcing)</td></tr>
</table>

Source: WTO, World Trade Report 2005, 2005, p. 267 and UNCTAD, World Investment report 2004: The Shift Towards Services, 2004, p. 148.

Outsourcing refers to the purchase of goods and services that were previously produced in the purchasing firm. The term is a compound expression from ‘outside resource using’ (Stehrer, 2006, p. 141). Such contracting out to external suppliers occurs in a range of economic activities linked to the intermediate stages of the production process. These activities include production of parts and components and semi-finished goods, as well as business related services. There is an important distinction between outsourcing and traditional arms-length transactions. Two key elements set the limits between the two: the long-term nature of the relationship and the amount of information in the form of detailed instructions and specifications on the part of the customer is tied with outsourcing as opposed to arms-length relationships (Curzon Price, 2001, p. 89). **Offshoring**, on the other hand, only partially overlaps the definition of outsourcing. It stands for the process of obtaining goods and services from companies outside the home country. In sum, outsourcing refers to the relocation of jobs and processes to external and independent providers regardless of the vendor's location, while offshoring refers to the relocation of jobs and processes to any foreign country without distinguishing whether the provider is independent or affiliated with the firm.

As shown in Table 1, there are four possible combinations of ownership type and location of input production, giving rise to interactions between the terms outsourcing and offshoring. If a firm obtains intermediate inputs from its own plant or division in home country, this is simply a domestic vertical integration or **domestic internal production**. Monopolized public utilities, small stores, and vertically integrated retailers are examples of such integrated "do-it-yourself" firms. When such a plant is moved to a foreign country to establish a production affiliate abroad, a parent firm is said to carry out a vertical foreign direct investment and performs **captive offshoring** of intermediates. Firms retain the ownership of the whole production process but locate parts of their activities abroad by setting subsidiaries. These are the traditional multinational companies that keep control over the production chain to preserve proprietary technology and know-how. In case of **domestic outsourcing**, a firm decides to farm-out a production of specific good or service to an outside, independent subcontractor in the home country. Construction firms, dentists, hospitals, and artisans belong to this type. The fourth organizational mode combines the internationalization of input procurement with a contractual relationship between a buyer and an input producer. **Offshore outsourcing** thus occurs when a foreign third-party provider sells intermediate goods or services to a domestic company. Automobile industry, electronics, and textile industry are the most notable examples.

Outsourcing, offshore outsourcing and captive offshoring jointly constitute a process called **fragmentation** (Jones & Kierzkowski, 2001). It has also been labelled as "slicing up the value chain" (Krugman, 1995), "disintegration of production" (Feenstra, 1998), "multistage production" (Dixit & Grossman, 1982), "intra-product specialization" (Arndt, 1998), "delocalization" (Leamer, 1996), "vertical specialization" (Hummels, Rapoport & Yi, 1998), and "splintering" (Bhagwati, 1984)[4]. Fragmentation is defined as the splitting of a production

[4] According to Hummels, Ishii and Yi (2001, p. 76), Balassa (1967) and Findlay (1978) were the first papers to note this phenomenon.

process into two or more steps that can be undertaken in different locations but that lead to the same final product (Deardorff 2001b, p. 122).

Insourcing and **inshoring** are the flip sides of the same coin, but are rarely mentioned in the political discussion on production relocation. In order to objectively assess net impact of delocalization, one must not ignore the effects of reverse process of such international engagement. Table 2 presents a more complete matrix of the production relocation options facing a domestic company.

Table 2: Complete production relocation matrix

		Location			
		Home country		**Foreign country**	
		Internalized	*Externalized*	*Internalized*	*Externalized*
Type of sourcing	**Outsourcing**	Domestic vertical integration	Domestic outsourcing	Captive offshoring	Offshore outsourcing
	Insourcing	Domestic vertical integration	Domestic insourcing	Inshoring	Offshore insourcing

Source: J. F. Kirkegaard, Offshoring, Outsourcing, and Production Relocation: Labor-Market Effects in the OECD Countries and Developing Asia, 2007, p. 43.

In the present study, only outsourcing type of sourcing will be considered since my goal is to study the effects of active outward internationalization of production process on local firms. This is of course not to suggest that insourcing aspect is not interesting or important. On the contrary, a brief examination of Slovenian economic structure would imply that the core sectors are in fact medium-high-tech and medium-low-tech industries producing intermediate goods and services to mainly EU final-good producers.

Outsourcing and offshoring are part of a broader process of **global relocation** or **delocalization** which is an umbrella term that captures voluntary and involuntary transfer of production and business services across the globe (Denis, Mc Morrow & Röger, 2006, p. 37). It entails voluntary offshore outsourcing, captive offshoring or any similar vertical/contractual cross-border business relationships, as well as involuntary demand implications. The latter include the closure or scaling down of some industries or parts of industries in a given location and their expansion in another part of the world according to different comparative advantages in these regions. It reflects rapid changes in technology, rise of the ICT, increased global competition levels and falling transport costs that jointly contribute to easier and more thorough fragmentation of production process, discussed in detail later in the thesis. Declining transaction costs on the one hand increase direct competition from abroad and on the other hand expose a larger scope of business functions or "tasks" to global competitive pressures. This results in the positive demand shift in favour of imports and increasing pressures on non-competitive industries in the developed countries (e.g. labour-intensive, low-technology and easy-to-imitate research-intensive goods and services).

This section presented most important terminology of the dissertation. The most commonly used expression in the remainder of the thesis will be offshoring, which refers to foreign sourcing of intermediate inputs or services and comprises offshore outsourcing and captive offshoring. The following sections will identify the driving forces behind the process of internationalization of production and clarify the estimated size of this phenomenon and recent trends. The facts presented will provide the relevance of the topic studied in this dissertation.

2.2 Reasons for increased international fragmentation of production

Fragmentation and outsourcing are far from being recent phenomena. They both originate in the Industrial Revolution or even predate it. In recent decades, however, both have developed international dimension and attained complexity to such an extent that they represent one of the most prominent aspects of globalization. Yet, even international production sharing is a long-standing and evolving process. Initially it involved a simple circular flow of goods starting at developing countries exports of primary commodities to developed nations where the inputs were processed, assembled and finally re-exported to the primary commodity producing countries. After the Second World War more complex forms of internationalization of manufacturing process began to emerge. More involved and larger-scale international fragmentation of production and the resulting trade in intermediate goods were already present in the early 1960s. The main player of this process was the US economy attempting to remain competitive vis-à-vis Western Europe and Japan and adjusting to structural changes. Geography, costs and history all combined to select efficient sub-suppliers of US firms in Canada and Latin America. The most prominent example of regional outsourcing of intermediate goods can be found in the Automotive Products Agreement of 1965 between Canada and the United States. The significant reduction in trade barriers led to a great expansion of trade in auto parts between the countries. The advantages of international fragmentation in the textile, clothing and automobile industries spread to other production sectors and to other countries across the globe. As vividly described in Tempest (1996), nowadays even the simplest products such as toys are made so that manufacturing or services activities done throughout the globe are combined with those performed at home. Outsourcing soon characterized trade around the globe. It spread to countries in Eastern Europe even before they abandoned planning and switched to becoming market economies. IKEA, for example, established production facilities in Poland already in the 1970's (Jones, Kierzkowski & Lurong, 2005, p. 307-308). In a relatively short period of time, transition economies have intensified intra-industry trade with Western Europe. They have also developed production sharing arrangements with numerous European Union firms particularly in automobiles and furniture production (see Kierzkowski, 2001 and Graziani, 2001).

In the early stages of vertical specialization escalation, multinational corporations were the main drivers of this process. Due to high transaction costs in doing business abroad, only the largest and most productive companies had sufficient resources and capabilities to take advantage of international multi-stage production. For smaller incumbents, foreign market entry costs and additional variable costs accruing to internationalization (transport costs, trade restriction costs, communication costs, managerial costs, risk, and the like) hindered their aspirations to slice up the value chain across borders. Even today, large international firms play a major role in international business activities. However, as globalization has levelled the field of competition, liberalization has torn down barriers to entry, and advancement in technology has lowered transaction costs for cross-border activities, the alleged advantage of large international firms has somewhat diminished. There has been a shift from intra-firm to arm's-length trade in fragmented goods, the latter being increasingly accessible to broader scope of smaller firms.

2.2.1 Motives for international fragmentation at the aggregate level

What were the main drivers of vertical specialization in manufacturing? Yeats (2001) identifies four major factors that contributed to increased international production sharing. First, in contrast to service offshoring, the growth of captive offshoring and international outsourcing in manufacturing has mostly been driven by tariff and non-tariff trade barriers reductions. Looking at the aggregate US trade since 1962, Yi (2003) finds that over 50 percent of the trade expansion can be explained by increased vertical specialization brought about by tariff reductions. Tariff cuts even of modest magnitudes produce large non-linear responses of trade in a model with several stages of production since trade liberalization affects each of the stages of production individually.[5] In 1947, before the General Agreement on Tariffs and Trade (GATT) started, the average tariff rate was between 20 and 30 percent (WTO, 2008a, p. 82). In the 1960's, industrial countries' tariffs on imports from developing countries still averaged about 17 percent (WTO, 2005a, p. 7). Trade barriers were not only high but also discriminatory against the latter group of countries, as reflected in the considerably higher average tariffs on their exports compared to the exports from other developed countries.[6] As a result of successive rounds of multilateral trade negotiations under the auspices of the GATT and its successor, the World Trade Organization (WTO), tariffs on imported industrial goods have declined substantially. In 1947 when GATT started, average tariff levels on industrial goods were as high as 40%, but once commitments made under the Uruguay Round are fully implemented, the overall import-weighted MFN tariff average on such products in industrialized countries will have fallen to less than 4% (WTO, 2005a, p. 7). Furthermore, until the early 1970's when first GSP schemes were adopted, developing countries had to compete with other suppliers from developed countries on an equal MFN

[5] For example, if value added in each fragmentation stage is infinitesimally small, a 1% tariff reduction lowers cost of producing by *N* percent, with *N* being the number of production stages (Yi, 2003).

[6] Mid-1960 tariff averages on total imports of manufactures in a group of industrial countries were 10.9%, while (as mentioned in the text) tariff averages on imports of manufactures from developing countries amounted to 17.1% (Yeats 2001).

basis.[7] Starting in the early 1960's, the world has witnessed a rapid growth of regional trade agreements that further lowered the applied tariffs on developed and developing countries imports. During the 80's the number of active RTAs in force levelled off at around 50, but rocketed during the 90's to exceed 200 in 2006 (WTO, 2008b). As a consequence, global tariff-cutting over the past decade was dominated by preferential trade agreements.

Non-tariff barriers, another important category of import restrictions, are hard to measure and only indirect evidence of their reduction in time exists (see for example the "border-effect"-based study by Mayer & Zignago, 2005). Nevertheless, the elimination of voluntary export restraints during the Uruguay Round (1986-1993), the phasing-out of the quota system in textiles and agriculture by developed countries, and improved transparency in terms of notification of standards and technical regulation are noteworthy achievements and indicate a reduced incidence of non-tariff trade barriers. In short, extensive reduction of tariffs and substantial elimination of non-tariff barriers liberalized the global trading system and enabled widespread international fragmentation of production as the entailing trade flows bore less trade costs.

Second, wage rate differentials between industrialized and developing countries were substantial and still remain so (see Table 3). During the 1970's wages of Latin American and Caribbean countries ranged between 60 to 80 percent below those in the United States (Yeats, 2001). Similar differences existed in Eastern block countries where the labour force was well educated and skilled. Despite lower labour productivity in these countries, unit labour costs were still substantially below the values in developed economies, especially if regimes in host countries allowed foreign direct investment. Despite rising labour productivity in developing countries, especially in China, large flows of labour force from the inlands has been keeping wages down and thus retaining production cost differential. It is estimated that 700 million new workers have been added to the world's non-agricultural labour force since 1995 and additional 1.5 billion are expected over the period to 2030 (Stevens, 2007, p. 10). Rising labour productivity unmatched with wage increases due to large inflows of workforce on the global labour market continued to push unit labour costs downward. To reap the benefits of lower production costs and to gain access to emerging markets, firms in high-wage countries moved some of their labour intensive production and assembly to low-wage countries.

[7] The idea of granting developing countries preferential tariff rates in the markets of industrialized countries was originally presented by Raul Prebisch, the first Secretary-General of UNCTAD, at the first UNCTAD conference in 1964. The GSP was adopted at UNCTAD II in New Delhi in 1968. In 1971, the GATT Contracting Parties approved a waiver to Article I of the General Agreement for 10 years in order to authorize the GSP scheme. Later, the Contracting Parties decided to adopt the 1979 Enabling Clause, Decision of the Contracting Parties of 28 November 1979 (26S/203) entitled "Differential and more favourable treatment, reciprocity and fuller participation of developing countries", creating a permanent waiver to the most-favoured-nation clause to allow preference-giving countries to grant preferential tariff treatment under their respective GSP schemes. There are currently 13 national GSP schemes notified to the UNCTAD secretariat. The following countries grant GSP preferences: Australia, Belarus, Bulgaria, Canada, Estonia, the European Union, Japan, New Zealand, Norway, the Russian Federation, Switzerland, Turkey and the United States of America (UNCTAD, 2008).

Third, it is widely accepted fact that transport costs have decreased and thus made the world flatter.[8] The finding of Hummels (2007), however, put this claim under scrutiny. His results state that ocean freight rates[9] have not declined in the post-war era and have even exhibited periods of substantial increases. In contrast to ocean shipping, the price of air transport has enjoyed steady and sizeable declines. There have also been some relative price changes, with long distance freight costs becoming cheaper relatively to short-distance routes, and land transport costs falling relatively to maritime transport. Nevertheless, technological changes in shipping have undoubtedly been important, yet it is unclear whether these yield better quality transport services to importers that are not already being measured in prices. More efficient ships ought to yield lower shipping prices, navigational aids that limit accidents should reduce insurance premiums, and one obvious quality improvement is also speed. Faster transport in general reduces cost of transport[10], opens up trade in entirely new goods and leads to entirely new organizations of production as it reduces the buffer stocks needed to face demand. A simple example is perishable food; a more compelling example is trade in intermediate components intended for just-in-time linkage into a multi-country vertical production chain. Furthermore, standardized containers allow the use of a multi-modal transport system without unpacking and repacking. Finally, GPS technology has allowed companies to carefully monitor their road freight and achieve better logistics control, enabling them to fragment their value chains (Farrell, 2004, p. 86).

Despite relatively low transport costs, even small variations can have a defining influence on the location decision of global production. In the end, it may not be the transport costs in a narrow meaning of the word that enabled and fostered international trade and vertical specialization, but the quality improvements of transport modes and infrastructure upgrading. Indeed, many empirical papers have shown the importance of infrastructure as a determinant of the location of economic activities. Limao and Venables (2001) show that infrastructure quality is an important determinant of transport costs and as such has a strong effect on trade flows. A positive impact of transportation infrastructure on the location of new foreign-owned plants is found by Coughlin and Segev (2000). Adverse infrastructure – transport costs in a broad meaning – appears to be one important reason for Sub-Saharan Africa failing to attract foreign investors despite very low prevailing wages. In connection of the first influential factor, trade liberalization, Hummels, Lugovskyy and Skiba (2009) find an empirical link between tariff reductions and transport fares, observing that shipping firms on average

[8] According to Yeats (1989), international freight and insurance charges averaged about 5 to 6 percent of the value of all US imports with the rates ranging from about 2 percent on watches and jewellery to 20-40 percent for furniture and some wood manufactures. In more recent study, Hummels (1999), employs customs data from the US, New Zealand, and five Latin American nations in 1994 and finds aggregate expenditures on freight ranging from 4 to 13.3 percent of total import volume. In 2004, aggregate expenditure on shipping for total imports was three times higher than aggregate tariff duties paid (Anderson & van Wincoop, 2004).

[9] As much as 65-75% of international trade in terms of value and 90% in terms of tonnage is transported by ships (Rodrigue, Comtois & Slack, 2006, p. 268).

[10] Hummels (2007) estimated that each day in transit is equivalent to a 0.8 percent tariff. Using gravity models, recent studies find that a 10 percent increase in time to export reduces trade by between 5 and 25 percent (Hausman et al., 2005; Djankov et al., 2006; Nordas, 2007; and Nordas et al., 2006).

decrease prices by 1-2 percent for every 1 percent reduction in tariffs. They also find that in the presence of market power of shipping firms, shipping prices depend on the demand characteristics of goods being traded. For example, markups increase shipping prices by at least 83 percent for the mean shipment in Latin American imports. The answer lies in deregulation of transport services. World Bank studies show that deregulation and fostering of competition in shipping services may reduce liner freight rates by as much as 50 percent (Bennathan, Escobar & Panagakos, 1989).

Fourth, government development and trade policies have improved institutional framework in numerous developing countries. Countries give special incentives to exporters in the form of tax holidays, export credits and rebates, subsidized business and political risk insurance, subsidized credits, premises and other infrastructure, exemptions from import duties or exchange controls, and tax refunds. On the other hand, developed countries promoted vertical integration through various instruments and programmes like tariff escalation, tariff provisions for international production sharing[11], and outward FDI promotion. One of the most widely used incentives to attract foreign business are free trade zones. They are a form of institutional islands providing lessened bureaucratic requirements, tax incentives, developed infrastructure and reduced foreign exchange restrictions. ILO reports that globally, there were 5,174 zones in 2004, employing around 42 million workers. The size and the pace of an increase is also remarkable: in 1986, there were only 176 free trade zones worldwide, rising up to 500 in 1995 (Welch, Benito & Petersen, 2007, p. 178).

Business firms are especially concerned with property rights protection and procedures for contract enforcement available to foreign parties. The legal environment in which international transactions are undertaken now appears less hostile and more predictable. In general, political situation worldwide has stabilized after going through a dismal decade of crises[12] and became more business friendly. Number of democracies in the World has risen from zero in 1900 and 22 in 1950 to more than 120 at present (Freedom House, 2008). For international vertical integration to be viable there should be low risk of supply disruption in a foreign location for it can bring the entire international production to a halt. Such disruptions can be caused by malfunctioning legal institutions, unfriendly business environment, political disturbances, strikes, shipping delays, and the loss of quality control. Risk of supply chain disturbances are one of the major fears of potential investors so the countries that adopted outward-oriented trade and development policies enhanced by institutional change generally

[11] US imports of products assembled abroad from US manufactured components qualify for special treatment (tariff provision 9802.00.80) are subject to duty at the full imported value of the good less the value of the US produced components. Tariff provision 9802.00.60 provides similar treatment for metals that are manufactured in the United States, exported for further processing, and then returned. European Community tariff schedules contain provisions similar to those of the United States. These provisions, known as "outward processing relief arrangements," allow EC components to be exported for further processing or assembly. Upon re-import, products may be exempted totally or partially from duties. The types of activities that may qualify for this special EC tariff treatment include fitting, assembling, processing, or repairing goods (Yeats, 2001).

[12] Crises in Mexico at the end of 1994, Asia in 1997, Russia in 1998, Brazil in 1999, Turkey in 2000, Argentina in 2001 and Venezuela in 2002 to name just the most important ones.

succeeded while those that pursued more restrictive inward-looking trade regimes generally failed to benefit from global production sharing.[13]

In addition to four factors mentioned above, increased competition played a role of an important push factor for global dispersion of goods production. With worldwide opening of the markets, instantaneous information access, and decreased importance of distance and political borders, companies increasingly feel the heat of global competition. These pressures on domestic companies have spurred further offshoring as managers were obliged to look for new ways to improve competitiveness. Companies have observed the benefits accruing to first-movers of global relocation process and were forced to reduce costs, hive off functions that can be performed more efficiently outside the boundaries of the firm, and focus harder on their core competencies. Opening of global markets also increased trade opportunities for local specialized firms, which enabled ever finer fragmentation. Adam Smith's observation that specialization is limited by the extent of the market (Smith, 1776, p. 121) is as true today as it ever was. A growing market provides new opportunities for firms to split like amoebae, offering downstream producers cheaper and more diverse set of inputs (Curzon Price, 2001, p. 98).

In the above discussion I identified four main drivers of offshoring and outsourcing of goods: trade liberalization, wage differentials, decreased trade costs, and benevolent government policies. Now I will briefly turn to service offshoring, even though services are not my topic of investigation. First, the factors that enabled the global shift of services will be identified, followed by an emphasis of the differences between goods and services offshoring.

New information and communication technologies were not mentioned among the drivers of goods offshoring even though they played an important role in the last 15 years. Technological change – in particular falling communication costs – brought about the "death" of distance as it made it economical to integrate distant operations and ship products and components across the globe in a search for efficiency. It enabled just-in-time production on a global scale, immensely decreased communication costs, and eased the management of global production structure. From organizational point of view, logistics benefited most from the advances in ICT with informatization of inventory management, warehousing and material handling, real-time control of shipments of intermediate and final goods, and organization and planning of supply chain. Novel ICT have not promoted only international fragmentation of goods production but predominantly the tradability of services. All sorts of information can now be stored by digitalization and much cheaper and faster transportation allows the

[13] Business-related risks can be further lowered through geographic diversification, a concept similar to asset risk reduction in finance theory. Indeed many firms with several investment or outsourcing projects are diversifying portfolio of their overseas projects. By opting for "China-plus-one strategy", many investors to Asia (e.g. Intel, Hewlett-Packard, Nike, Adidas, Toyota, and Hyundai) are hedging against political and economic risk, future asymmetric trade restrictions, and rising labour costs (Economist, 2007, p. 68-70). For the theory of real option in the context of multinational enterprises refer to Kogut and Kulatilaka (1994a, 1994b), Kulatilaka and Trigeorgis (1994), Belderbos and Sleuwaegen (2005).

instantaneous exchange of digitized information and voice communication between people anywhere around the globe (UNCTAD, 2004, p. 148).[14] The use of ICT allows more services that were traditionally obtained in-house to be detached and located elsewhere. For example, Gartner (in Economist, 2004a) estimates that between 60% and 70% of the services surrounding a data centre can be executed at a distance. Such fragmentation largely exceeds that in manufacturing because movement of goods entails much higher transport costs and consumes a great deal of time. On the other hand, services can be produced on one location and the very next second consumed on the other side of the globe without being exposed to any substantial risk and loss of quality. As a result, a wide array of services is already being relocated abroad, ranging from business services, computer and related services to financial and various professional services.

The driving forces for international outsourcing and offshoring of services are for the most part technology development, notably ICT, and economic growth. Referring to Y2K problem, Mitra and Ranjan (2005) showed that external shocks can also trigger the expansion of service offshoring in the presence of externalities and firm heterogeneity. The decision to relocate some service inputs also depends on labour costs, trade costs, institutional framework, tax and investment regime, quality of infrastructure (particularly telecommunications), and access to local skills and technology (particularly language and computer skills). Markusen (2005) lists some empirical regularities concerning offshoring of services. First, new things traded due to innovations in communications and technology create discontinuities on the extensive margin of trade expansion. Second, the new traded services tend to be intermediates, either upstream, downstream, or not part of a sequence. Third, offshoring of medium-skilled or even highly-skilled services often takes place towards skilled-labour scarce countries. Fourth, new offshoring is exports of services back to high-income-country firms either intra-firm back to parents or via arm's-length contracting. Finally, firms or owners of knowledge-based assets may offshore skilled-labour intensive activities that are complements to these assets, leading to skilled workers in the high-income countries being hurt. The adjustment pressures created in importing countries could provoke a surge of protectionism, some signs of which are according to Mattoo and Wunsch (2004) already visible in procurement and regulatory restrictions.

In general, the forces driving international fragmentation of goods and services production are similar but some important differences exist (Bardhan & Kroll, 2003; Mann, 2003). First, the Internet and advances in IT have rapidly removed a basic barrier to trade in IT-enabled services. As far as resources, space and equipment is concerned, relocation of services is

[14] The cost of one megahertz of processing power fell from $7,600 in 1970 to 17 cents by 1999. The cost of sending 1 trillion bits of data plummeted from $150,000 in 1970 to 12 cents by 1999. The entire contents of the United States Library of Congress can now be transmitted across the United States for $40, and soon it may be storable on one computer chip. In 1930, the cost of a minute's telephone call from New York to London was $300 at today's prices; today it is a few cents (UNIDO, 2002). It has also been estimated that the cost of an international 2Mbps fibre leased line in India dropped by up to 80% between 1997 and 2001 (McKinsey Global Institute, 2003b, p. 4, exhibit 5).

much easier than offshoring goods production. For that reason, services are much strongly subjected to the international division of labour than manufacturing activities. Second, most offshored services are generic and cut across industries, so they have an impact on all sectors. Unlike manufacturing, where slicing up the value chain occurred predominantly in a handful of industries like automobile, electronics, and transport equipment, offshoring of tradable services will have wider implications on the economy. Third, offshoring of services affects mainly white-collar workers whereas the relocation of manufacturing involved primarily blue-collar workers (see Jensen and Kletzer (2005) for empirical evidence based on the US data). The skill intensity of some services being farmed out has prompted a wave of revulsion and concerns about the possible job losses of white collar jobs.[15] Fourth, service offshoring is more footloose than goods offshoring due to lower sunk costs and capital intensity. This implies stiffer competition among competitive suppliers and among alternative locations and hence more need for labour market flexibility and business deregulation. Some major developing countries, especially India, have increased the available pool of highly educated technical workforce, although not all of them reach the standards of developed world firms. India produces 441,000 technical graduates, nearly 2.3m other graduates and more than 300,000 postgraduates every year. However, there are varying standards of tertiary education concealed by these figures: one-fifth world-class, one-fifth passable and three-fifths lamentable (Economist, 2006b). As a final point, since services account for between two-thirds and three-quarters of total employment in developed economies, productivity gains in this sector are essential to economic growth and improvements in welfare. They are an important input in the rest of the economy, so the productivity growth in services has apart from direct effect also an indirect impact on economic growth and welfare. As IT and other services become less expensive due to offshoring, demand for them will expand more than proportionate to the decline in price. As a result, the lagging sectors should be able to afford more ICT, the leading sectors should deepen their use of it and productivity growth should rise throughout the economy (Mann, 2005).

The above discussion revealed that a series of geopolitical, macroeconomic, and technological trends has opened the world's markets, made business activities much more transferable, and produced a level of discontinuity that has no precedent in modern economic history. Having

[15] One of the studies, for example, estimated that by 2015, 3.4 million service jobs are likely to have shifted from the US to low-wage countries (Forrester, 2004). This is only a tiny fraction of total labour market and even smaller number compared to figures of job losses and creations (around 4 million jobs every month). Schultze (2004, p. 8) reports that according to survey data only around 4% of non-seasonal extended layoffs in US can be assigned to "import competition" and " relocation overseas". The figure is similar also for Europe (Orberg Jensen, Kirkegaard, and Søndergaard Laugesen (2006, p. 27). In my opinion, though, these concerns are not only exaggerated due to low aggregate level of offshoring activities, but also because at the same extent of service and goods offshoring, potentially negative employment effects of the former will be much smaller as white-collar workers can adapt to new market conditions more easily and reemploy faster than blue-collar workers. Inshoring, the other side of the coin also should not be omitted from the equation as it is an important countervailing source of new job creation. Slaughter (2004, p. 3), for example, highlights a less quoted fact, namely that the increase in US employment due to international insourcing from foreign countries grew from 2.6 million jobs in 1987 to 5.4 million in 2002. Amiti (2004, p. 38) reports that the United Kingdom and the United States have actually the largest net surpluses in business services trade and that their trade in services actually largely takes place with other industrial countries rather than with developing countries.

reviewed major factors behind increased international fragmentation of value added chain in manufacturing and services, I now turn to presenting recent developments in a more quantitative term.

2.2.2 Motives for international fragmentation at the firm level

The decision to outsource at the firm-level is basically one of deciding which processes should be internalized and which can be sourced at arm's length (Markusen, 2005). The issue of which processes to keep within the boundaries of the firm has been one of the central focus questions in the large literature on internalization of production (e.g. Dunning, 2001; Rugman, 1980; Vernon, 1966). From a theoretical perspective, the motives for offshoring are well explained and predicted by the OLI (ownership-location-internalization) paradigm pioneered by Dunning (2001), along with other theoretical applications rooted in transaction cost theory, agency theory, resource-based theories, and the role of institutions (Anderson & Gatignon, 1986; Hoskisson, Eden, Lau & Wright, 2000; Meyer, 2004; Meyer & Peng, 2005). In a survey of outsourcing practices by U.S. firms, Bajpai, Sachs, Arora and Khurana (2004) find that two-thirds of companies in the survey outsource to cut costs, while the next most important motives are increasing capacity, access to better technology, and improving service to customers. The importance of cost reduction as a motive for outsourcing in US firms is confirmed also by Mankiw and Swagel (2006). In Dachs, Ebersberger, Kinkel and Waser (2006), firms from different European countries are surveyed to examine frequency, geographical distribution and motives for offshoring production processes. Contrarily to the findings on the extent of production offshoring and the respective target regions, surveyed companies from nine countries do not show marked differences with regard to motives on the whole and cost motives particularly. The most important motives for production offshoring by falling importance are costs of production factors, market opening, vicinity to key customers, flexibility[16], and ability to supply. Similarly, Paul and Wooster (2008) report that three major motives for captive offshoring are to secure market share, lower costs of production, and gain access to resources not available domestically. Therefore, fragmentation of production processes can be seen as a production strategy that not only serves to cut operational costs but also to grow and expand existing operations (Smith, 2006).

The pressure to cut costs through farming out non-core competencies (such as assembly, logistics, accounting, human resource management, etc.) is not necessarily the same across industries. Firms in competitive industries face more pressure to minimize costs than do firms in concentrated industries. For example, Information Technology (IT) firms operate in a highly competitive environment where continuous innovation is crucial success factor. By

[16] Swenson (2000, 2005a, and 2005b) examined the operations of firms located in U.S. foreign trade subzones to study the responsiveness of outsourcing to international cost changes. She found that firms reduce their reliance on foreign inputs when dollar depreciation increases the relative price of imported inputs and when sourcing country's costs rise relative to competitor's country. This confirms the claim that flexibility issue is a valid motive for firms embarking on international sourcing of inputs.

releasing resources from peripheral, non-core activities towards core business competencies, offshoring provides a cost-effective way of augmenting innovation capabilities. Recent literature also suggests that increased competition for high-skilled labour in innovation-based industries has accelerated the process of offshore outsourcing (Mann, 2004; Murtha, 2004).

2.3 Trends in international fragmentation

The purpose of this section is to present available descriptive data on the development of international fragmentation of production on the global, European and Slovenian scale. In general, lack of detailed and internationally comparable data aggravates the assessment of developments in the growth of internationalization of production. Nevertheless, the extent of international fragmentation can be evaluated with few available indicators. Since international fragmentation of production can proceed either in the form of arms-length relationship between independent firms at different stages of production value chain or intra-firm transactions within multinational firms, global relocation trends can roughly be measured by international trade figures and by examining shifts in the FDI flows. Ideally, one would have to have detailed firm-level data on imports of intermediate goods and services together with the information about the type of relationship between the buyer and supplier in order to distinguish between offshore outsourcing and captive offshoring. Without the data on trading partner relationships, it is impossible to distinguish between the two alternative variants of offshoring. We can only measure the extent of offshoring as a whole.

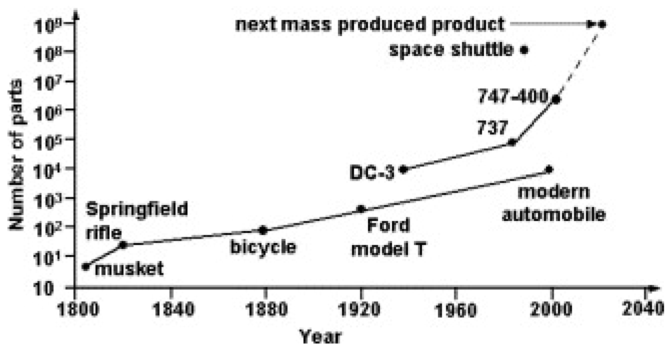
According to Feenstra and Hanson (1999), the use of international trade in intermediate goods as an indicator belongs to "narrow" measures of international outsourcing. Important drawbacks of this approach is that the measures omit four particular types of outsourcing: imports of final goods used in domestic production; imports of final goods that are sold under the brand-name of a domestic firm; imports of final goods that could potentially be produced domestically but are not; and imports of goods that could potentially be produced domestically for export purposes, but are produced abroad and exported to third markets (Molnar, Pain & Taglioni, 2007, p. 61). Nevertheless, the trade data presented below gives useful information about the direction and structure of trade flows and underlying international fragmentation of production.

Analysis of FDI flows can be used to evaluate the developments of captive offshoring part of relocation, but such estimates are burdened with several problems. First, majority of FDI flows represent horizontal type of investment whereas we are interested only in the vertical FDI as one of the alternative forms of international slicing of production chain. Secondly, even if total FDI flows were sufficiently correlated with vertical FDI, we would be measuring only the extensive margin of captive offshoring and not equally important intensive margin. Put differently, we would evaluate the formation of new offshore facilities and expansion of the existing ones, whilst totally ignoring the changes in production intensity of operational facilities abroad (e.g. increase of production, assembly and imports from foreign affiliates).

2.3.1 Evidence from intermediate inputs trade data

Increasing internationalization of production process at the regional and global level is creating rising levels of intra-industry and intra-firm trade. Production is becoming progressively more dependent on imports of intermediate goods that are either produced by independent suppliers and delivered in accordance with a contract, or by a subsidiary within a multinational network. Falling trade barriers, declining transport costs, advanced liberalization, technological progress, and rise of the Internet has enabled the decomposition of the production value chain into multiple successive upstream/downstream stages or tasks, frequently spread across a number of different countries. In addition, industrial products have also become more complex over time. For example, Ford's Model T was composed of 700 parts, while modern cars contain as much as 20.000 components – audio entertainment system alone nowadays has more parts than Model T (WTO, 2005b, p. 268). Not only has the product complexity increased dramatically, but the period for each successive wave has decreased (Figure 1).

Figure 1: The increase of the number of parts used in products



Source: Jeswieta and Hauschild, EcoDesign and Future Environmental Impacts, 2005, p. 631.

As products became ever more complex, it became impossible to combine mass production and specialization within one single plant. The number of tasks outgrew the number of operations that would still be efficiently organized and coordinated within one plant. Mass production brought about cost efficiency through exploitation of economies of scale. Economies of scope were also gaining importance since many of the components were designed so that they could easily be used in a modular way across different varieties and products. Countervailing force that held back the benefits from economies of scope was an increasing complexity and knowledge-intensity of component development which urged for specialization. Moreover, skills other than mechanical engineering and assembly became important in the process of delivering a product on the market. These tasks include design, marketing, customer relationship, and research and development. Increased technical and systemic complexity demanded organizational and managerial innovations that would regain the balance between specialization and economies of scale. Outsourcing production of non-core tasks has been central to continuous restructuring of industries across the board. Producers initially outsourced intermediate goods and services from outside suppliers in the home country but soon stretched across national borders to optimize production value chain even further. They identified and retained strategically important core activities in-house and focused attention and resources to these core competencies.[17]

Vertical integration revolutionized manufacturers as well as supply industries. Upstream intermediate goods are nowadays often highly standardized since they can be used in many different products. Therefore, they can be produced on a massive scale by highly specialized parts producers that are reaping the benefits of economies of scale and advantages of focusing on niche markets. These inputs are then used in the downstream stages of production process and assembled in various products of different types and qualities. Internationalization of production entails movement of such intermediates across borders and global relocation of supportive services. Trade in intermediate goods and services is thus a key feature of economic globalization and represents a specific form of the international division of labour. As we will see below, it is also quickly substituting for more traditional forms of internationalization that are based on importing raw materials and exporting finished goods (Havik & McMorrow, 2006, p. 5).

Apart from business surveys and input-output surveys, an analysis of trade in intermediate products is a widely-used approach for measuring the scale and nature of international fragmentation of production.[18] It should be stressed, however, that increasing trade in intermediate goods is a result of growing offshore outsourcing transactions as well as captive offshoring. As said before, to be able to disentangle the two sources of intermediate trade growth, we would have to have information on the type of business relationship between a supplier and buyer.

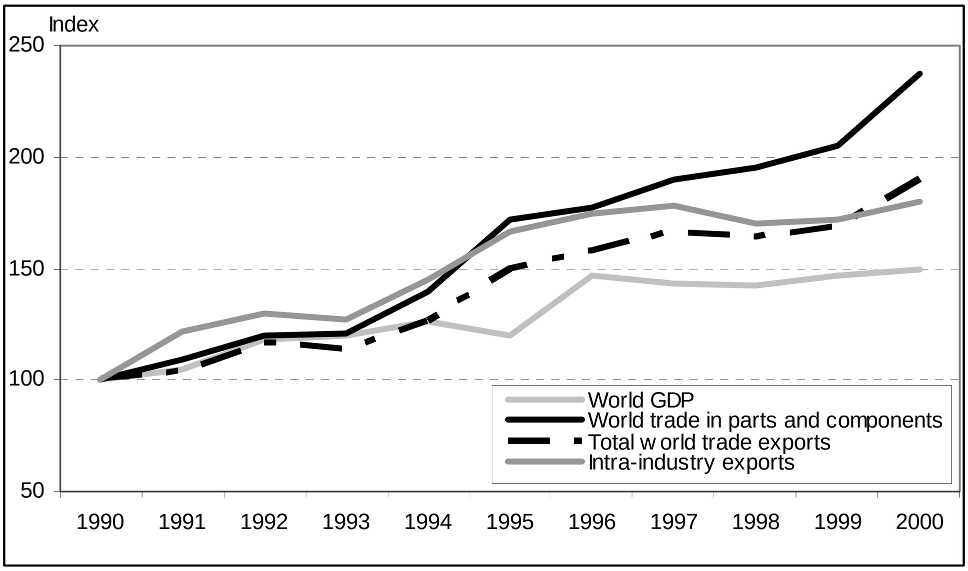
Figure 2 shows the growth of trade in parts and components during the period 1990- 2000 and is put in comparison to the evolution of world GDP, total world trade, and intra-industry trade. For the world as a whole, trade in intermediate inputs grew from $ 355 billion to $ 846

[17] It is important to note that whether an activity is considered core or peripheral to firm depends on the characteristic of this firm and the industry it belongs to. For example, while software development is the core business function of a software firm, it is not a core business of a bank or mobile phone manufacturer so the latter could outsource maintenance and adaptation of software to outside suppliers while a software firm will not. Methodology for identification of core competencies can be found in Walsh and Linton (2001), whereas for more managerial-based view on core capabilities framework, refer to Willcocks and Lacity (2006).

[18] Early empirical research found it difficult to asses the extent and nature of global production sharing because the international trade data generally have not distinguished between components and assembled products within the same industry. Revisions to the Standard International Trade Classification (SITC – both revision 2 and 3) now make it possible to identify trade in parts and components within several broad industry groups. Most of the countries shifted to the SITC Rev. 2 trade classification no earlier than by the early or mid-1980s (Yeats, 2001).

billion which gives an average rate of growth of 9.1% per year. By comparison, total world trade grew at 6.5% per year on average, while the world GDP expanded by 3.7% during the same period. It can also be seen that trade in parts and components grew faster than intra-industry trade. The reason is that many inputs (especially from electronics industry) now enter as inputs into broad range of industries. Micro chips, navigation equipment, and optical gadgets put together to manufacture cars, airplanes, and other transport means are a part of intermediate goods trade but not intra-industry trade. The result is that trade in intermediate goods accounts for roughly one-half of the total imports of developed countries (Kleinert, 2003, p. 464).

Figure 2: Global trade and income, 1990-2000

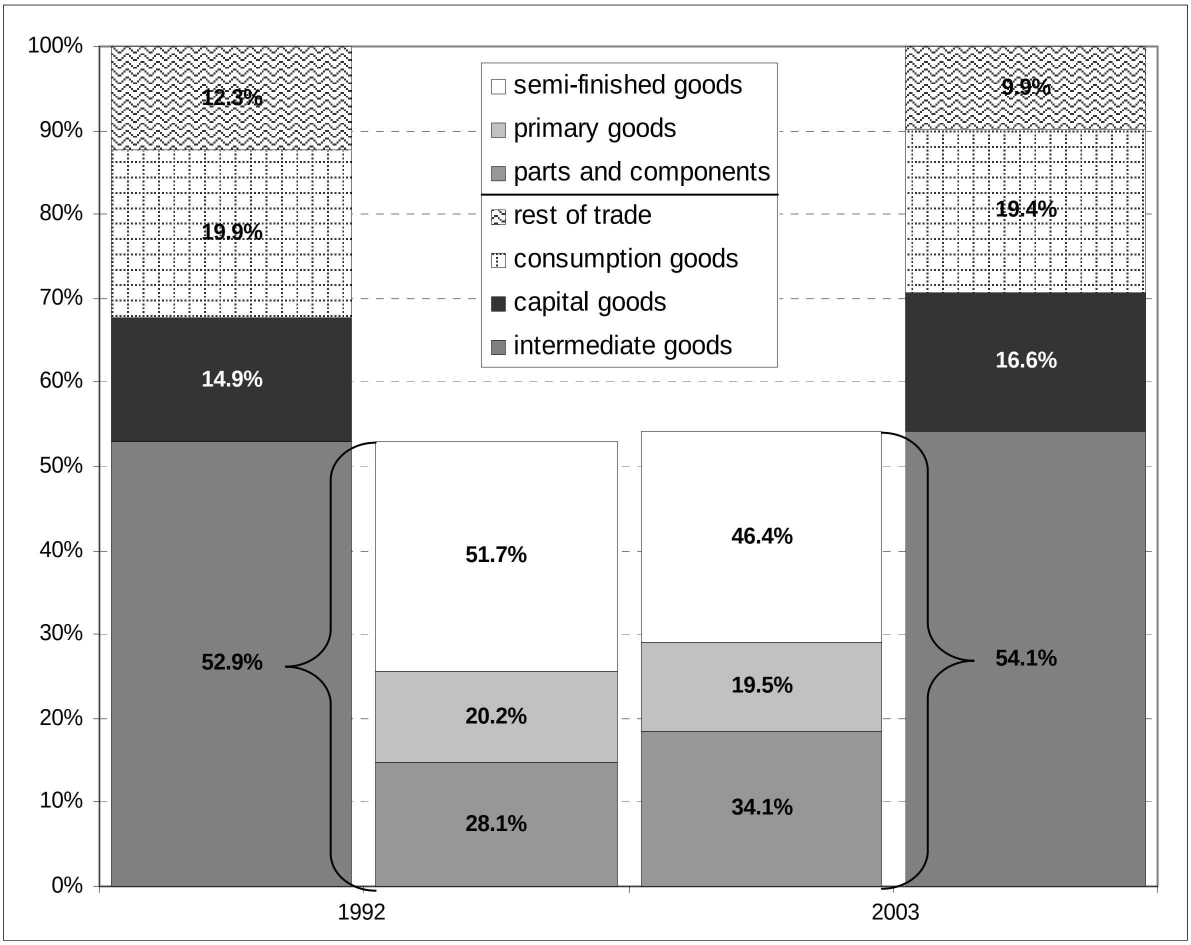


Notes: GDP figures from World Development Indicators, 2002, World Bank; trade data comes from Ng and Yeats (2001); intra-industry data is calculated from Industrial Demand-Supply Balance Database, 2004, UNIDO.

Source: Jones et al., What Does Evidence Tell Us About Fragmentation and Outsourcing?, 2005, p. 313.

In Figure 3 below, total world trade is classified according to the UN's Broad Economic Categories Classification (BEC). It categorizes products from the SITC firstly on the basis of their nature (whether they are primary or processed products) and furthermore according to their final use (whether they are intermediate, consumer or capital goods). The BEC breakdown is broadly equivalent to the 3 basic classes of goods used in the national accounts (SNA), namely intermediate, capital, and consumer goods. The classification therefore gives a valuable information about whether the imported goods are used for final consumption (consumption goods), capital formation (capital goods), or for industrial production (intermediate goods).

Figure 3: Breakdown of world imports by stage of production, in 1992 and 2003



Source: Havik and Mc Morrow, Global Trade Integration and Outsourcing: How Well is the EU Coping with the New Challenges?, 2006, p. 6-8.

Figure 3 provides a breakdown of world imports by stages of production for two snapshot years, 1992 and 2003. It indicates that in one decade, intermediate goods and capital goods have increased their shares in world imports at the expense of consumption goods and the unclassified grouping. Share of capital goods has increased by 1.7% points as a result of intensive industrialization of some major developing countries and due to amplified FDI flows in this period. Strongly linked with the rise of capital goods imports, intermediate goods have also increased their share in world trade (by 1.2% points). It is perhaps surprising that the latter increase was not larger, given the intensity of global production relocation. Aggregation on the worldwide level, however, masks a radically heterogeneous development in different regions. The most basic finding from the analysis of different countries and country groupings is that the TRIAD group (the EU, US and Japan) have all experienced a significant decrease in the share of intermediate imports in total imports, while the opposite happened in the rest of the world. Share of intermediates decreased from 62% in 1992 to 57% in 2003 in Japan, from 54% to 50% in EU15 and from 47% to 44% in US. This downward shift in the TRIAD has been more than compensated in the rest of the world, especially in the Asian countries. China has been a particularly important element in this story, increasing the share from 58% in 1992 to 72% in 2003. South-East Asia and EU10[19] groupings have experienced similar yet less intense increases with a rise from 61% to 64% and from 56% to 59%, respectively (Havik & Mc Morrow, 2006, p. 7).

Because the intermediate goods category is large and heterogeneous, it is further decomposed to three subgroups: primary goods, parts and components, and semi-finished goods (Figure 3). Even the aggregated world data on imports show an evident compositional shift away from semi-finished and primary goods towards parts and components. The latter category increased its share in intermediate goods group from 28% in 1992 to 34% in 2003. Automobile industry, ICT, office machinery, and electrical machinery have been the four major forces behind this structural shift (Yeats, 2001). Specific SITC products groups such as semiconductors, parts and accessories for computers, parts and accessories for motor vehicles and electrical circuits were among the top 10 key drivers of worldwide trade since the early 1990's (Havik & Mc Morrow, 2006, p. 7).

International relocation of production has extensively affected the structure of trade in the hinterlands of the TRIAD: EU10 and Asia (especially China). Much of the Western Europe's production in the period has been displaced in low-wage EU10 countries, most notably the automobile, food, and chemical industry. On the other side of the globe, US and Japan firms heavily invested in Asian countries to avail themselves of the large supplies of cheap labour. These FDI flows and the increase in the number and value of offshore outsourcing arrangements have changed the structure of EU10's and China's trade structure. On the import side, China increased the share of intermediate goods in total import from 58% in 1992 to 72% in 2003, mainly driven by the rise of the share of parts and components (from 11% to 28%). In the same period, the EU10 countries increased the share of intermediate goods in total imports from 56% to 59%, with parts and components again being the key generator of this surge (from 10% to 19.5%). On the export side, China increased both the share of intermediate goods (from 29.5% to 38%) as well as final goods (from 46.5% to 61%) to the detriment of unclassified category. Parts and components (from 3% to 16%) and capital goods (from 6% to 24%) gained the largest portion of Chinese total exports. EU10 likewise roughly doubled the share of parts and components (from 11% to 23%) and capital goods (from 8,5% to 15,5%) in total exports at the cost of consumption goods exports (from 31,5% to 21%) and primary goods exports (from 10% to 3%) (Havik and Mc Morrow 2006, p. 9-11).

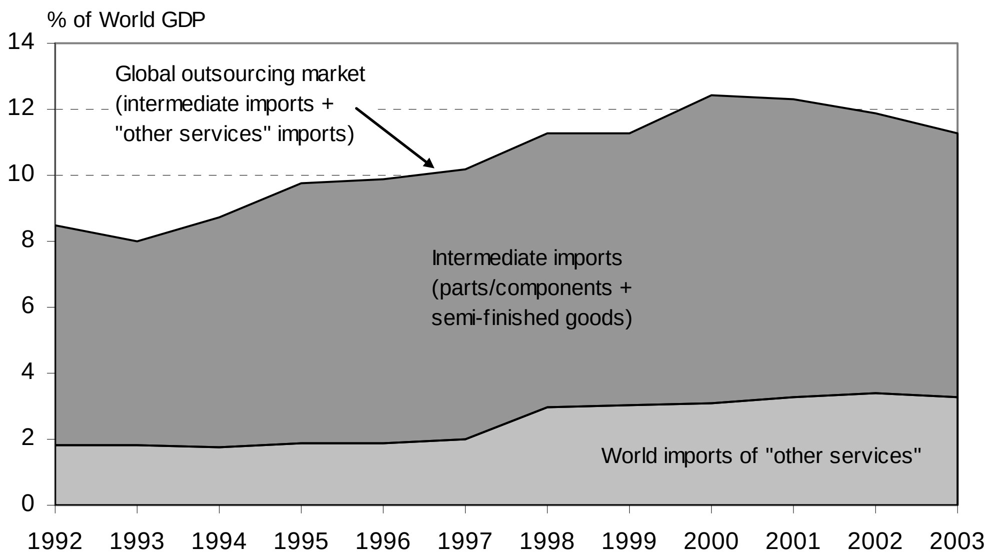
According to the above trade patterns, the China's comparative advantage – like many other South East Asian economies – lies in the downstream stages of production since it is specializing in the processing and assembly of a wide range of intermediate goods. EU10 grouping is characterized by comparative advantages in consumption goods. It is specialized in the production of low and medium-low technology, labour intensive goods as well as some capital intensive production such as motor vehicles and chemicals. Kimura (2005) reports

[19] The term EU10 refers to the group of ten countries that joined the European Union in 2004.

some interesting differences about the scope and characteristics of cross-border production sharing in CEE countries and East Asian countries. First, most of the intra-industry trade of the East Asian countries is of “vertical” rather than “horizontal” type. International fragmentation networks cover a number of countries at different stages of development, which is in sharp contrast to the horizontal intra-industry trade among core EU countries (Kimura, 2005, p. 6). Second, while transactions among less developed East Asian countries are substantial, those among CEE countries are still minimal. Third, agglomeration of intermediate input providers that would facilitate arm’s length transactions is not yet sufficiently developed in CEE countries, so that the production networks in the EU15-CEE nexus still depend on captive offshoring, while complex pattern of intra-firm and arm’s-length transactions is observed in East Asia. In CEE, production subsidiaries of different West European MNEs are still remotely located with each other, partially due to low population density and decentralization policy, and local firms do not successfully penetrate yet into international production networks, partially due to the lack of agglomeration (Ando & Kimura, 2006).

Production fragmentation therefore has a strong geographical dimension, where a parallel can be drawn in the complementarity between EU15 and EU10 on one side and between Japan, US and China, South East Asia. In sum, intermediate goods are by far the largest component of overall trade for both China and EU10, both economic areas are increasing their degree of participation in the international fragmentation of production processes, and both are specialized in areas of trade that have similar skill and factor intensities (Havik & Mc Morrow, 2006, p. 13).

Figure 4: Global Outsourcing Market, 1992-2003

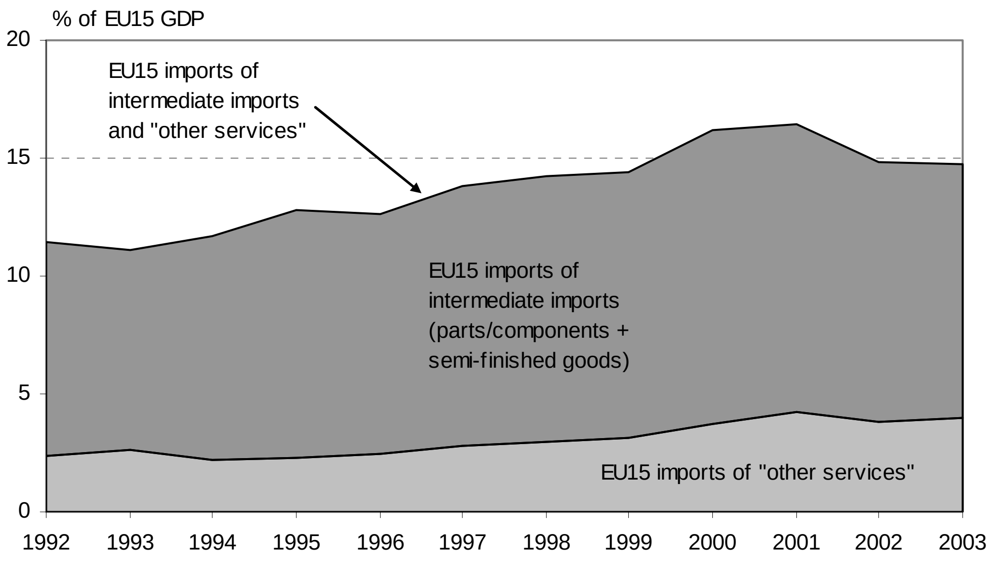


Source: Havik and McMorrow, Global Trade Integration and Outsourcing: How Well is the EU Coping with the New Challenges?, 2006, p. 20.

Measured by imports of intermediate goods and intermediate (essentially business) services, the overall global outsourcing market has expanded during the 1990's and faltered in the first years of current decade (Figure 4). In 2003, world outsourcing market was equivalent to 11% of world GDP, which is 3% points more than in 1993. Around half of the increase came from intermediate services and the other half from intermediate goods. The 2003 decline is a result of high growth of world nominal GDP in that year (12.1%) that largely exceeded the growth rate of intermediate imports. It should be noted that goods offshoring is much bigger than services offshoring, if one observes the share of imported inputs in the total use of inputs. Based on the input-output data of 29 OECD countries, (2008a, p. 102) finds that in 2000, 22% of total intermediate goods used in production (of both goods and services sectors) were imported, whereas only 3.4% of total services inputs were offshored.

EU's outsourcing market displayed a similar pattern of change as the global market: steady growth of imports of intermediate goods and services until 2001, followed by a slight deterioration in the following year (Figure 5). Like the world as a whole, EU15 experienced a similar increase of 3% points during the period 1992-2003. Despite similarities, EU's outsourcing market is significantly larger than global (compare 15% for the EU15 with 11% for the world in 2003). In sum, the EU and world economies have both considerably deepened the outsourcing market over the period, with this growth coming approximately equally from the increased trade in intermediate goods and in intermediate services.

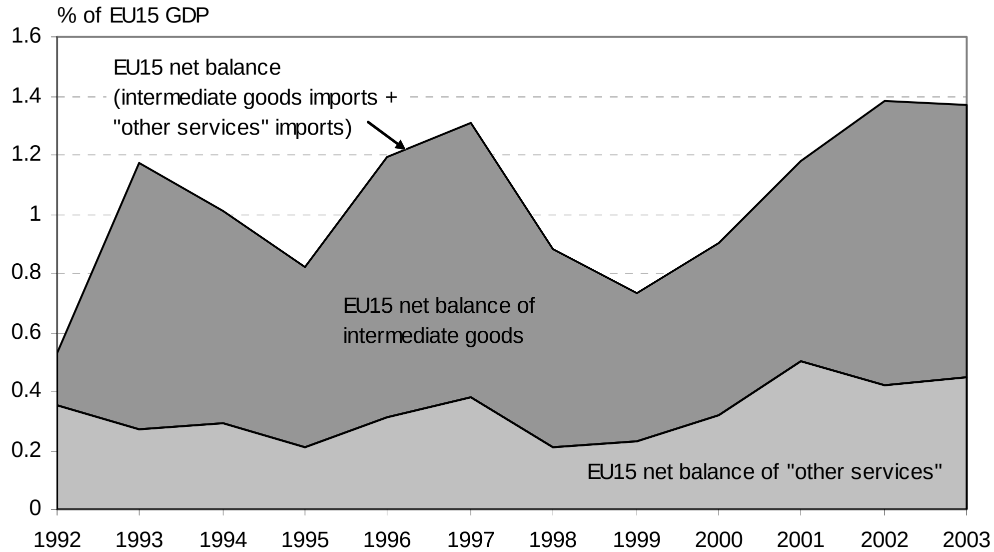
Figure 5: EU15 Outsourcing Market, 1992-2003



Source: Havik and McMorrow, Global Trade Integration and Outsourcing: How Well is the EU Coping with the New Challenges?, 2006, p. 20.

Despite the rising share of intermediate imports in GDP, EU has generated even larger escalation of exports of intermediate goods and services. Net balance of EU15 trade flows shows an increase from 0.5% of GDP in 1992 to 1.4% in 2003 (Figure 6). More than the fact that EU has experienced a rising surplus of intermediate goods and services, it is important and encouraging that the value of imports and exports and their share in GDP has been growing.[20] On the import side, this is a result of more firms finding cheaper inputs from abroad and thus optimizing their production process. This leads to more efficient use of available resources and lower prices for consumers. On the export side, domestic producers are being able to export more abroad, which enables them to grow and exploit economies of scale. This leads to resource allocation from less productive non-exporting firms towards more productive exporting companies, a process well documented by Pavčnik (2002).

Figure 6: EU15 Net Balance on intermediate goods trade (1992-2003)



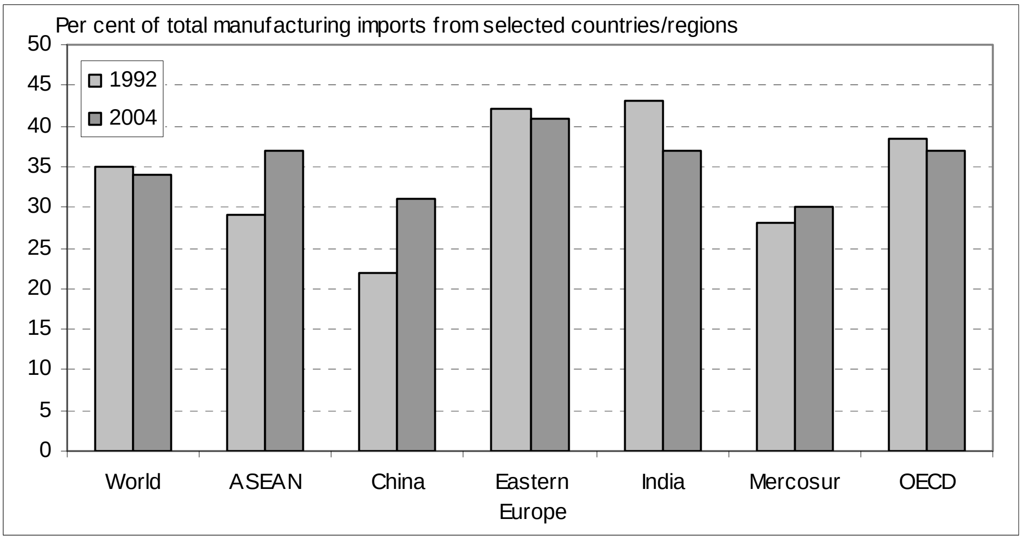
Source: Havik and McMorrow, Global Trade Integration and Outsourcing: How Well is the EU Coping with the New Challenges?, 2006, p. 20.

Two trends emerge from observing developed countries' imports of intermediate goods. First, the value of such imports has been increasing in time but with the matching increase of other types of goods (i.e. final and capital goods). As can be seen from Figure 7, the share of imports of intermediate goods in total OECD imports has hardly changed at all between 1992 and 2004. Nevertheless, the period featured a noteworthy geographical shift towards the imports from ASEAN economies and China. While intermediate imports into the OECD from China and ASEAN have increased sharply (from 22% in 1992 to 31% in 2004 in case of China and from 29% to 37% in case of ASEAN), this has been offset by reductions in intermediate imports from other countries (most notably from other OECD countries). Like in the world as a whole, imports of intermediate goods in OECD countries have risen as a proportion of domestic output, but this seems to be a consequence of the general rise in

[20] In fact, trade surplus is associated with country's weakness and not strength. Similarly, the main virtue of free trade comes from cheaper imports, whereas the exports are solely a necessity in order to keep the balance of payment sustainable (Krugman, 1993, p. 24).

import penetration over time as well as the fragmentation of production by multinational companies (Molnar, Pain & Taglioni, 2007, p. 11).

Figure 7: OECD imports of intermediate goods as a share of total manufacturing imports, 1992 and 2004

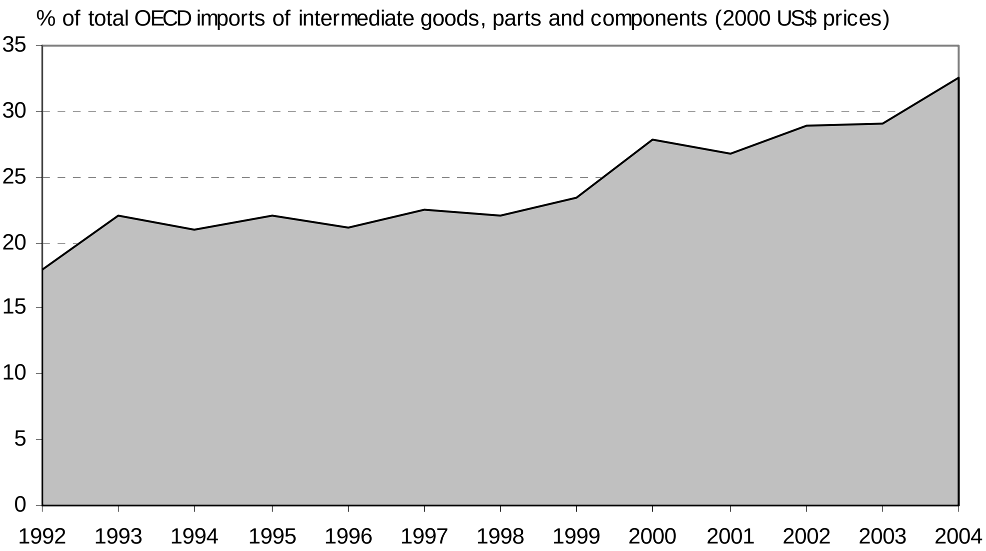


Source: Molnar et al., The Internationalisation of Production, International Outsourcing and Employment in the OECD, 2007, p. 16.

Second, the share of imports coming from developing countries is increasing. In the period 1992-2004, OECD country imports of intermediate goods increased by about 20% in value terms (Molnar et al., 2007, p. 63). Large bulk of this trade is still taking place between OECD countries, but the share of intermediate goods imports from non-OECD countries rose from 18% to 33% of the total (see Figure 8). The largest part of this increase can be attributed to imports from China and ASEAN countries (Figure 7). Among OECD countries, only Japan and Korea import as much final and intermediate goods from non-OECD countries as from other OECD countries. In other OECD members, the shares are either converging relatively fast (i.e. in US, the Netherlands, Finland) or almost stagnating (i.e. France, Austria, Italy) (Molnar et al., 2007, p. 17-18). Depending on the size of the economy, geography, outward orientation, and institutional factors, OECD countries obtain vastly different proportions of total intermediates from abroad. On one extreme, the ratio of imported intermediate goods to the total domestic use of intermediates in Japan amounted only to 5%, while in the Netherlands this share was 20%. The share of intermediate imports coming from non-OECD countries rose more or less persistently in all of the countries and was in the range from 1% (i.e. in Austria, Canada, France, Italy, UK, USA) to 4% in Korea (Molnar et al., 2007, p. 65-66).

Several reasons are possible for modest share of imported inputs relative to the total value of intermediates. First, distance and border effects are far from obsolete. Many inputs have unfavourable value-weight or value-volume ratio to be delocalized and shipped back. Second, large scale offshoring strategies are out of reach for smaller firms. They lack resources, scale of production and are financially constrained. Most importantly, they represent the majority of firms in the total population of companies. Third, when outsourcing arrangement entails a great deal of trust, relationship-specific investments, technical cooperation and joint R&D, business ties with local suppliers are harder to break as it is more costly to switch to offshoring. Head, Ries and Spencer (2004) for example show theoretically that a preference for insiders over outsiders results from endogenous decisions by insiders to conduct relationship-specific investment an confirm this empirically by showing that US automobile industry exports to Japan are reduced for parts where keiretsu sourcing is more important. Fourth, cultural distance and institutional differences continue to represent an important barrier in the process of internationalization. Last but not least, companies find it hard to find competent employees who would be willing to work and live abroad.

Figure 8: OECD imports of intermediate goods, parts and components from non-OECD countries (1992-2004)



Source: Molnar et al., The Internationalisation of Production, International Outsourcing and Employment in the OECD, 2007, p. 64.

On the whole, the amount of intermediate goods imported from low-wage countries is still only a fraction of the total domestic use of intermediates in developed countries, but it is on the rise. The growing share of imported intermediate inputs from low-wage countries comes at no surprise, considering the wage gap between developing and developed nations (Table 3). According to van Ark, Banister and Guillemineau (2006, p. 5), China's and India's manufacturing wages were only 2.9% and 2.5% of US manufacturing wages in 2002.

Table 3: Unit labour costs in manufacturing relative to USA, 2002 (US=100)

Country	**Unit labour costs**[1]	**Wages**[2]	**Productivity**[3]
Mexico	96,7	11,2	11,5
Poland	73,0	13,1	18,0
Czech Republic	62,8	13,1	20,8
Hungary	58,0	12,9	22,2
Turkey	32,1	5,1	16,0
China	21,3	2,9	13,7
India	19,7	2,5	12,5

Notes: [1] Unit labour cost is defined as the average labour compensation per unit of output and is measured as the ratio of labour compensation per employed person (or per hour worked) relative to output per employed person (or per hour worked) for the aggregate manufacturing sector (US=100).

[2] Average manufacturing wages in US$ relative to average US manufacturing wages (US=100).

[3] Productivity is measured as the output in US$ (PPP adjusted) per employed person for the aggregate manufacturing sector (US=100).

Source: van Ark, Banister and Guillemineau, Competitive Advantage of "Low-Wage" Countries Often Exaggerated, 2006, p. 5.

Manufacturing sector in Central and Eastern Europe and Mexico, for example, pay between 10% and 15% of wages paid in the U.S., and in Turkey, the level is around 5 percent. Wage cost, however, is only one side of the equation since wage bill is just part of the production cost. In order to take account of other costs, such as material inputs, capital cost, and (local) services, the level of labour compensation has to be adjusted for labour productivity gap. Returning to China and India, labour productivity there was also far below the US level at 13 percent and 12 percent, respectively. Nevertheless, productivity levels exceed compensation levels by a considerable margin. As a consequence, unit labour costs in China and India are on average at 20 percent of the unit labour costs in the US.

Adjusting for productivity gaps, the cost competitiveness of emerging economies is not as strong as suggested by wage differences. This is because their lower wage cost goes together with lower productivity. But most of the emerging economies still retain a competitive advantage because in majority of cases the productivity gap is smaller than the wage gap. This is because investors can benefit from better technologies and organizational techniques they apply in foreign subsidiaries, due to the above average productivities in the areas where FDI and domestic suppliers agglomerate, because large stocks of available labour is pushing down the wages in some countries and because some of the developing economies have undervalued currencies. In short, differences in productivity offset some, but not all, of cost advantages. While aggregate labour productivity has been estimated at 3-7% of US levels, it is purportedly much higher in foreign-financed and joint venture enterprises that are important exporters. Sectoral level data is sketchy, but productivity also appears to be higher in key export industries, such as footwear, apparel and electrical machinery (Adams, Gangnes & Shachmurove, 2004, p. 29). Increased fragmentation of production opens up additional determinants of country's comparative advantage. Costinot (2009) for example shows that better institutions and more educated workers are complementary sources of comparative advantage in the more complex industries.

The above analysis showed that the level and share of intermediate goods on the global scale in general and in EU in particular is on the rise. Because of the falling international transaction costs and considerable production cost advantages in developing economies, the developed countries increasingly import intermediate goods from low-cost locations. In the following subsection, I will turn to Slovenia. Before I describe the developments in Slovenian trade in intermediate goods and services, a short account to trade policy in transition and post-transition period will be given. Trade regime indeed plays a significant role in a country's development path as its liberalization opens up the domestic market to foreign competition, enhances technology spillovers, impacts the allocation of resources, and fosters the competitiveness of domestic firms in international markets. Furthermore, by studying the developments in the institutional sphere, I will be able to attribute or discredit the role that trade liberalization had in the advancement of international fragmentation of production in Slovenia. The issue of changes in the trade environment is especially relevant for the empirical part, since Amiti and Konings (2007) identified a significant effect of trade liberalization on the growth of productivity in Indonesian manufacturing firms. The following section will thus suggest whether or not it will necessary to include trade liberalization as a determinant of productivity growth in Slovenian manufacturing sector.

2.3.2 Slovenian trade policy

The development strategy of Slovenia before the independence was directed from Belgrade, Yugoslavia's capital, and was based on import substitution. Import tariffs were set according to the principle of tariff escalation in order to protect domestic production of consumer goods. Besides tariffs, various forms of restrictive and opaque import regimes were in place, including quotas, licenses, special import licenses, and conditionally free imports, together with complicated system of payment for imported goods. In 1986, 42 percent of the value of production of Slovenian industry and mining was additionally protected with some form of non-tariff trade barriers. Even more, 44 percent of imports were burdened with import restrictions such as quantity quotas, value quotas, and licenses (Majcen & Kaminski, 2004, p. 135). Estimated implicit effective protection rates for domestic sales, agriculture, and exports to industrial countries in 1986 were 35.5%, -6.2%, and -31.9%, respectively (Majcen & Lapornik, 1989).

After decades of import-substitution development strategy, Yugoslavia began to open up to foreign trade at the end of the 1980's as a response to severe economic crisis. Restrictive import regimes were dismantled and numerous import duty exemptions were extended. After 1991 when Slovenia proclaimed independence, trade liberalization continued at uninterrupted pace. The result was an almost complete elimination of non-tariff forms of protection, which was not compensated by a higher rate of value-based forms of protection. Further removal of direct import controls, introduction of convertibility of domestic currency for current account transactions, and a dramatic decline in additional import charges, made tariffs the most important tool of foreign trade policy in industrial products (Table 4).

Table 4: Shares of import value by import regime and tariffs and charges paid, 1986-96

Import regime	**1986**	**1990**	**1993**	**1996**
Free imports	3	78	97	98
Conditionally free imports	58	8	0	0
Quotas	37	12	1	0
Licenses	2	2	2	2
Import charge	**1986**	**1990**	**1993**	**1996**
Official tariffs[1]	11,0	12,0	12,3	10,7
Other official import charges[2]	17,5	16,0	2,0	0,0
Tariffs actually paid	7,4	7,1	.	5,6
Other import charges actually paid	4,8	9,3	.	0,0

[1] Unweighted averages; differences are due to the introduction of the harmonized coding system in 1988, code changes in 1993, and the new tariff schedule in 1996.

[2] Unweighted averages; numerous exemptions apply; special import duty on agricultural products not included.

Source: Majcen and Kaminski, Trade Policy in the Transition Process, 2004, p. 137, Table 9.2.

Upon accession to WTO, Slovenia bounded all of its tariff lines and abolished almost all import charges other than tariffs. It has also made specific commitments in two-thirds of the activities covered by GATS. As a result, a simple applied average MFN tariff rate fell from 15 percent in 1994 to 11 percent in 2001. After unilateral trade liberalization in the late 1980's and early 1990's and the multilateral phase with accession to the WTO in the mid 1990's, Slovenia opted for bilateral liberalization of its foreign trade policy following the vision to join the EU. In April 1992, diplomatic relations between Slovenia an EU were established and already in September 1993 the two put into force the Cooperation Agreement that was modelled on the 1980 agreement with SFR Yugoslavia. In June 1996, European Association Agreement was signed and in January 1997 the Cooperation Agreement was replaced by Pan-European Cumulating of Origin Agreement that established a single territory for purposes of rules of origin and set the stage for a single European trading bloc of industrial products, fully implemented on January 1, 2002 (Kaminski, 2001). Customs duties on imports into Slovenia of products from EU were immediately abolished for 41% of total imports, for sensitive goods the duties were reduced to 55% or 70% of the basic MFN applied tariff rates. By 2001 all customs duties on EU imports[21] were abolished. Nevertheless, despite intensive harmonization of trade regimes toward EU Common External Tariff and greater integration

[21] Basic agricultural products and processed foods are excluded.

among candidate countries, protectionist barriers were mainly reduced already at the end of the 1980's, when Slovenia was still a part of SFRY, and in the early 1990's (Table 5).

Table 5: Effective rates of protection in Slovenia in the period 1986-2001

Sector	1986	1993	1996	1997	1998	1999	2000	2001
Manufacturing	36.7	4.2	3.9	2.7	2.1	1.7	1.3	0.9
Capital goods	23.7	2.3	2.5	1.6	1.1	0.9	0.6	0.3
Intermediate goods	45.4	4.4	3.9	2.8	2.1	1.7	1.3	0.8
Consumer goods	32.7	4.7	4.6	3.1	2.4	2.0	1.5	1.1
All goods	30.9	7.0	7.9	7.1	6.6	6.4	6.1	5.9

Source: Majcen and Kaminski, Trade Policy in the Transition Process, 2004, p. 140.

Apart from Interim Agreement on Trade that entered into force in January 1997, Slovenia signed numerous bilateral FTAs with other enlargement countries (EFTA and CEFTA countries, FTAs with the Baltic states, Israel, and Turkey) and with the successor countries of SFR Yugoslavia (Croatia, FYR Macedonia, and Bosnia and Herzegovina), in total with 18 countries in addition to 15 EU countries (Majcen & Kaminski, 2004, p. 144). In May 2004, when Slovenia joined the EU, Common external Tariff of EU was adopted and applied MFN tariff rates in Slovenia lowered even further. The average applied MFN tariff in EU (and hence in Slovenia) is now 6.9% for all goods (4% for non-agricultural products and 18.6% for agricultural goods). Common external tariff forced Slovenia to give up bilateral preferential trade agreements with several Western Balkan countries that were partly compensated with Stabilization and Association Agreements and autonomous trade measures that allow duty-free access to products from the region into the EC market (WTO, 2007, p. 30-31).

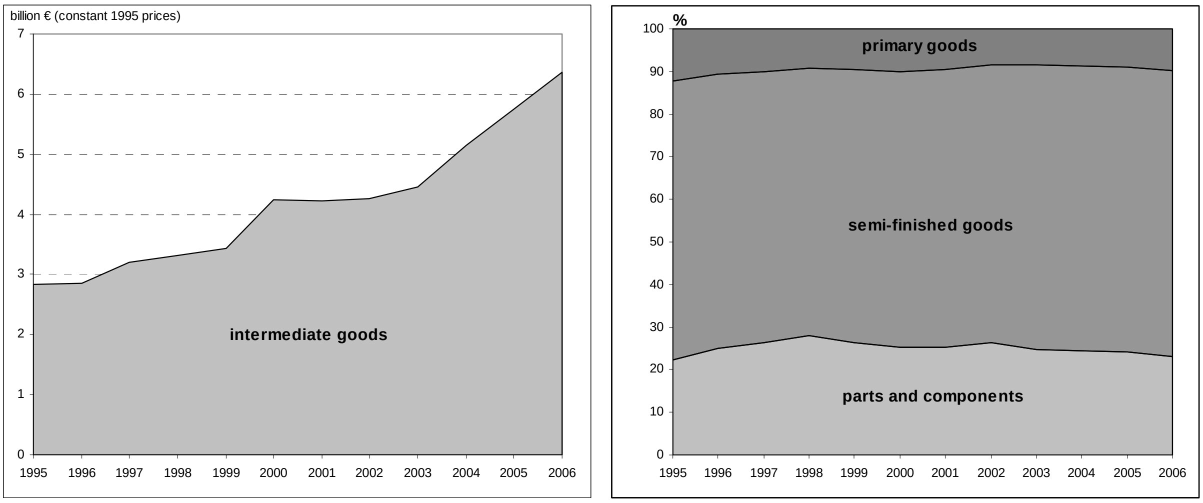
2.3.3 Trade in intermediate inputs in Slovenia

The above analysis of Slovenian trade policy revealed that major reductions in tariff and non-tariff trade barriers occurred already in the late 1980's as a result of the changes in the development strategy in SFRY towards more open and market-based economy. By the mid 1990's most of the trade barriers were considerably lowered so that further trade liberalization reduced the effective rates of protection persistently, yet only by a small fraction.

The level of intermediate goods imports to Slovenia more than doubled in real terms from 1995 to 2006 and it increased faster than real GDP (an increase of 56% in the same period). Imports grew relatively steadily, but an upturn can be observed after 2004, the year of accession into EU (Figure 9). Structurally, the pattern was more uneven, with the share of parts and components rising from 1995 to 1998 and afterwards steadily declining back to initial level of 20%. Compared to world data, Slovenia exhibits substantially smaller share of parts and components in the total value of intermediate goods imports (20% in Slovenia versus 34% for the World as a whole). On the other hand, its share of semi finished goods

(67%) greatly exceeds the World average of 46%. Whereas the world has experienced a shift from semi-finished goods in favour of parts and components, Slovenia maintained relatively stable and unchanged shares of the three subgroupings of intermediate goods imports. The share of the broad category of intermediate goods in total imports remained stable as well at around 60% throughout the period, but was higher than the world average (54%).

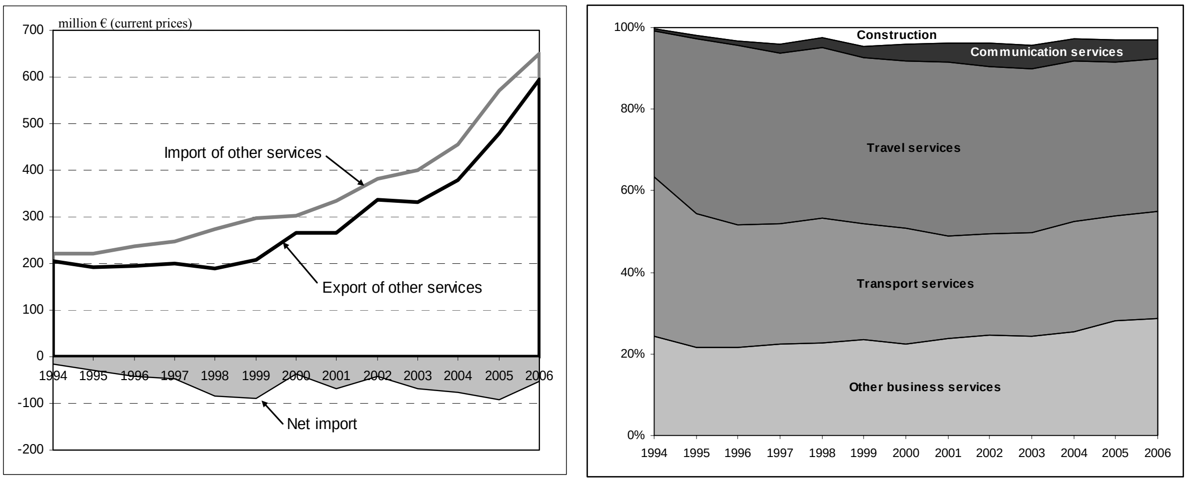
Figure 9: Value and composition of Slovenian intermediate goods imports, 1995-2006



Source: SURS Statistical Yearbook (various volumes).

Trade in other services – a rough measure of service outsourcing – in Slovenia tripled from 1994 to 2006. There has been an upward shift in trend after the EU accession, similar to intermediate goods trade. From the beginning of the sample period, Slovenia was a net importer of other services. Net position widened from 1994 to 1999 to -89 million euros but remained within the range until 2006. Share of other services in total services imports increased from 24% in 1994 to 29% in 2006. Almost identical 4% point increase happened on the field of imports of communication services at the expense of transport services share in total imports of services. In general, Slovenian trade in other services is showing positive signs of expansion, but compared to the level of intermediate goods trade remains modest. Whereas the value of imports of other services represents around 35% of the value of intermediate goods imports in EU15 and the world as a whole, the corresponding magnitude for Slovenia is only 6% (Bank of Slovenia, 2007a, p. II.-47).

Figure 10: Value and composition of Slovenian trade in services, 1994-2006



Source: Bank of Slovenia Bulletin 2007, 16(2-3), p. II.-47.

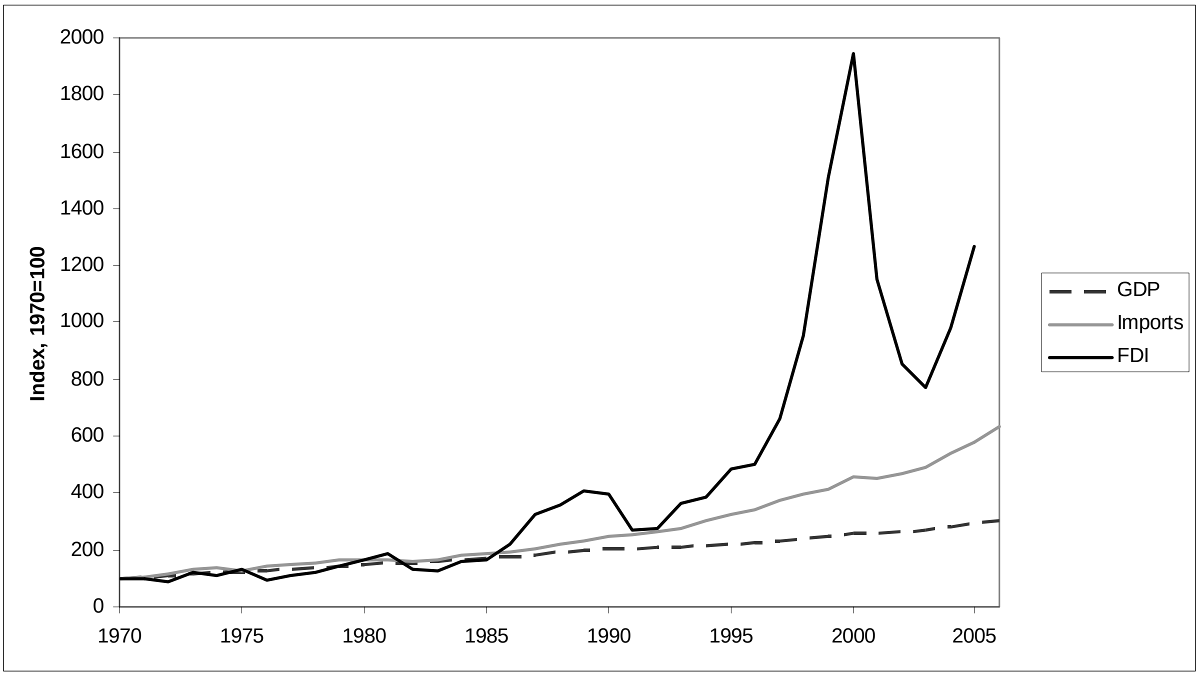
2.3.4 Evidence from foreign direct investment data

The second important category of international fragmentation is captive offshoring, the extent of which will be measured in this section using the data on foreign direct investment flows and stocks. As noted above, one must not be tempted to concentrate only on the part of international slicing-up the value chain that occurs within the boundaries of a single firm, under its ownership and control. Ownership dimension indeed describes nicely the cross-border aspect of fragmentation in firms that seek to relocate labour-intensive activities abroad without losing control over that part of the production chain, but it misses the growing movement toward offshore outsourcing. Although empirical evidence is rare, there are numerous reports in the press of firms embarking on arms-length cross-border relationships, sometimes even by replacing them for the existent intra-firm arrangements. Recent example of a switch from captive to arms-length offshoring is when Tommy Hilfiger Group, well known designer house, sold off its in-house global sourcing operations to Li&Fung and arranged for its Karl Lagerfeld and Tommy Hilfiger designer products to be produced by independent plants worldwide, instead of sewing them up in its own workshops in Asia or arranging for an independent contractor to do so in the US (Li&Fung, 2007).

However, in order to get the idea of the relative importance of captive offshoring and foreign outsourcing, firm-level data are required. The evidence is scarce and mixed. Antras and Helpman (2004, p. 554) show that the growth of offshore outsourcing by US firms might have outpaced the growth of the growth of their foreign intra-firm sourcing. On the contrary, Hanson, Mataloni and Slaughter (2005) and Feinberg and Keane (2005) provide evidence of significant increase in the intra-firm trade in the US. In a study closer to Slovenian context, Marin (2006) shows the importance of vertical FDI and intra-firm trade between Germany and eastern European countries, estimating that the share of intra-firm exports in total exports from Hungary, Slovakia, and the Czech Republic to Germany in the period 1996-2000 was

16%, 65%, and 40% respectively. In what follows, I will present the captive offshoring dimension of international fragmentation in order to identify its trends and intensity in the World, EU, and Slovenia. Because of the reasons mentioned earlier, the data on FDI is a poor measure of the intensity of captive offshoring operations. Nevertheless, I will use it as a rough assessment of the evolution of this particular form of international fragmentation in time rather than the measure of the scale.

Figure 11: World GDP, imports, and inward FDI flows, 1970-2002

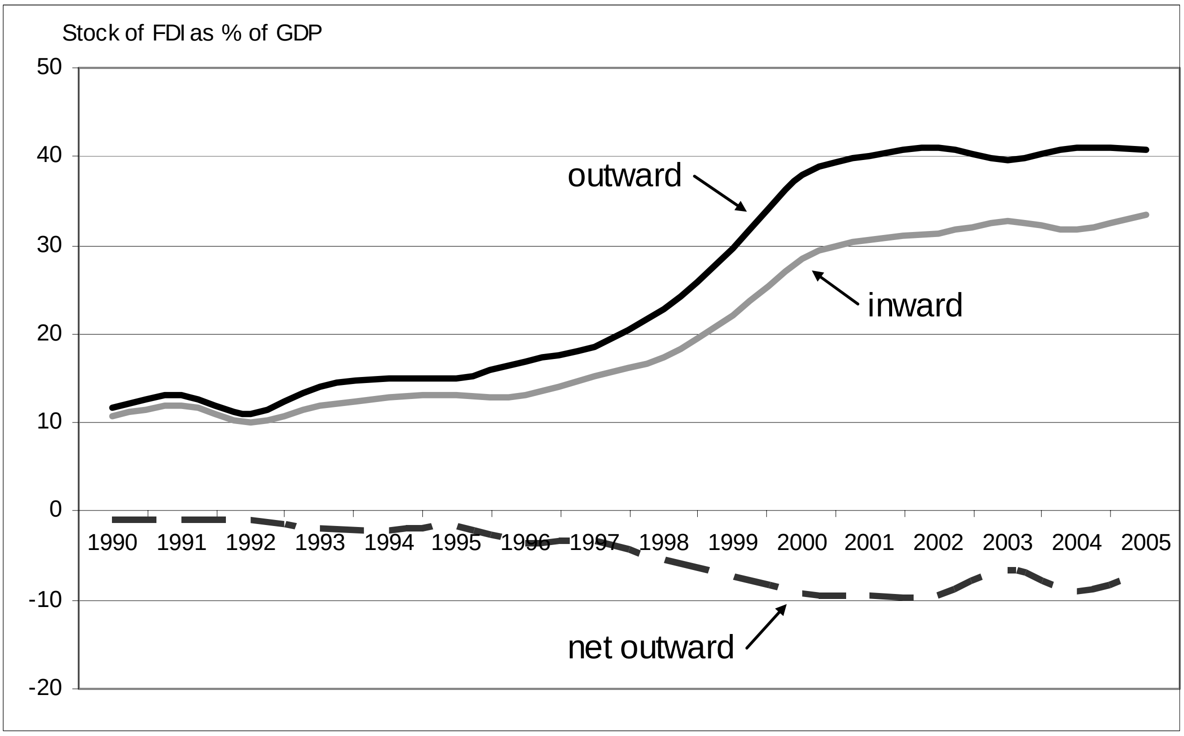


Source: World Bank, UNCTAD, WTO.

Compared to the value of world imports and world GDP, global FDI flows increased even more rapidly (Figure 11). At the peak of the cycle in 2000, world annual inward FDI flows were as much as 20 times larger than in 1970. After the 9/11 attacks and dot-com cooldown, the inflows fell to their 1998 values but have already reached new record in 2007 (UNCTAD, 2007). As a consequence of the surge of global capital flows, stock of foreign capital as a share of world GDP has increased significantly since the early 1980's. Inward stock of FDI increased modestly in the 1980's (from 6.5% to 9% of world GDP) and gained momentum in the 1990's when it rose from 9% in 1990 to 23% of world GDP in 2005 (UNCTAD, 2006, p. 307).

The share of inward FDI in GDP increased dramatically in developed as well as in developing countries (i.e. from 8.2% in 1990 to 21.4% in 2005 in developed economies and 9.8% in 1990 to 27.0% in 2005 in developing economies) (UNCTAD, 2006, p. 307-317). Observing the net outward FDI positions of major groupings reveals even more information about the geography of global capital shifts. Since the early 1990's when the net FDI positions were broadly balanced in both EU and US, their net positions deteriorated significantly over this period. Net FDI outflows from the EU reached almost 10% of GDP in 2002, while the deterioration of US net stock position was somewhat less severe compared to the EU. Its net deficits of 3-4% were more or less in line with the deficits of 1980's, especially in the early part of the decade (UNCTAD, 2001, p. 325-337 and UNCTAD, 2006, p. 307-317). Meanwhile, the rest of the world has experienced a significant increase in the net inward stock position throughout the 1990's and further on in the present decade to reach a level of over 8% of GDP in 2003 (Denis et al. 2006, p. 38). Developing economies net inward stock reached 14.2% of GDP in 2005, up from 5.5% in 1990 (UNCTAD, 2001, p. 325-337 and UNCTAD, 2006, p. 307-317). A significant part of the increase can be attributed to the opening up of China, where the net stock of FDI has grown from 4.2% in 1990 to 12.2% in 2005 (UNCTAD, 2006, p. 314).

Figure 12: Stocks of inward and outward FDI and net stocks for EU15, 1990-2005



Source: UNCTAD (various World Investment Reports) and own calculations.

EU's outward and inward FDI stocks increased during the 1990's from around 10% to 40.7% and 33.5% of GDP in 2005, respectively (Figure 12). The net outward stock reached 7.2% of EU GDP, which amounts to $975 billion. Despite the large figure, it should be stressed that it represents only a tiny fraction of EU's total capital stock of around 300% of GDP (Denis et al., 2006, p. 39). In addition, most of the FDI outflows are of horizontal rather than vertical type, but the distribution of FDI flows by region in recent years suggests a shift towards efficiency seeking investment projects. While in 1988-1990 only 17.5% of world FDI inflows were channelled to developing economies, the share doubled to 36.5% in 2005. Low-cost locations in South, East and South-East Asia absorbed more than half of the FDI flows going to developing world. South-Eastern Europe and CIS, other two attractive low-cost regions, received 4.3% of world inward FDI flows in 2005, up from 0.02% in 1998-1990 (UNCTAD 2006).

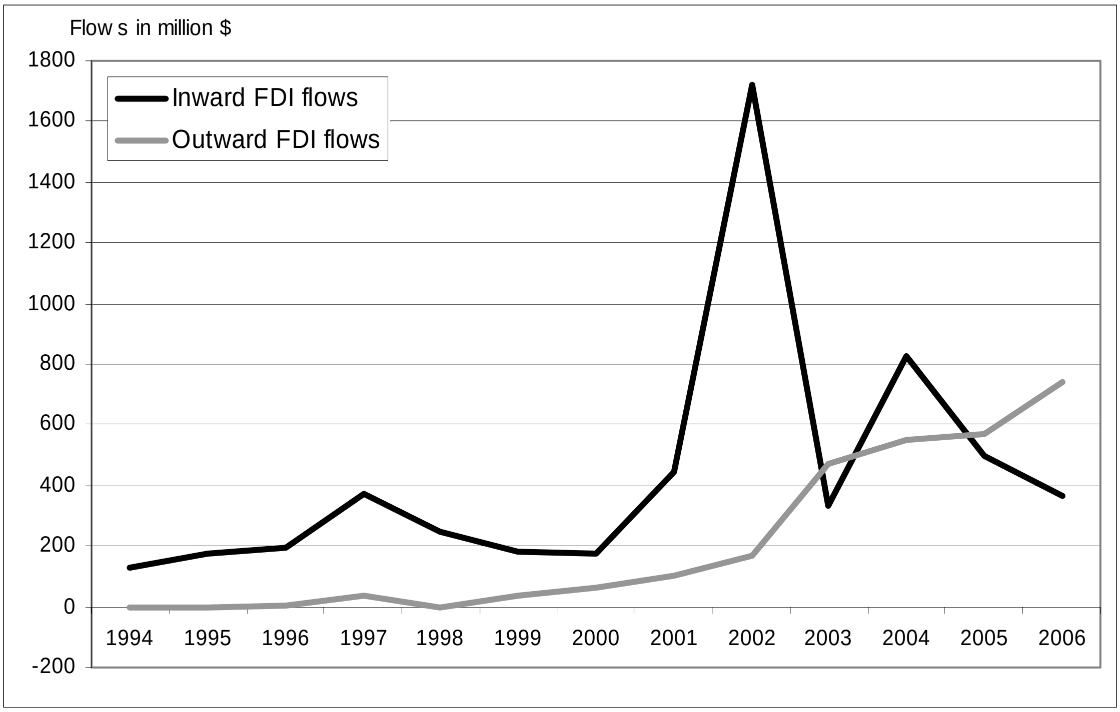
After initial period of inactivity, annual outward FDI by Slovenian companies grew every year between 1998 and 2006 (Figure 13). At the end of 2006, the stock of outward FDI amounted to €3,457.2 million, 12 times more than at the end of 1994, the first year for which detailed corporate figures are available (Bank of Slovenia (2007b, p. 25). Even though the outward FDI flows tend to outstrip inward FDI flows in recent years, outward stock at 10.6% of GDP is still only half as large as the inward FDI stock (Figure 14). At the end 2006 there were 2,314 outward investments (direct affiliation) that belonged to 972 Slovenian companies, representing 2.5% of the population of companies in Slovenia. According to the classification of FDIs into new, existing and other investments,[22] 51% of the total number of projects were greenfield investments, and they accounted for 52.5% of equity invested abroad. Investments in existing companies accounted for 22.7% of the total number, and 40.5% of the equity. Other investments represented 26.3% by number and 6.9% in terms of value (Bank of Slovenia, 2007b, p. 26-27).

Geographical structure of outward investments exhibits strong affiliation to former members of SFR Yugoslavia. Slovenian firms hold 72.8% of all FDIs in the countries of the former Yugoslavia and Croatia accounts for the bulk of the investments (37.5% of the total number and 26.8% by value) (Bank of Slovenia, 2007b, p. 26). The growing presence in the countries of former Yugoslavia began in the second half of the 1990's when Slovenian firms realized that regaining the lost market shares could only be achieved through establishing foreign affiliates. Damijan (2004, p. 341) reports that only half of the investment projects in the former Yugoslav markets involved the establishment of a new firm or the acquisition of an existing firm, while the other half accounted for the investments in real estate, bankrupt local firms, and other investments. This is in sharp contrast to Slovenian outward investments in other countries where the majority of projects is greenfield or acquisitions. Contrary to theoretical predictions, Damijan (2001) finds that the most important reason for conducting FDI in former Yugoslavia region is to secure payments for their shipments. Damijan (2001) and Svetličič and Jaklič (2001) both report that the key payment method in doing business in the former Yugoslavia region is cash, followed by completely unsecured payments to open accounts. The majority of investment projects to this region were trade-promoting, while only 20% of Slovenian investors established production facilities. The remaining outward investments (predominately to EU) are also predominately market-seeking, whereas low labour and material costs are even less important motive for investing in this region compared to former Yugoslavia (Damijan, 2004, p. 345-346). In a recent survey of Slovenian investors to former Yugoslavian countries, Udovič (2009) reports that the most important motives for

[22] New investments refer to cases where a resident is the founder or co-founder of a company in a host country. Existing investments are those made by residents in existing companies that they themselves did not establish. Other investments refer to investments made in institutions, branches, foundations, real estate and companies in bankruptcy (Bank of Slovenia, 2006, p. 26).

investing are market-related motives (4.27-4.59 on the 1-5 scale), followed by efficiency-seeking (3.04-3.58) and resource-seeking motives (2.88-3.15).[23] Among the most important risks for doing business in this region, the companies mentioned microeconomic, administrative and political security risks.

Figure 13: Inward and outward FDI flows in Slovenia, 1994-2006

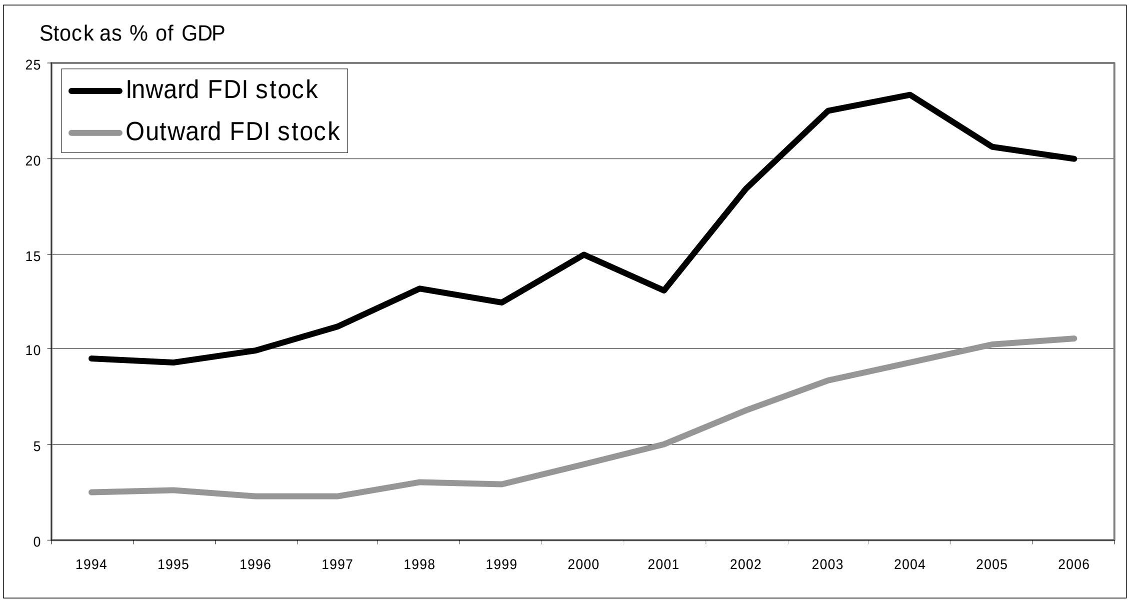


Source: UNCTAD (various World Investment Reports).

The breakdown of domestic companies by sectors reveals that at the end of 2006 companies involved in other business activities play a leading role, accounting for 17% of total Slovenian outward FDI. They were followed by companies in the retail sector (15%), chemicals, chemical products and manmade fibres (11%), financial intermediation (8%), and manufacture of food, beverages and animal feed (7%). Two of these are manufacturing sectors, while the remaining three are service-oriented, and have risen over the last five years to account for 39.8% of total Slovenian outward FDI. The proportion of outward FDI accounted for by the service sector has risen over the observed period from 33.5% in 1997 to 59.6% in 2006, while the proportion accounted for by the manufacturing sector has declined from 51.9% in 1997 to 39.6% in 2006. The value of the FDI is increasing in both cases, but the growth in investments by companies from the service sector is outpacing the growth in investments by companies from the manufacturing sector.

[23] Slovenian companies hold the majority (73.5%) of all FDIs in the countries of the former Yugoslavia. Most FDIs (39.3%) are held in Croatia (Bank of Slovenia, 2007, p. 26).

Figure 14: Slovenian inward and outward FDI stock, 1994-2005



Source: UNCTAD (various World Investment Reports).

With outward FDI stock at 10.5% of GDP, Slovenia is ahead of new EU members' average (5.7%) but well below EU15 (47.2%) and world average (26.1%) (UNCTAD (2007, p. 259-270). As a consequence of poor inward FDI performance and relatively intensive investments abroad, Slovenian flows and stock of outward FDI is lately approaching inward FDI figures. Annual flows and the accumulated stock of outward investments increased from late 1990's onward, largely fuelled by increased investments to former Yugoslavian countries. As noted above, the evidence based on surveys suggest that the bulk of investment projects is driven by market-seeking motives, whereas efficiency aspects play a minor role, especially for the FDI in advanced EU countries.[24] In general, Slovenian outward FDI is still of horizontal rather than of vertical type. This fact has an important implication for the empirical part of my dissertation. Namely, I will avoid interpreting the results for firms that source intermediate inputs from abroad and have at the same time investments abroad as the results for offshore outsourcing type of international fragmentation. Instead, I will rather focus on the location dimension of sourcing operations and for the most part set aside the consideration of the ownership dimension.

So far I have examined the existing evidence on the spread of international sourcing activities on the global scale and in Slovenia. On the basis of presented descriptive data and various studies examined above, it can be concluded that offshore outsourcing is one of the highest growing components in international trade flows and that fragmentation of production is gaining increasing importance in shaping production, trade, and organizational patterns in the globalizing world. Next chapter gives an overview of the existing theoretical and empirical

[24] The data at hand, however, does not allow me to distinguish between the two alternative types of offshoring since I have no information about the type of subsidiaries abroad and the status of foreign firms that supply Slovenian companies with imports.

literature on international fragmentation of production. It begins with a review of three branches of economic theories that are combined later in the dissertation into a common framework: trade theory, theory of the firm, and the theory of R&D. In the second half of the chapter, I examine empirical evidence on the relationship between international sourcing of inputs and productivity at the industry and firm level.

3 LITERATURE REVIEW

3.1 Theories of outsourcing and offshoring

3.1.1 Traditional models of international fragmentation

Traditional branch of international trade literature modelled fragmentation as a splitting of a production process into two or multiple component parts (e.g. Jones & Kierzkowski, 1990, 2001; Arndt, 2001; Deardorff, 2001a, 2001b; and Kohler, 2004). This body of literature, which will be presented in the first part of this chapter, has mostly extended traditional trade models (Heckscher-Ohlin and Ricardian models) and compared the outcome of standard integrated production function with internationally fragmented production in terms of welfare, factor prices, and trade flows. Although it offered some interesting results and insights, this stream of literature produced results that depend crucially on the details of production process and environment setting, so it is not easy to derive general principles from the specific cases that have been examined. In addition, the modelling of fragmentation as a discrete choice makes it difficult to study the evolution of trade in intermediate goods and services over time. Most importantly, it does not explain alternative forms of international fragmentation because the firms, as they are modelled, make no marginal decisions about how to organize production (Grossman and Rossi-Hansberg 2008, p. 1981). In other words, the black box of the firm was opened, but not in a manner that would allow endogenous formation of international production sharing and resolve the crucial issue of make-or-buy decision. These models can explain why a domestic firm might have an incentive to perform part of its production activities abroad, but they fail to explain why this will occur within firm boundaries rather than through arm's length subcontracting (Antras 2003, p. 1380). Bearing in mind the organizational, geographical and quantitative developments of modern multi-stage production, research focus has shifted away from studying overall implications of the disintegration for resource allocation, welfare, and the distribution of income, towards partial equilibrium analysis of firm's decision about organizational form and location of intermediate input production. After a brief overview of the early and more traditional literature on international fragmentation, this chapter will focus on the new generation of theoretical models, assorted in four major groups according to the corresponding theories of the boundary of the firm.

In an early paper Jones and Kierzkowski (1990) pointed out that international fragmentation should in general be beneficial since it enhances the gains from trade. They describe an informal framework which highlights the role of services in fostering international fragmentation and trade. With growth of a firm's output level, increasing returns and advantages of specialization of factors within the firm encourage a switch from integrated production to a process with fragmented production blocks connected by service links. Fragmentation entails lower marginal cost, but at the expense of a greater total sum of fixed costs, which ensures that average costs decline with output. This opens up the possibility of vertical specialization and the appearance of new specialized suppliers because in the limit, every production block and service link might represent a separate firm. The international market, with its variety of factor productivities (Ricardian framework) and factor prices and factor intensities (Heckscher-Ohlin framework) expands opportunities related to trade in production fragments according to comparative advantage. In addition, trade also augments gains to those associated with increasing returns and fragmentation as a result of output expansion. The role of services in linking value added bits across different countries enables developing countries to contribute in some segments of value added chain even when a comparative advantage in the integrated process is still out of reach. For example, in India software industry was virtually non-existent in the early 1980s. Today it employs more than 450,000 employees, sustaining annual growth rates of 30-40% in revenues and employment over more than 10 years (Arora & Gambardella, 2005, p. 1). NASSCOM forecasts in Economist (2004b) project the number of employees in the sector to grow to 2.7 million by 2012.

Jones and Kierzkowski (2001) build on the conceptualization of fragmentation described in their earlier work (Jones & Kierzkowski, 1990), where production process was decomposed into separable blocks connected by service links. They model a Heckscher-Ohlin world with two factors, many goods and fixed input coefficients. It is assumed that the technological performance of inputs differs across countries, leading to a Ricardian emphasis on technology and comparative advantage. When fragmentation is allowed to occur, initially integrated production becomes decomposed into components. As a result, world prices of components and the prices of final goods change. The model predicts that although the splitting up the value chain generally leads to welfare improvements, adverse terms-of-trade effects and hence declining welfare cannot be ruled out. The implications for the distribution of income suggest that while fragmentation may lead to real wage reduction for the unskilled workers, it may also increase their wages, depending on the interaction between factor endowments and factor intensities. These results suggest that the issue of the effects of international fragmentation on welfare and the distribution of income is more subtle than popular discourse suggests.

Deardorff (2001a) explores how fragmentation may matter for the prices of factors and whether and where fragmented technologies will be used. In the context of Heckscher-Ohlin model of two factors, many goods and many countries, he studies the effects of offshore outsourcing between countries located in different cones of specialization. Within these cones, countries share identical factor prices and fragmentation either does not occur or is not particularly interesting. Fragmentation across cones, on the other hand, does not necessarily contribute to factor-price equalization, since the movement of relative factor prices in each cone depends on the relationship between factor proportions of fragments and average factor intensities in that cone. The model also briefly analyzes the role of tariffs, which can both hinder and encourage fragmentation depending on whether and where tariffs are imposed on intermediate and final goods.

In another paper Deardorff (2001b) examines the effect of fragmentation on aggregate welfare, patterns of specialization and trade, and on factor prices using a Ricardian model and a Heckscher-Ohlin model of international trade. Both models are first analyzed from a small country perspective, followed by a large country setting in a two-country world. Results obtained from both models are as follows. First, as long as prices of final goods in the rest-of-world remain unchanged, the small country cannot lose from it and neither can the rest of the world. Second, if fragmentation leads to price changes, country's welfare can decrease if its terms of trade turn against it. Third, even if a country on average gains from fragmentation under the new set of prices, some factors within it can still be hurt. Finally, fragmentation can be a driver for factor price equalization between initially unequal countries.

In the model presented by Feenstra and Hanson (1996), a single manufactured good is assembled costlessly from a continuum of intermediate inputs using capital, skilled and unskilled labour. Sorting the inputs in increasing order of skilled/unskilled labour requirement and assuming the factor returns are not equalized between the two countries (high-skill and capital abundant home country and unskilled-labour abundant foreign country), the model enables a range of intermediate inputs to be produced domestically and the rest of components production to be outsourced abroad. Starting from the equilibrium with immobile capital and allowing capital to move from home to foreign country in the next step, raises (lowers) rental on capital at home (abroad), expands the range of intermediates outsourced to foreign country, lowers relative demand for unskilled labour in both countries, and rises relative wage of skilled labour in both countries. While the relative wage of unskilled workers falls in both countries, their real wages need not fall due to the benevolent drop in final good prices.[25] These results hold regardless of whether the increased outsourcing is due to a capital flow, growth in the capital endowments abroad at the rate exceeding that at home, or simply technological progress abroad exceeding that at home.

Arndt (1997, 1998) examine graphically the welfare implications of international fragmentation in a simple Heckscher-Ohlin model. Labour-intensive product is allowed to be

[25] Sayek and Sener (2006) show in a dynamic North–South trade model with outsourcing and endogenous innovation that an increase in the extent of outsourcing raises the real wage growth rate for all types of labor in both the North and the South despite increased income inequalities.

split into two components whose production technologies exhibit different capital-intensities. Under the assumption that factor-price equalization has not been achieved between the countries, wage differential offers the developed country a possibility to produce labour-intensive component of the labour-intensive final product in a low-wage country. If the resulting cost reductions are large enough to lead domestic firms to completely abandon labour-intensive component production in favour of imports, there will be cost savings in the industry producing labour intensive consumer good. Providing that home country is small (cost-savings cannot lead to lower goods prices since they are set on world markets), the adjustment will take place via relative factor prices. The result will be higher wages, increased (decreased) output of labour(capital)-intensive good and more capital-intensive production in both sectors, the effect similar to the well-known consequences of labour-saving technical progress in labour-intensive industry. When the country is large, the increased output of labour-intensive good will improve country's terms of trade. This price change exert pressures on the wage-rental ratio and production structure opposite to those generated by component specialization, but raises national welfare even more than in the small country case. Arndt (1997) also considers the second, developing country and shows that, contrary to standard Heckscher-Ohlin model, intra-product specialization by both countries raises nominal and real wages in both. An important policy relevant implication of both articles is that offshore sourcing enables industries producing labour-intensive goods under conditions of foreign competition to not only improve their survival chances by shifting production of their least efficient activities abroad, but to increase the number of jobs while boosting wages.

Arndt (2001) examines the implications of offshore sourcing under alternative trade policy regimes in the Heckscher-Ohlin framework. In a free-trade world, offshore sourcing is unambiguously welfare enhancing. An introduction of component specialization in the import-competing sector into an MFN tariff environment may raise or lower welfare, depending on the degree of tariff-induced distortions relative to the efficiency gains generated by component specialization. Further it is shown that whereas fragmentation may reduce welfare when introduced into an environment of MFN protection, it unequivocally increases welfare in the context of a preferential trade arrangement. Rules of origin, on the other hand, may inhibit countries from fully exploiting the benefits of the international division of labour to the level of parts and component activities. This may happen if the rules of origin and local content requirements oblige firms to source components from higher-cost members instead of low-cost non-members.

Harris (2001) develops a model that provides an alternative explanation for the expansion of fragmentation to those explanations based on factor-price differences and factor-intensity differences. It emphasises the role of the fixed cost and increasing returns associated with international trade networks, in particular communication networks. The world consists of a single industry and a number of markets, each of which supplies a unique variety of horizontally differentiated input. These can be produced either locally or globally. Global networking facilities, linking the suppliers of the industry in all markets, are assumed to be supplied by an international public monopoly with access available to any firm at a common price. Higher plant fixed costs increase the number of globally sourced components, boost the volume of trade, and decrease the number of locally sourced components. Furthermore, it is shown that technological improvements in global production networks will lead to an increase in the volume of trade relative to income and an increase (decrease) in the number of globally (locally) sourced components, but will not affect worldwide welfare. Market expansion has positive effect on the number of global component suppliers and the trade-income ratio. The model abstracts from factor-price and factor-intensity explanations of fragmentation and is thus suitable for describing cross-border fragmentation and trade in intermediate inputs between developed countries.

Yi (2003) develops a two-country dynamic Ricardian trade model with a continuum of goods that offers explanation for a rapid growth in the trade share of output in the world economy since World War 2 and the acceleration of that growth in the last two decades of the twentieth century despite the fact that tariff barriers have decreased by only 11 percentage points and that the declines were much larger prior to the mid 1980s. To reconcile the large growth in trade with relatively small change in tariffs and the nonlinearity of trade growth with respect to tariff reductions, he presents a model of vertical specialization where the process of producing a final good entails three stages. The first two stages can be produced in either of the two countries and traded back and forth, bearing the cost of tariff each time they are imported. The model explains the lack of vertical specialization when tariffs are sufficiently high and the increase of trade as the barriers gradually fall. At first, tariffs are still too high for fragmentation to occur, but trade volume grows as previously non-traded final goods become traded and because more of traded goods are exchanged. At some level of tariffs, vertical specialization becomes feasible and trade surges as production switches from traditional to vertically fragmented (external margin) and because the lower tariffs reduce the cost of producing existing vertically fragmented goods by a multiple of the tariff cut. Hence, trade grows by more than would be predicted by the standard trade model. Confronting the model with actual data, he is able to explain more than 50 percent of US trade growth since 1962 and partially match the extent of trade volume nonlinearity.

Kohler (2004) uses the well-known specific-factors model pioneered by Jones (1971) to explore the conditions under which international outsourcing is beneficial to the domestic economy. One of the two final goods produced in the economy can be fragmented into two processes, only one of them being transferable abroad. Specific capital employed in the mobile component production cannot be separated from production facilities (ownership advantage) and can be transferred to a foreign country with lower wage rate (location advantage), where the risk of asset dissipation precludes arm's-length type of sourcing in favour of vertical integration (internalization advantage). The model implies that a country that loses some portion of its domestic production through international outsourcing will reap welfare gain, provided such outsourcing does not involve any non-convexity in technology.[26] Interesting theoretical proposition is also that the larger the gains from international outsourcing the lower the redistribution effect in the form of lower wage income. The regime shift from domestic production to production fragmentation is modelled as a two-stage game, where the first stage involves deploying indivisible assets either at home or abroad and stage two involves profit-maximizing labour demand at home and abroad. The model determines the equilibrium share of fragmented firms, but leaves open which firm will chose a domestic or fragmented production mode.

Amiti (2005) develops a model with vertically linked industries embedded in a two-factor Heckscher Ohlin (H-O) model to analyse the effects of trade liberalisation on the location of vertically linked industries that differ in factor intensities. Unlike the H-O model, the real returns to both factors fall in the Home (labour abundant) country and rise in the Foreign (capital abundant) country when agglomeration forces initially take effect. This is followed by an increase in the real returns to all factors throughout the agglomeration phase of trade liberalisation until the fragmentation phase begins. During the fragmentation stage, the real returns to the abundant factor in each country increase (workers in Home and capitalists in Foreign), whilst the real return to the scarce factor falls in each country. The total world utility is increasing throughout the whole phase of trade liberalisation since the gains in the Foreign country outweigh any losses in the Home country.

Grossman and Rossi-Hansberg (2006) make a simple theoretical model of trading tasks in which they examine the economy-wide effects of the value-chain fragmentation for resource allocation, welfare and the distribution of income. In the world of two countries, each country can produce two goods with different technologies that require a continuum of L-tasks, a continuum of H-tasks, and possibly other sets of tasks as well. Firms can perform tasks at home or abroad, however, offshoring tasks does not distinguish between offshore outsourcing and international vertical integration. The cost of producing a *L*(*H*)-task abroad depends on foreign wage of low-skilled (high-skilled) workers, cost of offshoring and relative productivity of foreign task production. Tasks with higher index are increasingly more costly to farm out. Three channels through which increased opportunity of *L*-tasks offshoring affects domestic factor prices are identified. First, the productivity effect arises because the boost in productivity due to lower offshoring costs raises firms' demand for low-skilled labour, causing their wages to rise. The second effect is the relative-price effect which is analogous to Stolper-Samuelson mechanism. Improvements in technology for offshoring *L*-tasks will induce a fall in relative price of the low-skilled labour intensive good and hence dampen the wages of low-skilled labour. The last channel is the labour-supply effect that arises because the increased offshoring of *L*-tasks frees up domestic low-skilled labour. Home economy can only absorb these excess workers if their wages decline.

[26] The non-convexity considered is one where the specific factor used in the disintegrated component of value-added is a *fixed input* (Kohler, 2004, p. 795).

If an economy is a small Heckscher-Ohlin economy, taking relative price and foreign wage as given, increased opportunities in offshoring *L*-tasks produce positive productivity effect, but no relative-price or labour-supply effect. Firms decide to offshore additional segment of *L*-tasks while saving substantially on inframarginal tasks. Because the increase in profitability is greater in labour-intensive sector it expands relative to the skill-intensive sector, causing low-skilled wage to rise. However, if the offshoring *L*-tasks is possible only in high-tech sector, the benefits of falling costs of outtasking will trickle into wages of high-skilled labour and reduce the wages of the unskilled. When small-country assumption is relaxed, the reduction in offshoring costs generates the relative price effect in addition to the productivity effect. The former unambiguously rewards high-skilled labour, whereas the effect on the level of low-skilled labour wages is ambiguous. What is important is that while a fall in the cost of final goods trade necessarily creates winners and losers, a fall in the cost of task trade can generate Pareto improvement for the home country if the productivity effect is large enough.
After allowing also *H*-tasks to be offshored in addition to *L*-tasks, a reduction of offshoring costs for *L*-tasks generates a productivity gain for low-skilled workers whereas a fall in *H*-tasks offshoring costs incites additional offshoring of *H*-tasks and increases high-skilled wages. If the economy is large and only *H*-tasks are traded more easily, a relative-price effect benefits low-skilled labour and harms high-skilled labour. The same consequences arise when the economy is completely specialized in a single good and there is a fall in offshoring costs for *H*-tasks only.

New developments in the global economy have triggered research that better explains the changes in trade, investment patterns, and the reorganization of production across national borders. Traditional trade theory undoubtedly still has its role in explaining important segments of international involvement, but the emergence of some novel practices in international business required new approaches. Particularly vital has been the need to model alternative forms of business practices of internationally active firms, because organizational change has been central in the transformation of the world economy. The theoretical improvements have focused on the individual firm, studying its choices about the organizational form in response to its own characteristics, the industry in which it operates and the opportunities that foreign markets have to offer. The next section provides an overview and classification of the new generation of theoretical models that carry the methodological individualism one step further by exposing the inner workings of the firm. In contrast to traditional trade models where firms were atomistic and inseparable decision makers, new class of theoretical models examine the relationship and forces between constituent entities within the firm. In this way they are able to explain why certain business relationships stretch across the borders within the boundary of the firm and why the others dissolve into unaffiliated business links.

3.1.2 New generation of models of international fragmentation

The choice of whether to produce intermediate inputs inhouse or acquire them from an unaffiliated provider is a key decision about organizational form, alongside with the decision on the location of input production. A better understanding of these choices was needed in order to explain the recent trends in trade and FDI. The following facts explain why new generation of international trade models emerged and why these approaches dug into the realm of the theory of the firm, opening the black box of the neoclassical conception of the firm.

First, because of the advances in ICT, computer-aided design and manufacturing, falling communication costs, and institutional changes, outsourcing of material inputs and services has rapidly gained importance. This expansion of contract-based slicing of the value chain was reflected in greater specialization of intermediate inputs providers and increased purchase of these goods and services from unaffiliated vendors instead of within the firm. Most importantly, the boundaries of the firms dissolved and became harder to determine. These developments have been widespread across different industries and types of inputs (see for example Economist, 1991; Bardi & Tracey, 1991; Gardner, 1991; Helper, 1991; Bamford, 1994; Abraham & Taylor, 1996; and Bartel, Lach & Sicherman, 2005).

Second, and in connection with the previous fact, rich patterns of FDI and contractual relationships have emerged in international business that have not been adequately explained by traditional theories of international trade and foreign direct investment. These hybrid organizational forms, often labelled as "complex integration strategies" (Yeaple 2003), include for example MNEs that are both horizontally and vertically integrated, franchise arrangements, licence agreements, outsourcing contracts, and various combinations of these. Feinberg and Keane (2003) report that, in their sample of U.S. multinationals with affiliates in Canada, only 12 percent of the firms have negligible intra-firm flows of intermediate goods and thus can be considered to be purely horizontal multinationals, while only 19% of the firms have intra-firm flows of intermediate goods in only one direction, which would make them purely vertical multinationals. The remaining 69% of firms pursue more complex integration strategies and are dubbed as "hybrids". Similarly, Hanson, Mataloni and Slaughter (2001, p. 5) describe the rich patterns of FDI they find in their data pertaining to operations by U.S. multinationals and their foreign affiliates and conclude that "the literature's benchmark distinction between horizontal and vertical FDI does not capture the range of strategies that multinationals use."

Third, the sourcing of inputs from foreign countries (offshoring) has increased both in the form of outsourcing (arm's length trade) and vertical FDI (intrafirm trade), the fact already described in Chapter 2. Evidence on increased offshore outsourcing include Feenstra and Hanson (1996) who find more than a doubling of the share of imports in total purchases of intermediates from 1972 to 1990 in the U.S. (from 5.0% to 11.6%), while Campa and Goldberg (1997) reach similar conclusions about the trends in Canada and the UK. Hummels, Ishii and Yi (2001) and Yeats (2001) provide evidence that foreign trade in components has grown faster than foreign trade in final goods. Hanson, Mataloni and Slaughter (2005) report that intrafirm trade within U.S. multinationals has grown very fast, although at the lower pace than international outsourcing by U.S. firms. Feinberg and Keane (2005) find that sales of U.S. parent firms to their Canadian affiliates as a fraction of the affiliates' total sales, as well as sales of the Canadian affiliates to their U.S. parents as a fraction of the parents' total revenues, have almost doubled between 1984 and 1995. These findings suggest that MNEs remain the dominant player in the global movement of goods, services and capital, but that they pursue a multitude of strategies for international expansion (for a typology of cross-border cooperation modes see for example Dunning & Lundan, 2008, p. 261). The concept of vertical FDI has thus become insufficient in explaining an increasing share of trade in intermediate goods and services, now taking part within the sphere of tight cooperation and mutual dependence but beyond the boundaries of the firm. As a result, the traditional classification of FDI into vertical and horizontal has become less meaningful and the new theories have been developed that explain the remarkable changes in the nature and extent of international fragmentation. It should be noted, however, that the new generation of theories do not replace or supersede comparative advantage explanations of intersectoral trade and FDI flows, nor do they replace imperfect competition explanations of intra-industry trade. What they bring to international trade theory is the organizational choices of individual firm, addressing the well-known make-or-buy dilemma and questions like which firms are involved internationally, how do they engage in foreign markets and what determines the choice of organization (Helpman 2006).

A rich diversity of real-world organizational forms in international business culminated in a variety of alternative theoretical approaches to modelling firms' international involvement. Spencer (2005) and Helpman (2006) provide excellent reviews of the existing literature on organization of production across national borders. Spencer (2005) classifies the literature on the theory of outsourcing into four groups according to different theories of the boundary of the firm: property rights, transaction costs, incentive systems, and delegation of authority. Apart from that, theoretical models of international fragmentation differ in the variety of organizational forms and locations, sources of advantage of offshoring, the scope of outside options for agents, number of production factors, etc. Here, I will focus mainly on the property rights approach and only briefly describe contributions to other theoretical approaches to modelling international fragmentation of production.

3.1.2.1 The property rights approach to modelling international fragmentation

The property rights approach stems from the works of Grossman and Hart (1986) and Hart and Moore (1990) that see a firm as a composition of assets under its ownership or over which it has control. Firms weigh between purchasing inputs or services from an independent agent and, alternatively, integration of the production process. A crucial assumption of their models is that production decisions are sufficiently complex so that they cannot be specified in an ex-ante contract between the agents in a relationship. There are benefits and costs arising from transferring the ownership rights to within a firm. On one hand, integration reduces a holdup problem as it increases the share of ex-post surplus, which leads to increased incentives to make specific investments. On the other hand, it reduces the supplier's ex-post bargaining possibilities and hence its incentive to invest. A relationship between a buyer and supplier of an input is therefore governed by incomplete contracts which distort relationship-specific investments. The surplus from relationship can be apportioned only ex-post in a Nash bargaining game. Antras (2003), Antras and Helpman (2004), Antras (2005a, b), Grossman, Helpman and Szeidl (2005), Acemoglu, Aghion and Zilibotti (2003), and Acemoglu, Antras and Helpman (2007) develop incomplete contracting, property rights model of the boundaries of the firm incorporated in an imperfect competition setting, but focus on different aspects of equilibrium outcome.

Antras (2003) develops a model of firms producing a continuum of varieties of two types of final goods, with each variety requiring a distinct variety-specific intermediate input. The latter is produced using capital and labour with capital intensity in one industry being larger than in the other. Final-good producer first decides whether to enter an industry and if so whether to purchase the input from an arms-length producer or from a vertically integrated division. To explain the empirical fact that capital-intensive goods are transacted within the boundaries of multinationals while labour-intensive goods are traded arms-length, Antras (2003) extends the setting of Grossman Hart (1986) by allowing for the capital expenditures to be transferable to the input supplier. If the supplier bears all variable costs, the final-good producer will want to renegotiate the price of the input after it has been produced, leading to the supplier's underinvestment in labour and capital. If, on the other hand, final-good producer bears part of capital expenditures, it alleviates the holdup problem for the supplier but exposes itself to opportunistic behaviour of the supplier. It is shown that in capital-intensive industries ownership is optimally assigned to the final-good producer, giving rise to vertically integrated firms, while in labour-intensive sectors the preferred organizational structure is an outsourcing relationship. After the final-good producer decides about the cost sharing in capital investment, each agent invests and covers fixed costs in capital and labour. Having the intermediate input at hand, they then distribute the surplus in a generalized Nash bargaining. When more than one country is introduced and the trade between them is opened, the model predicts that capital-abundant country produces disproportionately larger share of capital-intensive input varieties and that the volume of capital-abundant country's imports is increasing with capital-labour ratio and the relative size of the exporting country.[27]

[27] In contrast, the share of intrafirm imports in total exports of capital-abundant country is unaffected by the relative size of each country at a given capital-labour ratio of the exporting country.

Because of within-industry homogeneity of firm productivity, Antras (2003) predicts identical organizational forms for all the firms in an industry but different vertical structures across industries. Firm heterogeneity as of Melitz (2003) was introduced in his later paper (Antras and Helpman, 2004) belonging to the property rights strain of literature. Antras (2005a) develops a model in which the incompleteness of cross-border contracts results in the emergence of product cycles. The setting is similar to Antras and Helpman (2004) with the Ricardian model of North-South trade, wage differential, final-good production demanding high- and low-tech inputs, and two types of producers: a research centre and a manufacturing plant. However, no firm heterogeneity is allowed since the focus is on the dynamics of shifting production between countries and property structures. Here also, investments are relationship specific and therefore useless outside the relationship. In contrast to Antras and Helpman (2004), contracts are assumed to be perfectly enforceable in transactions involving two firms located in the same country. This assumption erases the distinction between vertical integration and contracting in the North but leaves the two alternatives open in the South since high-tech inputs can only be produced in the North. Standardization of the good is modelled through exogenous decrease in output elasticity of high-tech input as time passes. The fact that international contracts are not perfectly enforceable gives rise to product cycles. In the process of the final-good becoming more standardized, the holdup problem for product development manager wanes and lower production costs in the South offset incomplete contracting distortions associated with it. In equilibrium with multinationals, products in an initial stage of development are produced entirely in the North. As they become more standardized their low-cost input production is shifted within the boundary of a firm to the South, and in the fully mature stage of the product, manufacturing is shifted to an independent supplier in the South.

In Antras and Helpman (2004), firms are allowed to differ in their productivity levels apart from the variety of final-goods they produce. The setting is Ricardian, so the advantages of internationalizing manufacturing of components comes from the wage differential between the North and the South and not from factor abundance differential as in Antras (2003). Final good production demands headquarter services that can be provided only in the North, and intermediate inputs that can be supplied from either country and from a stand-alone producer or vertically integrated assembly division. Upon paying fixed entry costs and observing productivity level, a headquarter producer chooses up-front the location and ownership structure of component production based upon ex-ante expected profits. These in turn depend not only on the wages prevailing in both countries but also on organizational-form-specific fixed organizational costs and bargaining power of the parties in relationship. Four factors individually determine the choice of organizational form. First, in terms of the location decision, variable costs are lower in low-wage South which promotes foreign production. Second, in terms of ownership structure, insourcing entails higher fixed organizational costs, encouraging outsourcing of the manufacturing process or input. Third, manufacturing in the home country induces lower fixed organizational costs, which advocates home-based production. Finally, integration gives the owner higher outside option and hence larger fraction of revenue to be negotiated in the ex-post bargaining. On the contrary, component producer's incentives to supply inputs are reduced in the case of insourcing, putting the weight on the other side of the scale. The choice of organizational form depends also on the productivity level[28] and the importance of headquarter services. At the certain range of importance of headquarter services in the production process, all four organizational modes appear in equilibrium by increasing level of productivity: outsourcing in the North, integration in the North, Outsourcing in the South, and integration in the South.

Grossman, Helpman, and Szeidl (2005) combine elements of Antras and Helpman (2004) and Grossman, Helpman, Szeidl (2006), but assume that the fixed organizational cost of integration are smaller then the fixed cost of outsourcing. Assuming that the production is intensive in the use of intermediate inputs the most productive firms outsource in the south while the least productive firms integrate in the North. Intermediate productive firms either outsource in the North or vertically integrate with an intermediate goods producer in the South. In the extension of their model, assembly is allowed to be shifted to the South after incurring an extra fixed cost. Costly transport of intermediate goods is introduced to provide an incentive for conducting FDI in assembly activities but is assumed to be sufficiently large to reduce eight potential organizational forms to only four. With separation of assembly and inputs production becoming unprofitable, firms choose between northern assembly and in-house or independent manufacturing in the North, and southern assembly and in-house or independent manufacturing in the South. Again, the most productive firms choose offshore outsourcing, intermediate ones select outsourcing in the North and FDI, while the least productive firms insource manufacturing activities and assembly process. Another main conclusion of Grossman, Helpman and Szeidl (2005) is that variation in the fixed cost of outsourcing and fixed cost of foreign operations produce a positive correlation between the fraction of firms that outsource and the share that source their intermediate inputs in the South.

Acemoglu, Aghion and Zilibotti (2003) construct a model with two types of firms (vertically integrated and domestic outsourcing firms) in the context of incomplete contracts literature and study the changes as the economy moves towards the world technology frontier. Far from the technology frontier, imitation activities are more important for firms and vertical integration is preferred. The value of innovation increases closer to the frontier, encouraging companies to outsource some production activities. The model however considers only domestic outsourcing and does not allow heterogeneity within firm population.

Feenstra and Spencer (2005) explore the relationship between proximity of the buyer and seller and the organizational form of outsourcing under the incomplete contracts framework. In their model, the alternative to contractual outsourcing is arm's length purchases as in

[28] Higher productivity brings about higher revenues and increases the benefits of producing in the low-wage country, so the firms are willing to bear higher fixed costs of manufacturing in the South. Even more productive firms choose to pay higher fixed costs of vertical integration in order to reap a larger fraction of the revenue.

standard models of perfect competition and trade. Intermediate parts with the highest technological sophistication are produced in the high wage country. As technological sophistication falls, parts are produced in turn, by contractual outsourcing to multinationals in the low-wage country, contractual outsourcing to purely domestic firms in the low-wage country and finally the purchase of generic inputs through the import of non-specialized parts from the low-wage country.

Acemoglu, Antras and Helpman (2007) present a general equilibrium model based on incomplete contracts to study the impact of the degree of contractual incompleteness and the degree of technological complementarities on the equilibrium adoption of technologies. They show that greater contractual incompleteness leads to the adoption of lower levels of technology while countries with better institutions specialize in sectors with greater technological complementarities and outsourcing intensity. Like in the previous paper, no foreign sourcing is allowed in this model.

3.1.2.2 Transaction cost approach to modelling international fragmentation

Under the transaction cost approach firms optimize their organization of production by minimizing the transaction costs. Coase (1937) and Williamson (1975, 1985) provide the basic instrumentation for this approach to modelling fragmentation. They argue that when uncertainty and asset specificity are high, transaction costs can be reduced by organizing transactions hierarchically rather than through market operations. This is achieved by giving one party a control over both parts of a transaction, which consequently leads to efficient levels of investment within the firm. The models of international trade and production based on transaction costs emphasize the thickness of the market as the key determinant of transaction costs. A thicker input market eases the search efforts with which a final-good producer can match with a producer of a specialized input. This conjecture is also born out by some empirical evidence. For example, Holmes (1999) provides empirical support for the positive relationship between agglomeration and vertical disintegration on US data, while Hubbard (2001) finds that doubling the thickness of the market in trucking business increases the likelihood that simple spot relationships instead of complex arrangements govern transactions by about 30%. McLaren (2000) and Grossman and Helpman (2002, 2003, 2005) belong to this class of models and are briefly summarized below.

McLaren (2000) considers an industrial sector composed of downstream final good producers that buy specialized inputs from upstream intermediate good producers. There are two possible procurement methods: arm’s length or market procurement, where non-integrated suppliers face a hold-up problem, and vertically integrated production in which the firm merges with the supplier and thus allows for the greatest technological cost reduction but faces higher fixed cost.[29] To alleviate the hold-up problem, each non-affiliated supplier chooses in equilibrium to produce an input that is less than completely specialized toward its intended buyer. The crux of the model lies in the "market-thickness principle": an input supplier is more likely to be able to find an alternative interested buyer to use as a threat point, the more non-integrated firms there are among producer-supplier pairs. Thus, there is a negative externality from vertical integration which makes arm's length arrangements less feasible for others. In a small autarkic economy with symmetric firms, the only possible equilibrium is complete vertical integration, because the input market is too thin to sustain any outsourcing relationship. In a large economy, there are two stable equilibria: complete integration and industry-wide use of outsourcing relationships. Opening of countries to trade in intermediate inputs effectively increases the number of independent suppliers and hence raises the outside option probability for every incumbent seller. Such thickening of market raises the incidence of outsourcing in both countries and is shown to raise welfare.

Grossman and Helpman (2002) build on the ideas of McLaren (2000) but abstract from international outsourcing. A typical firm in their model is faced with a make-or-buy decision bearing in mind the corresponding trade-off between the costs of integration and outsourcing. A vertically integrated production chain bears the costs of running a larger and less specialized organization and therefore cannot benefit from specialization in a narrow set of activities. On the other hand, outsourcing arrangements suffer from search costs for the input provider, uncertainty in finding a successful match, and imperfect contracting.

In the simple version of the model, production of a differentiated final good requires one unit of a specialized component that is specialized for a chosen final good variety and hence useless in any other production. An integrated firm is less efficient in specialized component production than a specialized intermediates producer. Fixed costs for an integrated firm are assumed to be larger than combined fixed costs of a specialized input producer and a specialized producer of final goods. Upon entry, firms incur fixed entry cost. In the second stage, specialized final-good producers and intermediate input producers engage in a matching that bring about the remaining fixed costs. Next, the production of intermediates takes place in vertically integrated firms or specialized input producers. In the case of outsourcing relationship, both specialized producers bargain over the terms of trade. Input producer ends up capturing a fraction of the surplus in the relationship with the final producer. Finally, production and sale of final goods takes place. There are three possible types of equilibrium: mixed equilibrium with both types of organizations present simultaneously, pervasive vertical integration, and pervasive outsourcing equilibrium. Mixed equilibrium is very unlikely and happens only in a knife-edge situation when the two demand levels required for the viability of each production mode are equal. Generally, no industry has both vertically integrated and specialized producers in the equilibrium. Pervasive outsourcing is more likely the greater the cost advantage of specialized component producers relative to vertically

[29] McLaren (1999) constructs similar model based on incomplete contracts where the degree of formality (contracts versus informal arrangements) in outsourcing relationships is analyzed.

integrated firms, the greater are the fixed costs for vertically integrated firms and the smaller are the fixed costs for the specialized producers. In addition, outsourcing is a more likely outcome the more efficient are the firms at matching with one another.

The elasticity of substitution between final-goods and the bargaining power of specialized input producer have ambiguous effects on the prevalence of each mode. If the final-good price of specialized producers is lower than the price offered by vertically integrated producers, an increase in the elasticity of substitution increases the relative viability of outsourcing. If the price condition is reversed, elasticity of substitution has either negative impact on the attractiveness of outsourcing mode of organization or positive at smaller elasticity and negative at higher values of the elasticity of substitution. The effect of bargaining power operates through three channels. First, higher input producer's bargaining power directly increases the profit share of specialized component producers, which decreases the demand level needed for these firms to break even. Next, higher bargaining power decreases the distortions caused by imperfect contracting. Third, it causes the relative number of intermediate-good producers to increase, lowering the chances of a typical producer to find a partner. When the bargaining power of component producers is in an intermediate range, the equilibrium mode of organization is pervasive outsourcing, whereas a very low or very high bargaining power points to vertical integration.

Increasing returns in search make industry equilibrium with pervasive outsourcing more likely to exist, the larger the aggregate market. This reflects the fact that when more firms enter on both sides of the production chain, every specialized firm has a better chance of finding a partner. This extension of the theoretical model seems to explain why firms in markets of different sizes opt for different organizational mode. Chinitz (1961) for example finds that firms in New York were much more specialized than those in Pittsburgh where the market is not so thick.

One of the most important contributions of the paper is the introduction of partial specialization of intermediates. Specialized input producers are allowed to decide upon the level of specialization of their component. However, they face a trade-off between specialization and standardization benefits. If an input is highly specialized it brings the highest value to final producer and therefore the highest surplus in their relationship. On the other hand, standardization brings more value from potential outside relationships but adds additional costs to final producer in order to adapt the input to fit its purposes. The implication of imperfect specialization on the equilibrium mode of organization is that outsourcing is less viable the more sensitive are manufacturing costs to the detailed characteristics of the intermediates. The main contribution of the model is the study of the determinants of alternative production modes pervasiveness in a general equilibrium framework. Equally important is the inclusion of elements from industrial organization and contract theory, such as relationship specific investment, bargaining, incomplete contracting, partner matching, and partial specialization of inputs. The model, however, assumes symmetric agents and hence yields symmetric equilibria, which is enough to highlight its purpose but unrealistic when confronted with empirical data on industry structures. Finally, it studies the trade-off between outsourcing and in-house production in a closed economy so it abstracts from international production and thus ignores the possibility of offshore outsourcing and vertical foreign direct investment.

Grossman and Helpman (2003) study the determinants of the choice between vertical integration and outsourcing of the component production in a low-cost location. The industry is monopolistically competitive and the production of one unit of final good variety requires one unit of a specialized component. Due to the substantial cost advantages, it is only feasible to produce component in the low-wage country. A final good producer from the high-wage North can either integrate the component production in the low-wage South or purchase components from a specialized southern supplier. As an integrated producer, a firm produces at relatively higher marginal costs, but faces only fixed design costs needed to introduce a new blueprint for variety. Potential component suppliers must deploy a fixed entry cost to develop expertise, and additional fixed cost in order to develop a prototype for a particular final producer. Prototype development cost is proportional to the disparity between characteristics of final producer and component supplier. The outsourcing relationships are governed by incomplete contracts since the parties can sign a contract that covers the performance of at most a fraction of the requisite investment in the prototype. After the investment contract is signed, the parties negotiate an order contract providing that the produced prototype is operational. The bargaining power is assumed to be equally distributed between both parties. Neither of them has any outside option in the relationship so each expects to earn half of the joint profits if an investment contract is signed and if the supplier makes the full investment necessary for the development of a workable prototype.

In equilibrium, both types of production modes coexist because the choice of the mode depends on the distance between a producer's expertise and the expertise of its most adjacent supplier. If the distance is too large, end-producer will opt for foreign direct investment since no existing suppliers would be willing to invest in component modification. In the opposite case, final good producers engage in an outsourcing relationship. The fraction and the market share of firms that choose to outsource is higher the larger the productivity advantage of specialized component producing firms relative to vertically integrated production. Larger market for final goods creates thicker market, which makes more final producers to find suitable outsourcing partners and more specialized component producers to enter the industry in the first place. Greater demand therefore favours outsourcing. The improvement in contracting environment increases the prevalence of outsourcing arrangements because it improves the chances of final good producer finding a supplier that would be willing to undertake the investment in customization. Finally, the rise of the relative wage in the South reduces the prevalence of outsourcing firms and their market share.

The model is instructive as it explains the forces that shape the relative prevalence of outsourcing and vertical modes of offshore input production in a world consisting of a high- and a low-wage country with differentiated consumer goods and free exit and entry of firms.

One of the interesting features is the ingenious representation of the expertise compatibility and matching between the final good and component producers, and the fact that both alternative types of value chain organization coexist in the industry equilibrium. However, it lacks the possibility of solely domestic production and the choice of production modes according to firm's performance characteristics.

Grossman and Helpman (2005) develop a general equilibrium model of monopolistic competition and trade where firms choose between domestic and international outsourcing, whereas vertical integration is not considered. In this respect the paper complements their previous work (Grossman & Helpman, 2002) where the issue is the make-or-buy decision in a closed economy. Outsourcing of components or services entails searching for a suitable contractor, subsequent customization of the inputs to suit producer's specific requirements, and operating in the environment of imperfect contracting. The world consists of two countries, low-wage South and high-wage North. Individuals consume a homogeneous good produced in both countries and varieties of a differentiated consumer good which is designed and assembled only by Northern firms. Production of a differentiated good requires one unit of the customized input that can be produced in either location. A final producer from the North must pay a fixed amount to design a product and a fixed cost of searching for a component supplier in the country of his choice. A component supplier, on the other hand, must bear a fixed cost of investment in expertise and equipment and a fixed cost of adapting a component for each of its customers. The customization cost for a particular client depends on the distance between its own expertise and the customer's needs. Up-front investment in customization produces a prototype which is then submitted to producer's inspection.

Bilateral relationship between the supplier and the final good producer is governed by incomplete contracts. This means that the order contract is negotiated only after the supplier has built a prototype that perfectly suits the needs of the producer. However, the supplier will be willing to invest in the prototype only if its share of the prospective profits exceeds the investment cost. If a producer is not too far away from its closest supplier, the contract will be signed and the profits will be equally shared. Two countervailing forces are at work in the model: positive feedback associated with the thick-market externality and the wage response. Thick-market externality arises when the number of suppliers or producers becomes larger. The greater the number of component producers in a country the more closely packed they are in the input characteristics space and the more profitable it is for final producers to search there. The chances of finding a supplier that will be willing to invest in customization get bigger while the expected customization costs decline with the shrinking maximum distance in input space between any producer that remains active and its supplier. Similarly, the greater the number of final producers that search in a country, the more profitable it is for a component producer to operate there. These agglomerative forces are offset by a wage response. With an inelastic labour supply in both countries, rising numbers of intermediate producers bid up the country's relative wage. This, in turn, reduces the incentive for final producers to search there. Wage response combined with the equal profitability condition in component markets creates nonlinearities that give rise to the existence of multiple equilibria with production of components in both countries but different patterns of outsourcing.

Comparative static analysis shows that an increase in the resource endowments of the South induces entry of local component suppliers and exit of such producers in the North. The entry and exit reshuffling brings about a boost in the outsourcing activity in the South and its decline in the North. In addition, an increase in southern labour supply increases the total volume of world trade, the fraction of trade in world income and the share of intra-industry type of trade in the total world trade. Despite the increased supply of labour in the South, new equilibrium wage rises in the South relative to that in the North. The direct effect of labour supply expansion, where excess supply of labour in the South and excess demand in the North tend to decrease relative southern wage, is undermined by the opposite effect of outsourcing activity. Thick-market externality makes the Southern market a relatively more attractive location for searching and producing components. Equal opportunities in both markets can therefore be restored only if relative wage falls in the thinner market in the North.

An equi-proportionate improvement in the technology for outsourcing in both countries leaves no effect on the component industry structure, relative wage, levels of outsourcing activities and the volume and composition of trade. Only if these improvements occur to a larger degree in the South does the world experience a rise in international outsourcing and supplementary growth in the trade volume and the share of intra-industry trade.

Improvements in contracting in the South only (with contracting in the North already partially verifiable) have in theory an ambiguous effect on the outsourcing pattern in both countries. Numerical computations covering a wide range of parameter values reveal that the volume of outsourcing in the North rises monotonically with the improvements in contracting in the South, whereas the volume of outsourcing in the South rises at poor contracting conditions in the South, but then falls to a level below that for the initial unverifiable contracts. The same inverted U-shape movement is observed for the ratio of world trade to world income, the share of intra-industry trade in total trade, and the relative wage in the South. These variables together with international outsourcing attain the highest values when the legal environment in the field of contracts is somewhat less developed in the South than in the North.

The major strength of this paper is the application of a thick-market externality to incomplete contracting environment with relationship-specific investments, partial verifiability of contracts and bargaining over surplus from the relationship between a final producer and specialized input supplier. The fact that both types of producers are attracted to locations with larger number of potential business partners creates the possibility of multiple equilibria. The model also admits stable equilibria with domestic and offshore outsourcing present simultaneously, but does not predict which firms specifically will chose a specific organizational mode. It also successfully explains how the recent upsurge in offshore outsourcing corresponds to the increased availability of foreign labour force, particularly those in India and China. The disturbing theoretical prediction, however, is that a uniform worldwide improvement in investment technologies have no effect on the volume and the composition of outsourcing activities.

3.1.2.3 Incentive systems approach to modelling international fragmentation

An incentive systems approach is based on optimal incentive contracts designed by a principal to induce investment or effort by managers. Since the level of effort provided by an agent is only partially observable, the first best level of effort is not achieved. Even though principal-agent contracts cannot be written conditional on unobserved effort levels, contracts are not incomplete but "comprehensive" (Hart, 1995, p. 20-23). This means that distortion in effort invoked is not due to the inability to write contracts but rather due to the cost of observing variables. As a consequence, there is no ex-post bargaining after investment has been made by the agent since all future obligations are specified. Grossman and Helpman (2004) and Feenstra and Hanson (2005) belong to this group of theoretical models and are briefly described below.

Grossman and Helpman (2004) use the incentive systems approach to analyze the tradeoff between cross-border vertical integration and international outsourcing in an industry with heterogeneous firms, and study the sorting of firms into different organizational forms.[30] The principal can choose between two types of agents that provide an essential component: an independent contractor or an internal division manager. The production of components requires the agent's effort in a variety of tasks. Only a fraction of manager's efforts can effectively be monitored by the principal. However, he cannot supervise any of the tasks undertaken by an entrepreneur heading an independent supplier firm. In either case, the principal designs an optimal contract that provides suitable incentives for agent's effort. Outsourcing relationship may be preferred over vertical integration for the following two reasons. First, the principal can confront an agent with higher-powered incentives because the latter bears the cost of component production. Second, when a principal has to induce a very high level of effort from her agent, the cost to the principal of providing the necessary incentives is less for an independent supplier than for an employee. On the other hand, the advantage of in-house production lie in the greater ability to monitor agent's effort of the tasks involved in producing components. On tasks that can be monitored, the principal can trigger a high level of effort without having to leave rents to the manager by simply paying a wage that compensates the manager for his effort. When input production is allowed to be

[30] Similarly, Horn, Lang and Lundgren (1995) study the design of optimal incentives for managers in a world of international trade, but they do not consider the choice between vertical integration and arms-length relationship. Their focus is rather on whether international trade brings welfare gains that arise due to increased effort by the manager and improved internal efficiency of the firm.

relocated across the two regions, high-wage North and low-wage South, the principal can opt for FDI or domestic in-house production.[31]

In the equilibrium with heterogeneous firms in line with Melitz (2003), the sorting of firms by increasing level of productivity is the following: the least productive firms exit, more productive firms engage in offshore outsourcing, firms with intermediate levels of productivity choose vertical integration, with the less productive cohort opting for FDI and the more productive firms undertaking domestic vertical integration. The most productive firms in an industry prefer offshore outsourcing because the principals who wish to induce the highest possible level of effort from the agents are able to shift input costs to a supplier but not to a manager. On the contrary, offshore outsourcing is preferred by firms at low productivity levels because the lower cost in the South and higher level of effort made by independent contractors is needed to make production viable. The increased ability to monitor managers in the South makes FDI more attractive option relative to both the alternative organizational modes. Trade liberalization increases the market share of imported components but it is ambiguous whether this reflects the rise in FDI or offshore outsourcing prevalence. Trade liberalization tends to favour multinational activity in industries in which outsourcing is performed predominantly by high-productivity firms. In contrast, trade liberalization spurs arms-length trade with suppliers when most outsourcing is undertaken by low-productivity firms.

Feenstra and Hanson (2005) develop a simple model of international sourcing and apply it to export processing in China, a major ingredient of China's foreign trade. The activity involves a firm in China obtaining intermediate inputs, processing them, and then exporting the finished goods. There are two possible regulatory regimes. In pure-assembly regime a foreign firm owns and supplies the inputs required for processing while the factory in China executes the order in return for a fee. In import-and-assembly regime the processing plant is responsible for finding and purchasing the inputs over which it retains control rights. The model is based on Grossman-Hart-Moore property-rights theory but introduces Holmstrom-Milgrom elements of incentive-systems framework by allowing foreign firms decide who should control input-purchase decisions apart from the standard decision about the ownership of the processing plant. Each project requires three types of effort: effort devoted to searching for an input (by either foreign firm or Chinese factory manager); effort devoted to processing the input by the factory manager; and effort devoted to marketing the final good by the foreign firm.

The model predicts that giving the same party ownership and control is optimal when investment specificity is high or when value-added in processing activities is low. In either case, there are relatively large gains to giving one party strong investment incentives in searching for inputs. The more common arrangement of divided ownership of processing

[31] The model, however, gives no advantage to outsourcing in the North to compensate for the higher production cost there. The only viable outsourcing location is therefore in the South.

plant and control over the purchase of inputs is more likely to be optimal when investment specificity is low, such that holdup costs are small, and when both parties' investments matter to the value of the project. Their contribution to the theoretical literature is to suggest that control over input decisions, by affecting parties' outside options, provides an additional instrument through which parties can influence investment incentives.

3.1.2.4 Delegation of authority approach to modelling international fragmentation

The theory of delegation of authority due to Aghion and Tirole (1997) applied to the literature on trade and organizational form represents an extension of property rights theory. Instead of studying the optimal way to procure intermediate inputs, this approach is valuable for understanding the role of information and knowledge creation since the efforts of the principal and the agent are directed at obtaining information in order to decide between competing projects (Spencer, 2005, p. 1113). Formal authority or the right to decide between a number of competing projects can be delegated to an agent (A-formal authority) or retained by the principal (P-formal authority). Under the A-formal authority, agent's incentives to require information are increased at the expense of costly loss of control for the principal. Under the P-formal authority, the principal retains the right to decide upon the project, yet this reduces effort provided by the agent. Puga and Trefler (2002) and Marin and Verdier (2003, 2005, 2008) are categorized into the delegation of authority approach to modelling international fragmentation and are briefly described below.

Puga and Trefler (2002) present a model in which firms choose organizational forms according to knowledge creation and control. The underlying mechanism is similar to Aghion and Tirole (1997) where a principal decides whether or not to delegate some form of control to an agent. On one hand, delegation induces agent's effort, but it also results in a loss of control and costs that follow it. However, where Aghion and Tirole (1997) start out from information asymmetry between the parties, Puga and Trefler build their theory of organizational forms on three foundations. The first is that there is an inherent uncertainty surrounding knowledge creation, which leads to a incomplete contracting. The second element is that knowledge is inherently a public good and hence non-appropriable. The third building block is the fact that incremental innovation is often embedded in a complex environment where an improvement of one input or component requires a modification of other components. Innovative efforts thus become imperfectly substitutable since innovation made by one party imposes costs to the other party in the relationship.[32]

The second and the third elements generate an issue of substitutability of innovative efforts and an issue of the degree of appropriability, respectively. The parameters of choice for the principal are allocation of knowledge creation (who is engaged in knowledge creation) and control (the right to choose whose blueprint will be implemented and who will bear the costs

[32] This is a form of Aghion and Tirole's (1997) concept of "congruence".

of residual incompatibilities). Provided that substitutability is sufficiently high, the principal has an incentive to employ an agent in knowledge creation and perhaps even give him the right of control. On the other hand, if the risk of appropriability is low, the principal will again have an incentive to engage the agent in knowledge creation.

Each principal matches with an agent with ex-ante unknown degree of substitutability but known distribution of this parameter. Upon signing a contract that states the payment that the agent will receive conditional on successful production under each organizational form, they start working together and begin revealing the degree of substitutability. The principal then chooses organizational form, namely who creates knowledge and who controls it. She has three options, schematically described in Table 6.

Table 6: Three alternative organizational forms in Puga and Trefler (2002)

Organizational form	Agent creates knowledge	Agent controls knowledge
Implementation form (I form)	no	no
Knowledge form (K form)	yes	no
Control form (C form)	yes	yes

Source: Puga and Trefler, Knowledge Creation and Control in Organizations, 2002, p. 10.

Each party maximizes her expected utility by choosing the appropriate level of effort conditional on the degree of substitutability and degree of appropriability. If appropriability costs are low, the principal chooses I form for low substitutability agent, K form for intermediate degree of substitutability, and C form when the agent is highly compatible. For intermediate levels of appropriability, only I form and C form are feasible, the latter organizational structure again being preferred in case of high substitutability of innovative efforts. In other words, despite moderate appropriability risk, provided that substitutability is sufficiently high, the principal engages the agent in knowledge creation and delegates him the control over the choice of the innovation. In the environment of high appropriability costs, the principle always chooses the I form because the risk of the knowledge being claimed by the agent is too high.

The model complements the property rights theory as it addresses instances when knowledge creation is a key element of an industry. For example, it succeeds to explain why Sony became one of the few integrated TV manufacturers after its invention of cathode ray tube that made flat screens possible. Because the new cathode ray tubes required different and more costly glass tubes (decrease in substitutability of innovative efforts) and because Sony acquired a jump on the field and crucial knowledge to hide from other manufacturers (increase in the cost of appropriability risk for the principal), Sony partially integrated the production by designing its own tubes, producing the key technological components, and keeping tight control over the technical specifications of the components it outsources. On the other hand, Hitachi having had no such breakthrough technological advances outsourced the production as well as design of its cathode ray tubes.

Marin and Verdier (2008) combine the Aghion and Tirole (1997) model of firm organization with a Dixit and Stiglitz (1977) model of monopolistic competition to examine the effects of competition, as modelled by the degree of substitutability of goods, on the firm's mode of organization in a general equilibrium setting. Doing so, they are opening the black box of the firm as an organization, by modelling the power dynamics between the CEO (principal or headquarters) and division manager (agent or assembly line). The principal allocates formal power to himself (P-organization) or to the agent (A-organization) and the mode of organization determines the incentives inside the firm. In the P-firm there are two layers of management and the decision power is centralized at the top of the organization. This mode of organization is an integration in which the CEO and the division manager are merged in one firm. In the A-firm, the CEO delegates formal control to the division manager, which makes the decision power decentralized and less hierarchical. This mode can be seen as outsourcing in which the CEO and the division manager run two independent firms. The third type of organization is possible in equilibrium: P-firm with no agent's initiative. This is a single-managed firm organization without an internal hierarchy where a corporation is run by a single manager.[33] The equilibrium industrial structure permits no mixed equilibria in which different types of firm organizations coexist in the economy. Nevertheless, multiple equilibria arise as a result of strategic complementarity of firms' organizational decisions. This feature can explain why two otherwise identical countries might have different corporate cultures which will tend to converge when countries become more integrated into the world economy. The organizational equilibrium to which the integrated world economy converges remains, however, undetermined. The main result of the model is that an increase in competition shifts the equilibrium organization of firms from centralization of power to decentralization of power and finally to a single managed firm. Marin (2008) provides some empirical evidence on the firm level that substantiate the theoretical predictions about the flattening of hierarchies in firm organizational structures.

Marin and Verdier (2003) examine the role of trade integration on the organizational structure of firms in an industry and on the empowerment of human capital.[34] They develop a general equilibrium model that combines elements from Aghion and Tirole (1997) theory of the firm with Helpman and Krugman (1985) theory of international trade. There are two sectors (perfectly competitive and monopolistically competitive), two factors (skilled (L) and unskilled labour (H)), and two countries (the North and the South). In the differentiated goods sector, the principal trades off the benefit from control against the manager's loss of initiative by choosing between keeping formal authority or delegating power to the manager. In the

[33] This type of firm corresponds to the Dixit-Stiglitz firm.

[34] Traditionally, two explanations to an increased importance of human capital in recent decades have been given in the economic literature: skill-biased technological change and trade integration with low wage countries. Marin and Verdier (2003) offer a novel explanation based on changes in the organization of the firm. Due to the globalization, human capital encounters more options where to go and as a response firms give more power and decision control to talent to prevent it from leaving the firm. The resulting shift in the organizational mix in the economy towards skill intensive firms, in turn, raises the relative demand for human capital in industrialized countries.

general equilibrium of the closed economy, there exist a range of relative factor endowments for which there are multiple equilibria, with all principals in the monopolistically competitive sector either outsourcing or vertically integrating the production process. Furthermore, there is a range of L/H ratios for which there exists a unique mixed equilibrium, with some principals delegating formal power and some principals retaining it. Trade integration triggers a 'war for talent' in which entrants compete with existing firms for scarce manager talent to start a business. This, in turn, bids up the wage for management talent and makes vertical organization too stifling for manager's initiative. To increase her incentives, CEO delegates power to the talented manager and the non-hierarchical firms emerge in the equilibrium. Trade integration thus increases the demand for skills in developed economies for two distinct reasons. First, trade creates the "brain hunt". Second, because globalization leads to an economy-wide shift in corporate organization from a low-skill intensive organization (the P-firm or integration in North and the O-firm or single-managed firm in South) to a skill intensive, non-integrated organization (the A-firm). In addition, trade integration brings about convergence in corporate cultures across countries towards the flatter corporate hierarchies.

Marin and Verdier (2005) study the impact of international trade and international competition on corporate organization on the one hand and on inter-firm reallocations within an industry on the other. Unlike Marin and Verdier (2008) that introduce firms' organizational choices in a Dixit and Stiglitz (1977) model of monopolistic competition, Marin and Verdier (2005) incorporate endogenous markups[35] using the linear demand system as in Melitz and Ottaviano (2008) and combine it with the elements of Aghion and Tirole (1997) theory of the firm. This way their model exhibits a link between trade liberalization, market size and the mode of organizations firms choose. The model predicts that larger countries will have tougher competition and more decentralized corporate structure, while smaller countries will face less competition and have more vertically integrated firms. In a cross section of firms, larger firms are expected to have more decentralized corporate organization than smaller firms. Furthermore, they show that international trade and the toughness of competition in foreign markets induce a power struggle in firms, which eventually leads to outsourcing corporate arrangements. A large enough trade shock may lower productivity in the liberalizing country by inducing a change in corporate organization from a P-organizational equilibrium to an A-organizational equilibrium in which power is delegated to the division manager to encourage his enthusiasm to find new projects for the firm.

For better clarity, all of the approaches to modelling international fragmentation described above are once again summarized in Table 7.

[35] Markups across firms are a function of the toughness of competition in a market.

Table 7: Summary of the new generation of models of international fragmentation

Approach	Main features	Contributors
The property-rights approach	Integration reduces a holdup problem as it increases the share of ex-post surplus, which leads to increased incentives to make specific investments. On the other hand, it reduces the supplier's ex-post bargaining possibilities and hence its incentive to invest. A relationship between a buyer and supplier of an input is governed by incomplete contracts which distort relationship-specific investments. The surplus from relationship can be apportioned only ex-post in a Nash bargaining game.	Antras (2003), Antras and Helpman (2004), Antras (2005a), and Grossman, Helpman and Szeidl (2005)
Transaction cost approach	Transaction costs approach emphasizes the thickness of the market as the key determinant of transaction costs. A thicker input market eases the search efforts with which a final-good producer can match with a producer of a specialized input. A vertically integrated production chain bears the costs of running a larger and less specialized organization and therefore cannot benefit from specialization in a narrow set of activities. On the other hand, outsourcing arrangements suffer from search costs for the input provider, uncertainty in finding a successful match, and imperfect contracting.	McLaren (2000), Grossman and Helpman (2002, 2003, 2005)
Incentive systems approach	The advantage of in-house production lie in the greater ability to monitor supplier's effort of the tasks involved in producing components. On tasks that can be monitored, the principal can trigger a high level of effort without having to leave rents to the manager by simply paying a wage that compensates the manager for his effort. On the other hand, outsourcing relationship may be preferred over vertical integration because the principal can confront an agent with higher-powered incentives (since the latter bears the cost of component production) and because when a principal has to induce a very high level of effort from her agent, the cost to the principal of providing the necessary incentives is less for an independent supplier than for an employee.	Grossman and Helpman (2004), Feenstra and Hanson (2005)
Delegation of authority approach	Delegation of authority (outsourcing-type of organization) fosters the agent's incentive to acquire information, but it also involves a potentially costly loss of control for the principal since an informed agent will choose a project partly based on private benefits (perks). Under the P-formal authority (vertical integration), the principal retains the right to decide upon the project, yet this reduces effort provided by the agent.	Puga and Trefler (2002), Marin and Verdier (2003, 2005, 2008)

Source: own review.

The revision of theoretical models of international fragmentation of production exposed the differences in methodology and complexity between the traditional and new-generation international trade models of offshoring. In my opinion, it also proved the exceptional ability of mainstream neoclassical research to regenerate, explain contemporary real-life economic phenomena, and confront numerous methodological critiques by absorbing and exploiting the very same elements whose absence was regarded as its major weakness. Furthermore, it illustrated the beneficial effect of embracing diverse theoretical agendas on the richness of the theory, something still missing on the international trade–international business relation. To comprehend the main source of the described variety of approaches to modelling the international fragmentation of production, I now briefly review the most important theories of the firm. These provide alternative starting points to the theoretical approaches described above

3.2 Theories of the firm

In the theoretical part, my dissertation aims to combine three strains of literature into a common framework by bringing together the theory of a firm, trade theory and growth theory. The most recent of the three theoretical segments to be applied to international trade theory is the theory of the firm[36], by which I refer to the body of theory that addresses the existence, the boundaries and the internal organization of the firm. In this chapter, I will present seven streams of research in the theory of the firm as proposed by Foss (1999). The classification is coherent despite some overlapping of ideas in certain areas. In addition, it includes less formal approaches from business literature that other classifications ignore (e.g. the one proposed by Gibbons, 2005). The aim of this section is to present the history, development, and current state of the art of the theory of the firm in a condense and informal manner. The exception to this concept is the subsection in which the property rights theory of the firm is introduced. Because this approach is the cornerstone of my theoretical model, I present it in greater depth, alongside with short formal presentation of the two most influential works in this field of research, Grossman and Hart's "The Costs and Benefits of Ownership: A Theory of Vertical Integration" (1986) and Hart and Moore's "Property Rights and the Nature of the Firm" (1990). After laying down a brief history of the theory, the following seven approaches to the theory of the firm will be presented: Nexus of contracts, Principal/agent theory, Incomplete contracts: coordination, Incomplete contracts: asset specificity, Incomplete contracts: property rights, The information processing view, and The knowledge-based view.

The theory of the firm has picked up steam relatively recently and was integrated with international trade literature only after 2000.[37] Despite overwhelming omnipresence of organizations in the real world (relative to connecting markets), economic research has long neglected theoretical approach that would provide economic rationales for the existence, the boundaries and the internal workings of organizations, including firms. Firms have long been

[36] In fact, »the theory of the firm« may be too narrow term for the body of literature that emerged in the last three decades. Much of the modern theories of the firm also relate to intermediate arrangements, such as joint ventures, franchising and also to the market institutions.

[37] Similarly, in business administration, the theory of the firm has become very influential. For example, the most quoted author in top business administration journals, such as Academy of Management Review and Strategic Management Journal, is Oliver Williamson, probably the most prominent contributor to the modern theory of the firm (Foss, 1999, p. xv).

a crucial element of the explanatory apparatus of economics, along with households, but analyzing the firm per se was outside the set of explananda of neoclassical economics. The firm was seen as the production function and its behaviour was not dependent on its internal organization or ownership structure. In basic neoclassical theory, ownership and institutions neither affected the objective of the firm, nor its performance, technology or cost efficiency. The assumption of market-contracting perfections that resolve all incentives, coordination and dispute issues left little room for studying comparative issues of economic organization. Economists were rather concerned with exchange as the main characteristic of the market economy. As McNulty (1984, p. 233) put it: "In economic theory, business firms differ from one another only in respect of the character of the markets in which they buy or sell, and are at bottom, simply connecting links in an economy."

Frank Knight (1921) was probably the first economist to argue that economic principles can help to explain the different forms of business organization found in the real world. In his book *Risk, Uncertainty, and Profit* (1921), he offers explanations of the firm involving morally hazardous behaviour, non-contractibility of entrepreneurial judgment, and the optimal allocation of risk. The latter was in fact a critical cornerstone in the monumental paper by Ronald Coase, The Nature of the Firm (1937), the paper that is now regarded as the founding contribution in the theory of the firm (Foss, 1999, p. xix). Coase defined the main tasks of a theory of the firm, namely to "discover why a firm emerges at all in a specialized exchange economy", to "study the forces which determine the size of the firm", and to investigate "diminishing returns to management". In other words, the theory of the firm should rationalize the existence of the firm, define the boundaries of the firm, and inquire into the internal organization of the firm. Coase also introduced informally some of the main ingredients of contemporary theory of the firm, namely incomplete contracts, transaction costs ("the costs of using the price mechanism"), and the role of flexibility in an uncertain world. In his analysis, firms come into existence when the cost of managing inputs to achieve a given output is less than the cost of using the price system. He suggested that there were a number of costs of using the price mechanism, among which were the cost of finding out what the relevant prices are and the cost of negotiating and concluding a contract. Coase's view depends upon uncertainty about the current and future states of events, since if events were predictable the price mechanism would render its signalling service at no cost. It is because of uncertainty that the competitive price mechanism in a market of individual producers and consumers breaks down. What Coasian legacy perhaps lacks and today's economics of organization is focused on is the idea of incentive conflicts.

Coase's seminal work was known and acknowledged, but remained unused for more than three decades (Coase, 1972). There was very little cumulative development of the theory in this interim period with two notable exceptions. In his article, Simon (1951) analyzed employment contract as an incomplete contract where the employer offers a wage in return for which the employee agrees to perform certain activities in line with employer's directions. The concept of incomplete contracts pertains to the fact that the parties involved cannot write a contingent contract that fully specifies requested actions as a function of all the possible states of the world. To this end, employment contract assures flexibility as in Coase (1937). The second bright exception is Malmgren (1961), drawing from various influences such as the work of Coase, Keynes, Hayek, Penrose, and Richardson. His paper is the first to "operationalize" the Coasian approach to the theory of the firm and suggest that ideas on firm capabilities may be combined with ideas from the contractual approach to the firm (Foss, 1999, p. xxi).

There are several reasons for negligible development of the theory of the firm until the early seventies. One is certainly the preoccupation of economics with competitive model, the others are the absence of insights and tools that could enrich and set off the theory development. A number of theoretical developments in the nineteen-fifties and nineteen-sixties combined to provide conceptual basis on which a revived theory of the firm was found (Foss, 1999, p. xxi-xxii):

- important contributions in social choice theory (Arrow, 1951) that provided justification for leadership and hierarchical governance;
- the emergence of the related fields of law and economics (notably contract law) and property rights economics (Alchian, 1965), which provided the first working definition of transaction costs as the costs of defining, exchanging and protecting property rights;
- advances in industrial organization by Chicago school that embraced comparative contracting and proto-transaction cost approach (Director & Levi, 1956);
- progress on the managerial (Williamson, 1964) and behavioural (Cyert & March, 1963) theories of the firm which gave prominence to conflicts of incentives between firm owners and managers and between intra-firm agents, respectively;
- work on welfare economics and information economics (Arrow, 1971, 1974) that highlighted various shortcomings of market mechanism and put forward the idea that firms arise because of market failures brought about by externalities, economies of scale and information asymmetries;
- improvements and relaxations of the general equilibrium theory by making states of nature unobservable to some agents (moral hazard) or to the auctioneer (adverse selection). Some of this work later developed into the mechanism design literature that just recently received a respected recognition in the form of the The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel.

All these contributions from the various fields of economics and beyond have spurred serious work on the theory of the firm, interestingly at the same time Coase (1972) lamented that his 1937 paper had been "much cited and little used". Two seminal contributions from that time were Williamson (1971) and Alchian and Demsetz (1972), the former starting the "transaction cost economics" branch and the latter "the firm as a nexus of contracts view" of the firm (Hart 1989). Other approaches also took off in the early ninety-seventies, namely the contract theory approach with the early contribution to formal principal/agent theory by Ross (1973), the team-theoretic approach of Marschak and Radner (1972) and the evolutionary theory of the firm by Nelson and Winter (1973).

Common denominator to all existing theories of the firm is that in answering Coase's question "Why firms exist?", they all introduce some imperfections in the perfectly competitive model. This is achieved by relaxing or rejecting the assumptions used by neoclassical theory in its core model of the competitive firm: i) markets function freely, ii) prices and technology are known to all interested parties, and iii) owners are effective in controlling the use of their assets (Demsetz, 1997, p. 428). With perfect and costless contracting, perfect foresight, and information availability, there would be no incentives for firms to emerge. Consumers could simply contract directly with owners of factor services and there would be no need for the services of the intermediaries known as firms. Imperfections in theoretical setting are thus necessary to rationalize firms and they take on different forms, such as imperfect foresight, noncontractible actions, small numbers bargaining, haggling costs, relation-specific investments, private information, cost of processing information or inspecting quality, increasing returns, etc.

There are several dimensions alongside which different approaches of the theory of the firm differ (see Table 8). Apart from distinct conceptualizations of the firm per se, one common point of departure from a neoclassical tradition is a view of human nature that allegedly goes beyond the conventional maximizing behaviour. Such deviations take the form of potentially opportunistic or morally hazardous behaviour of contracting parties (Foss, 1999, p. xxiv). In my opinion, however, the difference from conventional maximizing and any other morally questionable form of self-interested behaviour stems only from the underlying assumptions about the contracting environment. Where maximization in neoclassical view of the firm is free of ex-post opportunism, moral hazard, and adverse selection, it is various imperfections of the world that open up prospects for "opportunistic" appropriation of quasi-rents from the contractual relationship. Foss (1999, p. xxiv) goes even further by claiming that "the unifying theme of the above subfields is that all contracting problems, and therefore problems of economic organization more generally, are represented as stemming from *incentive conflicts*."

When such incentive conflicts arise in the relationship, parties will prefer some sort of contractual constraints to avoid inefficient outcomes. Indeed, the aspect of contracting is the third dimension that draws distinction between different streams of research. Contracts can be complete (as in nexus of contracts and principal/agent theory) or incomplete in some respects. Complete contracting means that agents can foresee all future uncertainties and can costlessly write contracts over all possible outcomes. Contact failure may take various forms, such as the assumption that some contingencies are omitted because of information costs, the unavoidable emergence of unpredictable developments, the cost of defining all possible states of the world, etc. Incomplete contracting theories are based on the assumption that there is for some reason impossible to write perfect contracts, so that there is a need for ex-post governance. The theories that fall into this category are Incomplete contracts: coordination perspective, Incomplete contracts: asset specificity, Incomplete contracts: property rights approach, The information processing view, and The knowledge-based view, although the proponents of the latter two often avoid relating to the complete/incomplete dichotomy. Complete contracting theories, on the other hand, break with the assumption of symmetry of information so that there are principal-agent incentive problems of either moral hazard or adverse selection variety. Although contracts are complete, they are not perfect in the sense of Arrow-Debreu contracts due to the constraints imposed by the presence of asymmetric information and divergent risk preferences (Foss, 1999, p. xxviii). Nexus of contracts and principal/agent theory belong in the complete contracting category.

Table 8: Streams of research in the theory of the firm.

	Conceptualization of the firm	Rationality	Contracting	Transaction costs considered
Nexus of contracts	A legal fiction	Maximizing	Complete	Ex-post TC, e.g. monitoring and bonding costs
Principal/agent theory	No distinct conceptualization	Maximizing	Complete	Costs of monitoring
Incomplete contracts: coordination	An authority relation	Mostly bounded	Incomplete	Haggling and communication costs
Incomplete contracts: asset specificity	A collection of residual decision rights to physical assets	Bounded	Incomplete	Costs of drafting complex contracts
Incomplete contracts: property rights	A collection of residual decision rights to physical assets	Maximizing	Incomplete	Costs of drafting complex contracts
The information processing view	A team specialized in the collection and processing of information	Bounded	Incomplete	Costs of transmitting, storing, retrieving information
The knowledge-based view	A bundle of knowledge assets	Bounded	Incomplete	Costs of integrating knowledge in firms and transmitting knowledge across the boundaries of the firm

Source: Foss, The Theory of the Firm: An Introduction to Themes and Contributions, 1999, p. xxx.

The group of theories further differ in the choice of manifestation of transaction costs that Coase (1937) identified but not formalized. Incomplete contracting theories most often refer to the ink cost of drafting long complex contracts or the cost of making ex post adaptations. On the contrary, complete contracting stream builds on the costs of monitoring and costs of setting up incentive arrangements. According to Foss (1993), the view of the firm as an information processor and the view of the firm as a knowledge-bearing entity ignore incentive conflict problems in order to focus on the costs of storing, using, producing and transmitting information and knowledge. Next, each of the listed conceptualizations of the firm will be briefly described.

3.2.1 The nexus of contracts view

The nexus of contracts notion of the firm holds a view that a firm is simply one form of legal fiction which serves as a nexus of contracting relationships (Jensen & Meckling, 1976, p. 311). According to the founding contributions to this branch of research (Alchian & Demsetz, 1972; Fama, 1980; Cheung, 1983), firms are merely special kinds of market contracting. The difference from other market contracts lies mainly in the continuity of association among input owners.

Alchian and Demsetz (1972) argue that long term contracts between employer and employee are not the essence of a firm because, so they claim, the difference between the authority-based and the market-based contractual relationship is superficial. The firm does not own all its inputs, nor does it have the power of fiat, authority, or disciplinary action any different from ordinary market contracting between a producer and supplier. What looks like a long-term employment relationship is in fact only a cover for perpetual negotiation between employer and employees: “To speak of managing, directing, or assigning workers to various tasks is a deceptive way of noting that the employer continually is involved in renegotiation of contracts on terms that must be acceptable to both parties.” (Alchian & Demsetz, 1972, p. 777). The relationship between parties within a firm differs from the market contracting in that the technology of team production has inseparable individual production functions, which implies that marginal products of an individual is costly to measure.[38] To avoid a free rider problem in the form of shirking, a firm is given a monitor with the right to fire and hire members of the team, and the right to the residual income of the team project.[39] The resulting classical capitalist firm is thus explained in terms of the reduction of post-contractual measurement cost (Foss, 1999, p. xxxii).

Jensen and Meckling (1976) extend the work of Alchian and Demsetz (1972) but depart from the assumption that team-production is essential to explaining the existence of a firm. Instead they extend the agency problem between the owners and managers that take the form of the costs of monitoring, bonding costs, and the residual loss defined as the difference between the actual residual and the first best outcome for the principal. Fama (1980) is essentially a critique and extension of the Jensen and Meckling (1976) article, emphasizing the role of labour markets in providing the discipline and opportunities for individual participants in the firm and in particular its management. Fama and Jensen (1983) explain the survival of organizational forms largely in terms of the comparative advantages of characteristics of

[38] Following this assumption, however, it is hard to explain the existence of conglomerates.

[39] Sticking to the belief that the power of employer is by no means different from the power of contractor in the market environment implicitly assumes that employees are either nonspecialized or their specific knowledge or investments are instantly and causelessly reemployable elsewhere.

residual claims in controlling the agency problems of an activity and in terms of the division of labour between decision management and decision control. Holmström (1982) provides an important formal contribution to the nexus of contracts view of the firm. Using Alchian and Demsetz's (1972) concept of team production, he focuses on monetary incentive problems of team production. Under the assumption that the monitor is uninformed about individual effort levels of team members, he shows that a budget-balancing incentive system cannot reconcile Nash equilibrium and Pareto optimality. The fundamental advantage of the firm is that third parties (shareholders) can be made sinks so that the team does not have to balance its budget.

The contributions of Jensen and Meckling (1992) and Barzel (1997) and recent formal models by Bajari and Tadelis (2001), Tadelis (2002), and Levin and Tadelis (2005) are testimony that the nexus of contracts research tradition is far from dead. Bajari and Tadelis (2001) compare two contract forms (fixed-price and cost-plus) between firms with defined boundaries. Tadelis (2002) enriches this work by formalizing the make-or-buy decision with a reduced-form model that could be conditionally classified to the nexus of contracts tradition. Finally, Levin and Tadelis (2005) develop the first formal model in the contract tradition where heterogeneous transactions and many forms of contract exist, ranging from one that looks like employment to another that looks like outsourcing. It is shown that in equilibrium, only two extreme contract forms are chosen: integration and non-integration.

3.2.2 Principal/agent theory

What is here called the principal/agent theory derives its name from a classic early contribution "The Economic Theory of Agency: The Principal's Problem" by Stephen Ross (1973). In its simplest form, the principal/agent theory of the firm can be seen as an accidental theory of the firm, because instead of focusing on traditional make-or-buy decision, this line of research focuses on an incentive problem between a principal and an agent (Gibbons, 2005, p. 206). In the nineteen-eighties, when formal work on agency theory fully picked up steam, it became almost synonymous with contract theory. The latter is characterized with a situation where an informed party trades with an uninformed party and where the asymmetric information in question relates to either what a party does (hidden action) or what his attributes are (hidden information). Salanie (1997, p. 4) classifies models according to which of the parties (informed or uninformed) has the first move and distinguishes between adverse selection models (where the uninformed party has imperfect knowledge of the characteristics of the informed party), signalling models (where the informational structure is the same, but where the informed moves first), and moral hazard models (in which the uninformed party moves first, but is imperfectly informed of the actions of the opposite side).

Holmström and Milgrom (1994) present a firm as a system of complementary contractual arrangements that mitigate incentive conflicts. Firms use a variety of incentive instruments: the most direct is a payment based on measured performance, more powerful incentive is asset ownership, and lastly the design of a job (the tasks included in the job description). While coordination perspective of incomplete contracts (e.g. Coase, 1937 and Simon, 1951) emphasize the discretion that the employer has over the employee's set of activities, asset specificity/property rights perspective of incomplete contracts (Klein, Crawford & Alchian, 1978; Williamson, 1985; Grossman & Hart, 1986) focus on the ownership of assets, and the early principal/agent work (Alchian & Demsetz, 1972; Holmström, 1982) stresses monitoring and compensation issues, Holmström and Milgrom (1994) try to understand whether a coordinated use of all three mentioned instruments explains their typical covariation. The choice between the employment contract and independent contracting depends crucially on how accurately every dimension of a person's contribution can be measured. When an important activity cannot be adequately measured, it is counterproductive to give a person high-powered incentives (asset ownership) because he will rationally give little attention to immeasurable activity. According to their view, lack of measurability is an important determinant of firm's boundaries. Since the allocation of property rights play an important role in this model, it belongs not only to a principal/agent but also to an incomplete contracting theory.

Aghnion and Tirole (1997) take a broader view and allow the authority to result from any explicit or implicit contract that allocates the right to decide on specified matters to a member or a group of members of the organization. They distinguish between two concepts of authority, *formal authority* (the right to decide) and *real authority* (the effective control over decisions). The distinction between the two becomes possible in the context of asymmetric information. A principal with a formal authority, say a manager, can always reverse her subordinate's decision but will be reluctant to do so if the subordinate is much better informed and if their interests are similar. When the principal is well informed, she can act confidently in her interest and so she has real authority apart from the formal one. However, when her information is poor, the principal is forced to approve the subordinate's proposals in fear of selecting even worse alternative on her own. In that case, it is the subordinate who possesses real authority although no formal one. The basic trade-off is that an increase in an agent's real authority promotes initiative, but also leads to control losses from the point of view of the principal.

In sum, the distinguishing characteristic of the principal/agent theory of the firm is that asset ownership (one of many possible incentives, but the one that interests us here) can be an instrument in a multi-task incentive problem. Asset ownership has both direct effects (incentives from asset value) and indirect effects (changes in the optimal incentive contract). Joint optimization over asset ownership and contract parameters determines the optimal organizational structure of the firm (Gibbons, 2005, p. 207).

3.2.3 Incomplete contracts: coordination

The origins of coordination view of incomplete contracting approach are to be found in Coase's (1937) remark that the real costs of contracting may lie in their inflexibility. In his view, firm is an institution that lowers the costs of coordination in a world of uncertainty. Employment contract provides the employer the discretion over the actions to be performed by an employee after the uncertainties unfold. In an influential paper which is cast as a theory of employment rather than the theory of the firm, Simon (1951) compares the employment contract and the market contract in terms of efficiency. The employer contract specifies only a range of acceptable actions the employee is obliged to perform in return for remuneration. In contrast, supplier contract defines the actions to be executed and the price. As in Coase, flexibility is the main advantage of employment contract and it becomes more pronounced the greater the uncertainty of business environment.[40] Under such a contract, a subordinate faces a tradeoff between flexibility and exploitation: he can sacrifice flexibility by locking in a decision now (market contract) or he can risk exploitation by allowing the boss to decide ex-post (employment contract).

Wernerfelt (1997) overcomes some of the objections against the Simon's theory of the firm by considering the organization of the firm's activities as institutional mechanisms (game forms). In such governance mechanisms, players adapt to changes in the environment and communicate about these changes. The employment relation (hierarchy) is defined as a game form in which the parties engage in once-and-for-all wage negotiation, while later the boss determines the sequence of desired services as the states of the nature evolve. In such a setting, the parties avoid the costs of continuous or complex negotiating and provide lower overall adaptation costs than the market gameform if many diverse and frequent adjustments are needed.

In short, coordination perspective asks whether integration or non-integration better facilitates adaptive, sequential decision-making in environments where uncertainty is resolved over time. The emphasis is on the question of authority and control over the decision making, whereas the principal/agent theory ignores control in favour of incentives and the property rights theory blends the two.

3.2.4 Incomplete contracts: asset specificity

Asset specificity variant of incomplete contracts theory and the property rights branch operationalize Coase's key ideas by combining elements from previously introduced streams of the theory of the firm. Nexus of contracts and the principal/agent theories contribute the assumption of morally hazardous behaviour or opportunism, whereas Coase and Simon

[40] Loasby (1994) compares this benefit of employment contract to advantages of real options.

provide the incomplete contracting concept. The need for a new approach came from the belief that each of the two just mentioned conceptualizations independently describes the reality only partially, whereas they both describe some very important mechanisms that define the existence and boundaries of the firm. For example, Coase and Simon are criticized for insufficient discrimination between alternative types of economic organization because they suppress the notion of moral hazard. Similarly, the main critique of the nexus of contracts and principal/agent views is that they rely on complete contracts. Incomplete contracts approach of the asset specificity and the property rights branch merge ex-post opportunistic behaviour with relationship-specific investments and study the organizational implications of their interplay.

The most influential author in the asset specificity line of incomplete contract approach is Oliver Williamson with his series of valuable contributions (e.g. Williamson 1971, 1975, 1985, 1996). Starting at the behavioural assumptions, Williamson embraced Simon's concept of bounded rationality, from which he derived contractual incompleteness and a need for adaptive, sequential decision making. The problem of incomplete contracts is often constructed as stemming from defective information that precludes independent agents to establish efficient contracting. Next, agents are opportunistic, so the contracts that govern their relationship need a variety of safeguards. Optimal governance structure that consists of a contract and the arranged safeguards is chosen according to the type of transaction between the parties. Relevant characteristics of transactions include frequency and asset specificity. The latter, however, does not originate in Williamson's work, but can be found in Klein, Crawford and Alchian (1978). They study the importance of asset specificity in connection with the concept of appropriable quasi-rent: "The quasi-rent value of the asset is the excess of its value over its salvage value, that is, its value in its next best use to another renter. The potentially appropriable specialized portion of the quasi-rent is that portion, if any, in excess of its value to the second highest-valuing user." (Klein, Crawford & Alchian, 1978, p. 298).

Thanks to Klein, Crawford and Alchian (1978), asset specificity has become a central building block in Williamson's works. The logic is as follows: specific assets enable opportunism because agents operate in an unpredictable environment where only incomplete contracts are possible. As the uncertainty unfolds, the contracts are renegotiated and if a supplier has incurred sunk costs in investing in specific quality of its assets, the other party can opportunistically appropriate an unjustified share of the investment's payoff (quasi-rents) by threatening to withdraw from the relationship (Foss, 1999, p. xl). This situation is described as a holdup problem and leads to Pareto-inferior outcome. Pareto-improvement may be brought about by vertical integration due to certain advantages of internal organization over market contracting. Especially in times of conflicts, the firm possesses comparatively efficient resolution machinery since fiat is frequently more efficient way to settle minor conflicts than is haggling or courts (Williamson, 1971, p. 114). In contrast to property rights approach, Williamson's theory believes there is more to integration than simply concentration of ownership rights. Authority plays an important part role as an arbitrator in conflicts and disagreements over unanticipated contingencies. In addition, market-based organizational arrangements differ from hierarchical structures in qualitative and quantitative aspects of information structures. And these are exactly the issues that disentangle the property rights approach from Williamson's legacy.

3.2.5 Incomplete contracts: property rights

Whereas the asset-specificity theory ignores internal organization, an important element of the property-rights theory is not only that it defines and evaluates life under integration, but also that it does so also for non-integration. Without this feature, the property-rights theory could not provide a unified account of the costs and benefits of integration, a challenge that no formal theory had previously overcome (Gibbons, 2005, p. 205).

In a well-functioning legal environment, an ownership over property or asset gives the owner the right to utilize his property as she wishes. In words of Grossman and Hart (1986), the owner has "residual rights of control" over the asset. What is important in the context of the theory of the firm, an ownership title gives the owner the right to appropriate all the revenues generated by the asset after he has fulfilled his obligations towards a third party. Grossman and Hart's definition of ownership is thus based on residual rights of control and hence differs from the definition proposed by Alchian and Demsetz (1972) and Jensen and Meckling (1976). Namely, they define the ownership of the firm as the right to claim residual cash-flows. The property rights approach makes the assumption that the possession of control rights is crucial for the integration decision. For example, if firm 1 wants to acquire part of firm 2's verifiable cash-flow stream, it can always do this by contract. However, if firm 1 wants to acquire control over firm 2's assets, it needs to integrate it within its organizational boundary (Hart & Moore, 1990).

The distinction becomes important as we move from the standard incentive systems theory to the incomplete contracts approach where control over assets is a crucial element. The owner of a firm not only has the right to all revenues generated by his asset, but in particular the right to exclude others from using the firm's assets. This right is a safeguard against ex post opportunistic behaviour of a contracting party not owning the asset. To illustrate this, let us imagine an entrepreneur whose firm comprises of headquarters and an input production plant. Being the owner of upstream production facility gives him the right to expropriate inputs in case of a dispute and prevents any kind of blackmailing of input manufacturing division. On the other hand, if input manufacturer is an independent firm, headquarter manager has no legal rights over the inputs. Input supplier can free willingly sell access to inputs to downstream firm and thus protect the returns from ex ante relation-specific investments in input production.

Grossman and Hart (1986) develop a simple and rigorous theory of the boundaries of the firm based on the notion of residual rights of control. They define a firm as a set of assets under common ownership or control. The crux of the theory is the proposition that regardless of ownership structure, relation-specific investment is distorted due to the holdup problem arising from the inability to fully reward investment under incomplete contracts. Ownership serves as a protection against future holdups by other trading partners. It thus gives stronger incentives for ex-ante relation-specific investments by the owner of an integrated firm, but weakens previous owner's bargaining position. Based on the tradeoff between higher bargaining position of the owner and the acquired agent's reduced incentives to invest, Grossman and Hart are able to determine when it is optimal to integrate or not. Their theory of the boundaries of the firm has been further elaborated by Hart and Moore (1990) and synthesized by Hart (1995). In its simplest form, the property-rights theory of the firm predicts that ownership of productive assets should be given to the party that requires the most protection against ex post opportunism.

Grossman and Hart (1986): The costs and benefits of ownership: A theory of vertical and lateral integration

Grossman and Hart (1986) build their model using the insights from Coase's (1937) transaction cost based theory and further advancements by Klein et al. (1978) and Williamson (1979). While fully embracing the idea of transaction costs between independent agents on a market and within a firm, Grossman and Hart (1986) criticize Coase (1937) for not being able to elucidate what the pros and cons are of organizing the transactions within the firm. According to them, Coase (1937) does not give any clear statement as to how can integration ever be strictly worse than non-integration, or in other words, what limits the size of the firm?[41]

Klein et al. (1978) and Williamson (1979) contribute the following four important building blocks to Grossman and Hart's (1986) theory of the firm. First, they argue that relationship between independent agents will be burdened by *opportunistic behaviour*. Contracting parties have an incentive to interpret the contract to their own advantage ex post and this behaviour can lead to both ex-ante and ex-post inefficiencies. This possibility arises because of the second theoretical concept: the assumption that it is impossible to write a complete and contingent *contract* in which a clear division of all possible ex-post *surpluses* could be defined. Another thing that makes opportunistic behaviour more likely is the existence of *relation-specific investments* that have smaller value outside the relationship than within the relationship. Incomplete contracts, relation-specific investments, division of ex-post surpluses, and opportunistic behaviour all represent a great value of Williamson's (1979) and Klein et al.'s (1978) work but their theories nonetheless cannot explain the boundary of the

[41] Coase (1937) indeed states that the boundary of the firm is implicitly outlined by the ability of the manager to manage an increasing number of activities. Grossman and Hart (1986), however, find this argument unconvincing since the owner could always hire another manager to administer some part of the organization.

firm as they do not give a sufficiently clear definition of integration. Whereas Williamson (1979) and Klein et al. (1978) implicitly assume that integration yield the outcome that would arise under complete contracts, Grossman and Hart (1986) argue that incomplete contracting does not vanish under integration. Instead of comparing non-integrated outcome with complete contract outcome, they contrast a contract that allocates residual rights of control to one party to a contract that allocates them to another.

In view of that, Grossman and Hart (1986) place a great emphasis on the definition of integration for its costs and benefits to be assessed. In their model a firm is defined as a set of assets under common ownership. Ownership gives the owner the right to use the assets and to exclude other people from interfering with these assets. Firms operate in an environment where contracts are costly, meaning that it is difficult to write a complete contract between a buyer and a seller. Contractual rights can be either specific rights or residual rights. The former can be defined in a contract between the parties, however at a certain cost. When it is too costly for one party to specify a long list of the specific rights, it may be optimal for that party to purchase residual rights, that is all the rights except those specifically mentioned in the contract. Integration by itself does not change the cost of writing down a particular contractual term. Nevertheless, it does define who has control over those provisions not included in the contract, so called residual rights. The owner therefore has the residual rights of control, meaning that he rightfully controls all aspects of the asset that have not been explicitly given away by contract.

There are two firms that can engage in a relationship that is either vertical or lateral and is assumed to last two periods. In the ex-ante period, each firm i (i=1,2) makes relationship-specific investments a_i right after the contract between the agents was signed. At date 1, some further actions q_i are taken and gains from trade $B_i = B_i\left[a_i, \phi_i\left(q_1, q_2\right)\right]$ are realized. Say firm 1 is a producer of high-tech inputs and a provider of managerial services, while firm 2 is a low-tech inputs producer. Then the a_i's can represent the effort of constructing good-quality inputs. The q_1 can denote the investment of firm 1 into the production of high-tech inputs and q_2 can indicate firm 2's investment in the production of low-tech inputs. Next, let the function ϕ_i denote the production function, while letting B_i stand for net benefits or surplus function. If either of the inputs is of bad quality, no benefits from the relationship can be realized.

None of the variables a_i, q_i, and B_i is ex-ante contractible, so they qualify as a residual right of control. Hence, the owner of firm i has the right to choose them at the corresponding dates. The ownership rights are allocated at date 0 in the ex-ante contract and after it is signed, a_1 and a_2 are chosen noncooperatively and simultaneously by managers of the firms. At date 1, the owner of the firm i has the right to choose q_i. Given that q's become contractible at date 1, the contract may be renegotiated costlessly. Since it is assumed that the parties have symmetric information, costless recontracting will always lead to ex-post efficient allocation, regardless of the initial positioning of property rights. What is important is that the distribution of the surplus from the relationship depends on the allocation of ownership rights, affecting ex-ante investment decisions, a_i's. In the final step, B_i's are realized.

If either the a_i's or q_i's were ex-ante contractible the parties would reach the first-best solution[42] regardless of the ownership type. It is possible to achieve socially optimal investments as long as the q_i's are ex-ante contractible, even if the a_i's are not. This result holds because it is assumed that B_i is independent of a_j. In our example, this means that i's net surplus depends only indirectly on the level of firm j's investments, a_j, through q_j. First-best solution would be achieved also if B_i's are contractible since in this case the agents could always sign a contract defining the transfers from firm i to firm j. In order to make a model interesting, though, at least some aspects of those variables should be noncontractible.

The model then analyses three possible allocations of ownership rights and compares them with the first-best level of surplus. In the first case, both firms remain independent, in the second case, manager and the owner of firm 1 owns also firm 2, and lastly, firm 2 owns firm 1.

By backward induction, at time 1, each of the managers can choose the levels q_1 and q_2 in order to maximize ϕ_1 and ϕ_2, respectively (due to separability assumption on B_i). The result is a unique Nash noncooperative equilibrium $\hat{q} = (\hat{q}_1, \hat{q}_2)$. After some relevant aspects of $\hat{q}$ are observed by both parties, they can renegotiate the contract costlessly. The new contract defines ex-post optimal levels of q_i's, namely $q(a)$=[$q_1(a_1, a_2)$, $q_2(a_1, a_2)$] that maximize $B_1[a_1, \phi_1(q_1, q_2)] + B_2[a_2, \phi_2(q_1, q_2)]$. Instead of determining the levels of q_1 and q_2, the contract stipulates a transfer amount from one firm to another that serves to allocate the gains from renegotiation. This Nash bargaining solution is also Pareto-optimal outcome. The overall payoffs to firm $i, \xi_i(a, \hat{q})$, then consist of noncooperative (reservation) surplus plus half of residual ex-post surplus from the relationship.[43]

Shifting to date 0, each agent chooses ex-ante the investment level a_i that maximizes the overall payoffs ξ_i. This gives the Nash equilibrium pair $\tilde{a} = (\tilde{a}_1, \tilde{a}_2)$ that maximizes the total ex-ante surplus from the relationship, $B_1\{\tilde{a}_1, \phi_1[q(\tilde{a})]\} + B_2\{\tilde{a}_2, \phi_2[q(\tilde{a})]\}$. The first order conditions for the Nash equilibrium are then:

$$\frac{\partial \xi_i}{\partial a_i} = \frac{1}{2}\frac{\partial B_i}{\partial a_i}[a_i, \phi_i(\hat{q})] + \frac{1}{2}\frac{\partial B_i}{\partial a_i}\{a_i, \phi_i[q(a)]\} = 0 \quad \text{for } i\text{=1,2.}$$

---

[42] First-best solution is represented by vectors $a^* = (a_1^*, a_2^*)$ and $q^* = (q_1^*, q_2^*)$ that maximize the total ex-ante surplus of the two managers: $B_1[a_1, \phi_1(q_1, q_2)] + B_2[a_2, \phi_2(q_1, q_2)]$.

[43] It is assumed in the model that the parties split the increase in total surplus evenly.

On the other hand, first order conditions for the solution of total ex-ante net benefits of the two managers (from the social planner perspective) are:

$$\frac{\partial B_i}{\partial a_i}\{a_i, \phi_i[q(a)]\} = 0 \text{ for } i=1,2,$$

which yields higher optimal investment levels a_i, and hence a higher total net surplus. This inefficiency arises, because each manager puts half the weight on the noncooperative outcome $\hat{q}$, even though it never occurs. The socially optimal result can be achieved only if ex-ante investments are irrelevant for the benefits in the second period. In sum, the fact that contracts are incomplete opens up the possibility of noncooperatve outcome and this is enough to distort the investments, leading either to underinvestment or overinvestment of each agent.

In the case of firm 1 controlling firm 2 (vertical integration) manager 1 now chooses investment levels in both plants, q, to maximize ϕ_1 if no further negotiation takes place. Therefore, in the case of status quo, there exist a unique pair ($\bar{q}_1, \bar{q}_2$), which maximizes ϕ_1, but is ex-post inefficient. At date 1, recontracting will proceed, yielding ex-post Pareto optimal investment levels $q_1(a_1, a_2)$ and $q_2(a_1, a_2)$. Being the owner of both firms, manager 1 faces higher status quo utility, $B_1[a_1, \phi_1(\bar{q})]$, while the subordinate manager of firm 2 confronts lower outside option, $B_2[a_2, \phi_2(\bar{q})]$. The first-period optimization yields ex-ante optimal level of investments and the final level of total surplus, which are again inefficient from the social point of view. Firm 2 control has similar results, so I will omit them.

The optimal ownership structure will be chosen to minimize the overall loss in surplus due to investment distortions. No matter which ownership structure we choose, there is always some inefficiencies due to distortions in ex-ante firm-specific investments, a_i. These distortions cause second period investments ([$\hat{q}_1, \hat{q}_2$] under lateral integration and [$\bar{q}_1, \bar{q}_2$] under vertical integration) to differ from socially optimal investment pair [$q_1(a_1, a_2)$, $q_2(a_1, a_2)$]. The closer the distorted investment vector to the optimal investment vector, the smaller the inefficiency in the a_i's and welfare loss. Furthermore, the efficiency of ownership structure crucially depends on ϕ_i, that is the production function in our example. If the noncontractibles q_l (l=1,2) have a small effect on firm j's ϕ and benefit B_j, it is efficient for firm i to control them. If i owns them, she will use the control rights in such a way that she will distort ex-ante investments of firm j. However, since these distortions have by assumption only small effects on firm j's benefits, there will be only negligible distortion in the total benefits. Firm 1 control will therefore be desirable when firm 1 ex-ante investment is much more important than firm 2's and when overinvestment by firm 1 under firm 1 control is a less severe problem than underinvestment by firm 1 in other ownership structures. The analogous case is valid for firm 2 control. Non-integration will be optimal when ex-ante investments of both firms are approximately equally important. If the ownership of low-tech inputs over the high-tech downstream firm is not allowed, lateral relationship will be preferred over vertical integration when high-tech firm's underinvestment causes less severe problems.

Hart and Moore (1990): Property rights and the nature of the firm

Grossman and Hart (1986) analysis is somehow restrictive as it views the costs and benefits of integration solely in terms of the effects on the incentives of top managers/owners of firms. Hart and Moore (1990) enrich the analysis in that they allow several agents to work on an asset. Some of them are the owners of this asset (employers) while the others have no ownership rights (employees). Firm is still defined as the assets that its owners control, but the meaning of residual rights of control narrow down to the right of the owner to exclude others from the use of that asset. As in Grossman and Hart (1986), contracts are incomplete and subject to renegotiation in later periods. Prior investments are asset-specific in the sense that they cannot be paid-off outside a specific relationship. Agent's bargaining power therefore depends on which asset he is bound to and who owns the particular asset. After the investments are performed and gains from trade eventually realized, parties observe each agent's actual investment levels and under symmetric information negotiate over the split of net surplus from their relationship. The model takes cooperative approach to the bargaining problem by adopting the Shapley value as the solution of the division of gains from trade.

The model formulates a simple theory of the optimal assignment of assets in the context of incomplete contracts, asset specificity, and ex-post efficient bargaining over the relationship net surplus. The main findings of the model are that an agent is more likely to own an asset if his action is sensitive to whether he has access to the asset and is important in the realization of surplus, or if he is a crucial trading partner for others whose actions are sensitive to whether they have access to the asset and are important in the generation of surplus. Because the logic and structure of Hart and Moore's (1990) model is a vital part of the theoretical model in my dissertation, I briefly present the theoretical structure for the case of two agents and two assets. I begin with presenting two essential building blocks of the model, control structure and Shapley value.

The control structure

The ownership and control allocation is represented by a mapping α from the set of subsets of $\underline{S}$ to the set of subsets of $\underline{A}$. The mapping $\alpha(S)$ denotes the subset of the assets $\{a_1, a_2, \ldots, a_N\}$ owned by the coalition S. It is assumed that each of the assets is controlled by at most one of the groups of agents, S or $(\underline{S} \setminus S)$. In addition, the assets controlled by any subgroup $S' \subseteq S$ must also be controlled by the whole group S.

The Shapley value

Given the ownership allocation $\alpha(S)$, a vector of ex-ante investments x, and the associated ex-post surplus for any given group of agents S, $V[S, \alpha(S)|x]$, the Shapley value gives the share of agent i in V(x):

$$B_i(\alpha|x) = \sum_{S|i\in S} p(S)\left[v(S,\alpha(S)|x) - v(S\setminus\{i\},\alpha(S\setminus\{i\})|x)\right]$$

where

$$p(S) = 1/I\binom{I-1}{s-1} = \frac{(s-1)!(I-s)!}{I!}$$

and $s=|S|$ is the number of elements in S. Shapley value is therefore an expected payoff, where expectations are taken over all possible subgroups of S that agent i might join ex-post. $p(S)$ represents the probability that agent i is in a coalition with any s-1 other agents. For example, let the agents from $\underline{S}$ be chosen randomly in the group of s agents, with each coalition being equally likely. There are $\binom{I-1}{s-1}$ possible sets of s-1 agents to be formed from the set $\underline{S}$, where we excluded the i-th agent. The probability that we excluded i-th agent from the formation of a group with s-1 agents is exactly $1/I$. Combining both, the probability of incidence of a particular group S where $i\in S$ is $p(S)=(1/I)*(1/\binom{I-1}{s-1})$. The Shapley value assigns to each agent i in the group the difference in surplus obtained with the entire group S and with the group excluding agent i: $\left[v(S,\alpha(S)|x) - v(S\setminus\{i\},\alpha(S\setminus\{i\})|x)\right]$. In other words, the Shapley value assigns to each agent i the expected contribution of that agent to the overall ex-post surplus obtained through multilateral trade between all agents.

Suppose we have two agents (I=2), a headquarter manager (H) and a manufacturing plant manager (M). The two assets ($A=\{a_h,a_m\}$) are a headquarter plant and a manufacturing plant, respectively. Each agent can make investments x_i in a first stage, and trade takes place in a second stage. There are four possible control allocations in this setting[44], but we will study only the following two:

1. Non-integration: $\alpha(H)=\{a_h\}$, $\alpha(M)=\{a_m\}$
2. H-integration: $\alpha(H)=\{a_h, a_m\}$, $\alpha(M)=\{\emptyset\}$

Non-integration: The Shapley value for agent H is given by:

[44] That is, non-integration (H owns and controls a_h, whereas M owns and controls a_m), H-integration (H owns and controls both assets), M-integration (M owns and controls both assets), and reverse nonintegration (H owns and controls a_m, whereas M owns and controls a_h).

$$B_H(NI|x) = \frac{1}{2}\left[v(\{H,M\},\{a_h,a_m\}|x) - v(M,a_m|x)\right] + \frac{1}{2}\left[v(H,a_h|x) - v(\emptyset,\emptyset|x)\right]$$
$$= \frac{1}{2}\left[v(\{H,M\},\{a_h,a_m\}|x) + v(H,a_h|x) - v(M,a_m|x)\right]$$

and for the afent M by:

$$B_M(NI|x) = \frac{1}{2}\left[v(\{H,M\},\{a_h,a_m\}|x) - v(H,a_h|x)\right] + \frac{1}{2}\left[v(M,a_m|x) - v(\emptyset,\emptyset|x)\right]$$
$$= \frac{1}{2}\left[v(\{H,M\},\{a_h,a_m\}|x) + v(M,a_m|x) - v(H,a_h|x)\right]$$

where *NI* stands for non-integration.

***H*-integration:** Under agent *H*'s ownership of both assets, it may be possible for *H* to generate an ex-post surplus on his own, since he has control of both productive assets. The Shapley value is then as follows:

$$B_H(HI|x) = \frac{1}{2}\left[v(\{H,M\},\{a_h,a_m\}|x) - v(M,\emptyset|x)\right] + \frac{1}{2}\left[v(H,\{a_h,a_m\}|x) - v(\emptyset,\emptyset|x)\right]$$
$$= \frac{1}{2}\left[v(\{H,M\},\{a_h,a_m\}|x) + v(H,\{a_h,a_m\}|x)\right]$$

$$B_M(HI|x) = \frac{1}{2}\left[v(\{H,M\},\{a_h,a_m\}|x) - v(H,\{a_h,a_m\}|x)\right] + \frac{1}{2}\left[v(M,\emptyset|x) - v(\emptyset,\emptyset|x)\right]$$
$$= \frac{1}{2}\left[v(\{H,M\},\{a_h,a_m\}|x) - v(H,\{a_h,a_m\}|x)\right]$$

where *HI* stands for *H*-integration.

Knowing the expected payoff from ex-post negotiations (conditional on the value of investment vector *x*), each agent chooses his ex-ante investment to maximize his respective expected payoff:

$$\max_{x_i}\left\{B_i\left[\alpha|x_h,x_m\right] - C_i(x_i)\right\}.$$

Because of the assumption that the investment decisions are too complicated to be specified in a date 0 contract, the investment levels are chosen noncooperatively. Each ownership allocation nevertheless results in Nash-equilibrium investment levels that can be obtained from the first order conditions of each agent's optimization problem:

$$\frac{\partial B_i\left[\alpha|x_h,x_m\right]}{\partial x_i} = C_i'(x_i)$$

Under **non-integration**, equilibrium investment levels, $x^{NI} = (x_H^{NI}, x_M^{NI})$, are given by the following FOC conditions:

$$\frac{1}{2}\left[v^H\left(\{H,M\},\{a_h,a_m\}\middle|x^{NI}\right)+v^H\left(H,a_h\middle|x^{NI}\right)\right]=C'_H(x_H^{NI})$$
$$\frac{1}{2}\left[v^M\left(\{H,M\},\{a_h,a_m\}\middle|x^{NI}\right)+v^M\left(M,a_m\middle|x^{NI}\right)\right]=C'_M(x_M^{NI})$$

where $v^i(\cdot)$ is *i*'s marginal return on investment and $C'_i(x_i)$ is *i*'s marginal investment cost.

Under ***H*-integration**, FOCs for agents' investment levels, $x^{HI} = (x_H^{HI}, x_M^{HI})$, are given by:

$$\frac{1}{2}\left[v^H\left(\{H,M\},\{a_h,a_m\}\middle|x^{HI}\right)+v^H\left(H,\{a_h,a_m\}\middle|x^{HI}\right)\right]=C'_H(x_H^{HI})$$
$$\frac{1}{2}v^M\left(\{H,M\},\{a_h,a_m\}\middle|x^{HI}\right)=C'_M(x_M^{HI})$$

Now let's first compare which ownership structure gives each agent more incentives to invest. To do that for manager *H*, we must compare the two FOC conditions, each corresponding to a different ownership structure. Following from the Assumption 6 in Hart and Moore (1990)[45] and the assumption that $C_i(x_i)$ is monotone increasing and strictly convex, the manager of headquarters division has greater incentives to invest for any given level of *M*'s investment under *H*-integration than he has under non-integration. Because of the Assumption 2 in Hart and Moore (1990)[46], the manager of manufacturing division has greater incentives to invest under non-integration. Thus, staring from a position of non-integration, the integration of manufacturing plant under manager *H*'s ownership induces higher investment for *H* but lower investment for *M*. Depending on the overall effects of each agent's changes in incentives, one can determine equilibrium ownership structure. This is the assignment of assets that brings the highest total net surplus. Two strong underlying assumptions are at work here and they need to be mentioned explicitly. First, it is assumed that there are no wealth constraints on either side, meaning that each contracting party is able to buy any ownership title ex-ante. Second, after the period 0 contract has been signed there are no further gains to retrading ownership rights.

[45] Assumption 6 states, that the marginal return on investment increases with the number of other agents and assets in the coalition. Formally, for all subsets $S' \subseteq S,\ A' \subseteq A,\ v^i\left(S,A\middle|x\right) \geq v^i\left(S',A'\middle|x\right)$.

[46] Assumption 2 says, among other things, that *i*'s marginal return on investment is always nonnegative: if $\bar{x}_i > 0$, then $v^i(S,A|x) \geq 0$ for $x_i \in \left(0,\bar{x}_i\right)$.

It is interesting to compare equilibrium investment levels for each ownership setting with the social planner's efficient levels of investments, (x_H^*, x_M^*). The first-best overall surplus is given by:

$$\max_x W(x) \equiv V(x) - C_H(x_H) - C_M(x_M),$$

where *V(x)* is the maximum total value at date 1, $v(\{H, M\}, \{a_h, a_m\} | x)$. By model assumptions, optimum investment vector x^* is unique and is characterized by the following first-order conditions:

$$v^H(\{H, M\}, \{a_h, a_m\} | x^*) = C'_H(x_H^*)$$
$$v^M(\{H, M\}, \{a_h, a_m\} | x^*) = C'_M(x_M^*)$$

Comparison between private and socially optimum first-order conditions for manager *H* reveals that his private marginal return on investment is less than the socially efficient level. For lateral relationship setting, this is true as long as *H*'s marginal return on investment in the case where he controls the asset a_h is smaller than the marginal return on investment in the grand coalition: $v^H(H, a_h | x^{NI}) < v^H(\{H, M\}, \{a_h, a_m\} | x)$. For vertical integration, underinvestment occurs if *H*'s marginal return on investment in the case where he controls both assets is smaller than the marginal return on investment in the grand coalition: $v^H(H, \{a_h, a_m\} | x^{HI}) < v^H(\{H, M\}, \{a_h, a_m\} | x)$. Assumption 6 in Hart and Moore (1990) guarantees that this is indeed the case.

Similar result emerges on the side of manager *M*. Because he places only half the weight on socially optimal investment condition and the other half on ex-ante inefficient condition burdened with holdup problem, his investment levels under non-integration are socially suboptimal. In case of *H*-integration, *M*'s underinvestment follows trivially from both first-order conditions.

The underinvestment occurs because of the externality: when an agent makes prior investments to improve his productivity, some of the benefits will be dissolved in bargaining at date 1. The ex-post negotiating position of one of the parties may have worsened because that party is locked into the supply relation as a result of relationship-specific investments that are costly to reverse. Agents then anticipate that they may end up in a weaker negotiating position ex-post and so they rationally refrain from making socially optimal level of investments.

Comparison with socially optimum investment levels revealed that both ownership structures make agents underinvest relative to the first-best because some of the benefits from their investment are dissipated in future bargaining. Living in a second-best world, one nevertheless has to determine equilibrium ownership structure. Thus we have to compare total net surpluses in both ownership allocations, $V(x^{NI}) - C_H\left(x_H^{NI}\right) - C_M\left(x_M^{NI}\right)$ and $V(x^{HI}) - C_H\left(x_H^{HI}\right) - C_M\left(x_M^{HI}\right)$, where we used the fact that the Shapley values in any ownership structure sum up to *V(x)*. Because agents have more incentives to invest in distinct control arrangements, the choice of ownership structure is ambiguous. It primarily depends on the characteristics of marginal investment functions, such as the extent of complementarity between the investments ($\partial^2 V(x)/\partial x_M \partial x_H \geq 0$), the relationship between $v^H(H, a_h|x)$ in $v^H(H, \{a_h, a_m\}|x)$, and the shape of marginal costs. In the second stage, it also depends on the value and cost functions, *V(·)* and *C(·)*.

For example, starting from comparison of first order conditions for manufacturing manager *M*, we see that she has greater incentives to invest under non-integration. If investments are complementary, this in turn implies higher marginal investments in *H*'s FOC under non-integration, leading to higher *H*'s investment levels. From the opposite direction, however, there is a tendency for higher *H*'s investment under vertical integration due to the fact that under Assumption 6 $v^H(H, a_h|x) \leq v^H(H, \{a_h, a_m\}|x)$. Higher investment of agent *H* under integration tends to increase *M*'s investment levels as well through possible complementarity of investments. This is again exactly counterweighing our initial tendency for higher *M*'s investments under non-integration. If complementarity of investments is large and if the difference between $v^H(H, a_h|x)$ and $v^H(H, \{a_h, a_m\}|x)$ is small, non-integration can be preferred control structure as the implied investment levels would be higher for both parties. Under strict complementarity of assets[47], on the other hand, vertical integration happens to be the optimal choice from the point of view of both parties' investment levels.

The property-rights theory of the firm addresses the question of when transactions should be carried out within a single firm and when through the market. Its approach is to combine simple elements that explain how different ownership structures affect economic decisions and what the costs and benefits of integration are. One of the most important constituent elements of the theory is the assumption of incomplete contracting. The other is the assumption that ownership over an asset brings about the residual rights of control over this asset. The consequence is that the quasi rents from specific investments cannot be divided up appropriately in advance, so the ownership over the asset increases the share of ex-post surplus and ex-ante incentives to invest in the relationship. Agent's bargaining position will depend on which assets he has access to. If the assets he controls contribute significantly in creation of ex-post surplus from relationship, his bargaining power will be greater. In this sense, ownership over an asset is viewed as a bargaining lever in ex-post bilateral negotiations. It should be stressed that, unlike some other theories of the firm, property-rights

[47] By definition in Hart and Moore (1990), two assets a_h and a_m are (strictly) complementary, if they are unproductive unless used together. For all coalitions *S* and all sets *A* of assets containing a_h and a_m, $v^i\left(S, A \setminus \{a_h\}\right) = v^i\left(S, A \setminus \{a_m\}\right) = v^i\left(S, A \setminus \{a_h, a_m\}\right)$ if i∈S.

theory does not presume a different type of transactions between integrated entities as compared to non-integrated ones. All transactions remain negotiation-based and still evolve in the same centralized marketplace. What determines the choice of optimal ownership structure is the interaction of bargaining positions or terms of trade of the agents under specific ownership allocation. It is efficiency that dictates that the agent who is to make the most important asset-specific investment should own the asset. Opportunism is not avoided by integration, but rather shifts incentives for opportunistic behaviour. Optimal ownership arrangement is therefore the one that via its impact on incentives minimizes the consequences of opportunism.

The virtue of property rights theory as opposed to transaction cost theory is that it simultaneously addresses the benefits and the costs of ownership. One limitation of the theory is that it sees integration not as leading to grater centralization but solely as reallocation of bargaining power between division managers/owners. The second limitation is that it is a theory explaining the existence of entrepreneurial firms run by owner-managers. Firms are poorly defined as it is not clear how we should interpret the identities of agents. If we treat them as entrepreneurs, the parties involved are just single individuals, the fact that bears little empirical relevance. If we treat them as a group of individuals, then we have a problem with unobserved investments that cannot be transferred (Holström & Roberts, 1998, p. 79). The same critique is shared by Bolton and Scharfstein (1998) who call for a more unified theory of the firm. On one hand, Williamson (1975), Klein, Crawford, and Alchian (1978), Grossman and Hart (1986), and Hart and Moore (1990) made substantial progress in answering Coase's question, "If production could be carried out without any organisation at all, well might we ask, why is there any organization?". On the other hand, Berle and Means (1932) raised another fundamental question about the nature of the firm: "Will corporate managers continue to act in the interest of investors despite their small ownership stakes?". The property rights theory of the firm left this question unanswered, whereas Alchian and Demsetz (1972), Mirlees (1976), Jensen and Meckling (1976), Holmström (1979), and others have made important steps towards understanding the implications of Berle and Means's emphasis of the separation of ownership and control in most corporations. Even though highly complementary, both strains of literature seem to progress in solitude. However, both can learn a great deal from each others insights. Coasian view of the firm could be enriched with two tiers of agency relationships: one between investors and corporate headquarters and the other between corporate headquarters and the divisional non-owner managers. At the same time, a broader understanding of the corporate ownership and control issues put forward by Berle and Means requires some notion of what a firm is – an answer to Coase. Bolton and Scharfstein (1998) suggest that Berle and Means agency costs theory has to be broadened to introduce Coasian themes of integration and internal organization, but to take into account also 1) a role for corporate headquarters in the bargaining process among managers; 2) the fact that managers at corporate headquarters and divisions are not owners but rather agents or shareholders; and 3) that bargaining takes place over the allocation of corporate resources rather than over manager's compensation as in Grossman and Hart (1986) and Hart and

Moore (1990). Regarding the allocation of capital among firm's divisions, Bolton and Scharfstein (1998) claim that another consideration should be discussed in the theory of the firm: the widely accepted view that internal capital markets are less efficient than external capital markets. The presumed reason is that internal capital markets replace the profit-based decision-making of investors with the bureaucratic decision-making of corporate executives.[48]

3.2.6 The information processing view

Absorbing the ideas from other sciences has always been beneficial to the development of economic theory and the same goes for the theory of the firm. By admitting to the organization theory perspective, the information processing view of the firm argues that one important function of the firm is to collect, process, and adapt to new information from the environment and within. In terms of the complete/incomplete dichotomy, one can argue that this line of research belongs to incomplete contracting camp (Radner 1996). The classic contribution on team-theory and a standard reference for this strain of theory of the firm is the book by Marschak and Radner (1972). Adopting completely different approach as the nexus of contracts and transaction cost view, it disregards incentive conflicts or rather assumes that they have been solved so that every member of a firm shares common organizational goals. In the contributions that followed, the red line remains the switching from modelling the incentive conflicts to the analysis of information acquiring and processing activities and capabilities of members of the firm. Furthermore, nowhere else is the changing and uncertain environment of the firm more emphasized than in the information processing view. Agents have limited capabilities of collecting and processing information and the advantage of a firm is that it can economize on bounded rationality by appointing members to collect and process different types of information.

Bolton and Dewatripont (1994) see the firm as a communication network that is designed to minimize communication costs of distributing information among agents and the cost of processing new information. Communication is costly because it takes time for receiving agent to absorb new information, but the costs can be lowered by specializing in the processing of particular types of information. Each agent processes a different type of information and the distinct types of information are aggregated through the communication network. There is a trade-off between benefits of specialization and costs of communication, so when the former outweighs the latter, the firms arise.

[48] It is assumed that even though integration increases monitoring incentives and gives more complete information to headquarters managers, corporate politics in a two-tiered agency setting more than offsets those advantages. Large empirical body of evidence suggests that headquarters do not allocate capital efficiently, in a so-called "Robin Hood" approach (taking from cash-rich divisions with poor investment opportunities and giving to cash-poor divisions with large investment opportunities), but rather inefficiently, as in dysfunctional socialism (Bolton and Scharfstein, 1998). An illustrative example is Airbus with its recent quarrels over which country gets production and which one has to bear massive layoffs.

There is a number of papers within the information processing approach that analyze the internal organization of the firm (e.g. Aoki, 1986; Cremer, 1990; Carter, 1995). However, this work, despite being very informative and important, departs from the make-or-buy problem that defines the current aspect of the theory of the firm.

3.2.7 The resource-based view of the firm

Resource-based theory (RBT) argues that resources that are valuable, rare, inimitable, and non-substitutable (the VRIN conditions) are the sources of rents. When captured by the firm rather than an independent supplier, they yield super-normal profits (Barney, 1991; Wernerfelt, 1984; Dierickx & Cool, 1989). Resources that are valuable and rare can lead to the creation of competitive advantage. That advantage can be sustained over longer time periods to the extent that the firm is able to protect against resource imitation, transfer, or substitution. In normal circumstances and in the absence of market imperfections, extra profits would sooner or later dissipate by the entry of new rivals on the market. RBT asserts that firms can earn sustainable super-normal returns only if they possess superior resources and only if these are protected by some sort of isolation mechanism that prevents strategic resources from leaking throughout the industry.

A short explanation of VRIN conditions is in order at this point. First, for a resource to be valuable, it must in the first place contribute to the provision of a product or service valued by customers (Bowman & Ambrosini, 2000). The sufficient condition, though, for a resource to be valuable to the firm is that it must be generating rents, which form a part of the super-normal profit stream captured by the firm (Bowman, 2003, p. 409). A key point of the RBT argument is that the value of a particular resource may be enhanced if it is combined with other complementary resources (Dierickx & Cool, 1989). Second, a resource is rare if its owner can generate either superior margins or superior sales volume off of an equivalent cost base to competitors. In other words, relative scarcity of a resource is conditioned by its shortage across other competing firms. Third, inimitability stems from the difficulty for competing firms to replicate the resource. The reasons for imperfect imitability include unique historical conditions, path dependency, causal ambiguity, and social complexity (Bowman, 2003, p. 410). Finally, there must not exist strategically equivalent valuable resources that are themselves either not rare or imitable.

The first author to contribute to the RBT field was Edith Penrose (1959, p. 24), when she wrote: “a firm is more than an administrative unit; it is also a collection of productive resources at the disposal of which between different users and over time is determined by administrative decision. When we regard the function of the private business firm from this point of view, the size of the firm is best gauged by some measure of the productive resources it employs.” Even though it was Wernerfelt (1984) who first coined the name, most scholars consider Jay Barney as the father of the modern RBT of the firm (seminal articles include

Barney, 1986a, 1986b, 1986c, 1988, 1991). More recently, the dynamic capability perspective has extended the RBT to the realm of evolving capabilities. A firm can stay ahead of its competitors and maintain competitive edge by developing capabilities based on sequences of path-dependent learning (Teece, Pisano & Shuen, 1997).

In short, RBT states that a firm's valuable, rare, non-substitutable, and inimitable resources generate a competitive advantage and, thereby, an above-normal rate of return. Thus, the heterogeneity of resources across firms explains their comparative differences in competitive advantage in the marketplace. Resource heterogeneity can be long lasting and therefore produce sustainable advantage since these resources may be not perfectly mobile across firms.

3.2.8 The knowledge-based view

The development of the knowledge-based view of the firm relies heavily on the borderline areas between economics and business administration, such as strategy research, technology studies, evolutionary economics, and international business. Penrose (1955) represents the first thorough conceptualization of this line of research. Her view of the firm is organizational: firms are collections of resources and services obtained from these resources, all organized under an administrative structure. It is widely acknowledged that her later work, Penrose (1959), is one of the more influential books of the second half of the twentieth century, bridging strategic management and organizational economics (Pitelis, 2002; Kor & Mahoney, 2004). Penrose built on a number of concepts of neoclassical economics, and accepted the profit-maximizing assumption as largely consistent with the pursuit of an optimal growth path. But optimal growth, not the pursuit of rents, was the focus of her analysis. Through perpetual learning processes, management team optimizes existing activities and so release resources. These surplus resources can subsequently be used for firm growth and diversification, so that we arrive at a basic account for the multiproduct firm. Conceptualization of the firm as an organization of knowledge is central for understanding the growth processes and the boundaries of the firm (Penrose, 1959, p. 2): "All the evidence we have indicates that the growth of a firm is connected with the attempts of a particular group of human beings to do something; nothing is gained and much is lost if this fact is not explicitly recognised".

This relatively narrow view of the firm is later challenged by Teece (1982), where he points to the need for combining her notions with transaction cost reasoning which identify the market failures that deter excess resources being traded rather than used internally. Even before Teece's contribution, the knowledge-based stream was enriched by Richardson (1972) who introduced the term "capabilities" to refer to the limited knowledge firms and individuals posses. In his terminology, production can be broken into numerous activities, some of which are similar in that they exploit the same capabilities, and some of which are complementary in that they need to be coordinated with one another in order to form a production chain. The organization of production is then determined by interaction of similarity and complementarity between activities. For example, closely complementary and similar activities are optimally undertaken within the boundaries of a firm.

Richardson's view that capabilities, rather than transaction costs per se, determine the boundaries of the firm is shared with Demsetz (1988). He conjectures that the crux of the firm can be explained in terms of letting the more informed direct the less informed, which reduces the costs of transmitting knowledge. Next, the boundaries of the firm are determined similarly: to economize on knowledge transmission costs, goods that require less information to use than is required to produce them are bought instead of made within the firm. In Demsetz's example, the knowledge required to make use of steel may be greatly different from the knowledge required to produce steel; therefore the steel is bought and not produced.

Conner and Prahalad (1996, p. 477) go so far as to say that knowledge-based resources are "…the essence of the resource-based perspective". They assume limited cognitive capabilities of individuals and presume opportunism will not happen. The latter allows them to test whether knowledge-based theory has independent explanatory power, as compared to the opportunism-based, transaction-cost approach. Organizational mode through which individuals within a firm operate determine the amount, type, and quality of knowledge they apply to productive activities. This is nearly as far as one can depart from the Hart position that what matters is property rights to physical assets and that information structure can be chosen endogenously (Foss, 1999, p. xlviii).

The review of existing major theories of the firm has demonstrated the depth and broad scope of the theoretical approaches to explaining the existence and boundaries of the firm. The simple dichotomy between firms and markets turns out to be in reality a continuous spectrum, evolving in time and space. Nevertheless, it is a spectrum in which certain elements and forces have been identified as important. Each of the presented approaches to the theory of the firm stresses one or couple of them, necessarily omitting the others. Nevertheless, one must not treat different approaches as competitive research agendas, but rather as valuable complementary contributions to a demanding and yet unresolved question of the existence and the boundary of the firm. The first of the forces inside the firm to be identified was the question of incentive structure: people in general and organizational structures in particular respond to incentives provided to them and these incentives can be structured in a different manner inside or outside the boundaries of the firm. Secondly, the key competencies, valuable resources and knowledge, which are assets not easily reproducible and providing their owners with much lower transaction costs in performing the associated tasks. Thirdly, there are issues about ownership, residual rights and control. Fourth, increasingly more important is the issue of information: how to receive them, absorb them, distribute them and exploit them. Any kind of organizational structure should be studied bearing in mind all these contexts.

Seven distinct streams of research have been presented and their most important characteristics are presented in Table 9. *The nexus of contracts view* of the firm denies that integration has any real effects. The firm in this tradition is simply a descriptive term, a collective noun denoting a particular cluster of otherwise ordinary contractual relationships. The benefits of firm-like contracting relative to market-based contracts stem from the monitor's power to alleviate the inability to measure individual contributions in team-production or from the ability to reduce other agency costs. *The formal principal/agent theory* gives the asset ownership the power of an instrument in a multi-task incentive problem. Next three theoretical approaches belong to a broad group of imperfect contracting paradigm and all regard integration as reallocating decision rights, rather than payoff rights. *Coordination perspective* stresses the importance of exercising control rights in the unpredictable and ever-changing business environment that demands adaptive, sequential decision-making. The distinctive point in the *asset specificity perspective* is the hypothesis that the ownership over a productive asset can stop haggling that is undertaken via alienable instruments. *The property-rights theory* of the firm is a mixture of principal/agent theory and coordination perspective: integration reallocates decision rights (as in the adaptation theory), but the efficiency consequences of these reallocated decision rights appear in ex-ante actions (similar to the principal/agent theory). The last two theories transcend the boundaries of economics and incorporate the ideas from various neighbouring and distant sciences. The firm as an *information processor* focuses on the information acquiring and processing activities and capabilities of the individuals, instead of on incentive conflicts. Firms resist the problem of bounded rationality by making members specialize in collecting and handling different types of information. According to *resource-based view* of the firm, certain assets with certain characteristics (value, rarity, inimitability, and non-substitutability) will lead to sustainable advantage and therefore high strategic returns in terms of market share or profits. When these resources are not perfectly mobile through the market, firms are superior organizational structure to market-based relations. Finally, *knowledge-based perspective* of the firm highlights the importance of routines, experiences, and organization of the use of firm's resources. These are not valuable per se but because of the services rendered by them. The knowledge-based theory of the firm considers knowledge as the most strategically significant resource of the firm. Firms exist because markets are incapable of coordinating the knowledge of individual specialists, the role given to the management within a firm.

Table 9: Distinctive characteristics of the theories of the firm

	Contracting	**Transaction costs**	**Concept of the firm**	**Major contributors**
Nexus of contracts	Complete	Ex-post TC, e.g. monitoring and bonding costs	A firm is a form of legal fiction which serves as a nexus of contracting relationships.	Alchian and Demsetz (1972), Jensen and Meckling (1976), Fama (1980), Cheung (1983)
Principal/agent theory	Complete	Costs of monitoring	A firm is a system of complementary contractual arrangements that mitigate incentive conflicts.	Ross (1973), Holmström and Milgrom (1994), Aghnion and Tirole (1997)
Incomplete contracts: coordination	Incomplete	Haggling and communication costs	A firm as a form of integration emerges in order to better facilitate adaptive, sequential decision-making in environments where uncertainty is resolved over time.	Simon (1951), Wernerfelt (1997)
Incomplete contracts: asset specificity	Incomplete	Costs of drafting complex contracts	Firms possess more efficient resolution machinery when efficient contracts between opportunistic agents with asset-specific investments are impossible to write.	Williamson (1971, 1975, 1985, 1996), Klein, Crawford and Alchian (1978)
Incomplete contracts: property rights	Incomplete	Costs of drafting complex contracts	A firm is a set of assets under common ownership or control and arises when the assets under control contribute significantly in creation of ex-post surplus from relationship.	Grossman and Hart (1986), Hart and Moore (1990), Hart (1995)
The information processing view	Incomplete	Costs of transmitting, storing, retrieving information	A firm is a communication network that is designed to minimize communication costs of distributing information among agents and the cost of processing new information.	Marschak and Radner (1972), Bolton and Dewatripont (1994)
The resource-based view	Incomplete	Costs of transferring resources from firm to firm	A firm is a system of resources and capabilities that are valuable, rare, imperfectly imitable, and not substitutable. Firms attempt to exploit these strategic resources to sustain competitive advantages.	Penrose (1959), Wernerfelt (1984), Barney (1986a, b, c, 1988, 1991), Dierickx and Cool (1989), Prahalad and Hamel (1990)
The knowledge-based view	Incomplete	Costs of integrating knowledge in firms and transmitting knowledge across the boundaries of the firm	To economize on knowledge transmission costs, goods that require more information to use than is required to produce them are made within the firm instead of bought on the market.	Penrose (1955, 1959), Richardson (1972), Teece (1982), Demsetz (1988), Conner and Prahalad (1996)

Source: own review.

3.3 Review of economic growth theory

Theoretical part of the dissertation aims to combine three strains of economic theory into a unified partial equilibrium framework by drawing from the advances of international trade, theory of the firm and modern growth theory. In this part, I will deliver a brief review of aggregate models of growth and R&D and afterwards proceed to micro-founded endogenous growth models of industrial dynamics. I have no attempt to provide an exhaustive and systematic literature review of neither of the classes of growth models, but to give a brief exposition of the development of growth theory and characteristic features of the latest class of dynamic heterogeneous-agent-based models of industry dynamics.

Many of the basic elements of the modern theories of economic growth date back to the works of classical economists, such as Adam Smith (1776), David Ricardo (1871), and Thomas Malthus (1798), and, much later, Frank Ramsey (1928), Allyn Young (1928), Fank Knight (1944), and Joseph Schumpeter (1934). These ingredients include the basic accounts of competitive behaviour and equilibrium dynamics, the role of diminishing returns and its effect on the accumulation of physical and human capital, the relation between per capita income and the growth rate of population, the effects of technological progress in the forms of increased specialization of labour and discoveries of new goods and methods of production, and the role of monopoly power as an incentive for technological advance (Barro and Sala-i-Martin, 2004, p. 16).

The seminal paper by Ramsey (1928) represents the starting point of modern growth theory. Ramsey's innovative treatment of household optimization over time transcends the domain of growth theory since optimality conditions by Ramsey (1928) and Fischer (1930) became a cornerstone of modern consumption theory, asset pricing, and business-cycle theory. Unfortunately, economic profession did not acknowledge Ramsey's valuable contribution to economic theory until the 1960s. Meanwhile, Harrod (1939) and Domar (1946) made some attempts to integrate Keynesian analysis into the growth theory, yet very little of their analysis remains influential for contemporary economic literature.

It was not earlier than the mid 1950s that economic growth theory received a stimulus in the form of Solow (1956) and Swan (1956) contributions. Widely-known as the Solow-Swan model or simply Neoclassical growth model, it introduced neoclassical structure of production function in which constant returns to scale and diminishing returns to each input are assumed. In contrast to Harrod (1939) and Domar (1946) models, the Solow-Swan model also assumes some positive elasticity of substitution between the inputs. The key result of the model, that has considerable explanatory power for economic growth across countries and regions, is the concept of conditional convergence: if countries possess the same technological possibilities and population growth rates but differ in savings propensities and initial per-capita GDP, then there should be convergence to the same growth rate, yet not necessarily at the same level of development. The Solow-Swan model also implies that the growth of income per capita cannot be sustained without continued technological progress. Its perspective on the strategy of economic development is entirely different from the Harrod-Domar model that identified capital accumulation as the engine of development. Important contribution made by the Solow-Swan model was to elucidate the decisive role of technological change in economic growth. However, its contribution was limited because the model assumed technological change to be given exogenously and did not attempt to incorporate the mechanism within the economy to generate progress in technology.

Recognizing the inconsistency of the neoclassical growth model with the observed positive and persistent rates of per capita growth over a century or more, growth theorists began to search for modifications that would reconcile the theory with factual evidence. Cass (1965) and Koopmans (1965) invoked Ramsey's analytical apparatus back into the neoclassical growth model and endogenized the savings rate. This extension preserves conditional convergence but does not eliminate the dependence of the long-run per capita growth rate on exogenous technological progress. Thus, although these models provide interesting frameworks for studying transitional dynamics, they are not helpful for understanding the sources of long-term growth. In short, the neoclassical tradition constructed models of economic growth that explain everything but long-run growth.

As Barro and Sala-i-Martin (2004, p. 18) note, the inclusion of technological change in the neoclassical framework is difficult, because the assumptions of perfect competition cannot be maintained. Technological advance entails the creation of new ideas, which are partially nonrival and therefore have characteristics of public goods. For a given state of technology, it is reasonable to assume constant returns to scale in the standard, rival factors of production, such as labour, capital, and land. However, the returns to scale tend to be increasing if the nonrival ideas are included as factors of production. These increasing returns are incompatible with perfect competition. In particular, the compensation of nonrival old ideas in accordance with their current marginal cost of production—zero—will not provide the appropriate compensation for the research effort that inspire the creation of new ideas.

In Solow-Swan and Ramsey models the exogenous rate of technological progress determined the steady-state growth rate of per-capita income. Recent theoretical advances endogenize this process of technological improvement as they explain how and which factors influence an economy's long-term per capita growth rate. Arrow (1962) and Sheshinski (1967) provided the first step towards endogenous determination of economic growth. They constructed models in which ideas were unintended by-products of production or investment, a mechanism described as learning by doing. In these models, each firm's knowledge is a public good that any other firm can access at zero cost because knowledge is nonrival.

Research on economic growth experienced a boom after the mid-1980s, beginning with the work of Romer (1986) and Lucas (1988). Their works introduced important changes in the neoclassical growth model to incorporate an analysis of imperfect competition. It was acknowledged that competitive framework is incompatible with the assumption that discoveries depend in part on deliberate R&D investment and that an individual's innovations spread only gradually to other firms. As a result, they initiated a novel stream of theoretical literature under the common term "endogenous growth models". Even though they explained the long-term growth within the model, the first wave of endogenous models (Romer, 1986; Lucas, 1988; and Rebelo, 1991) did not in fact introduce a theory of technological change. In these models, growth may go on indefinitely because the returns to investment in a broad class of capital goods do not necessarily diminish as economies grow richer. The reason is that knowledge spillovers across the economy and positive externalities from human capital help to avoid the tendency for diminishing returns to the accumulation of capital.

Romer (1987, 1990), Aghion and Howitt (1992) and Grossman and Helpman (1991a) were the first papers to incorporate R&D theories and imperfect competition into the growth framework. The distinctive feature of these models is that technological advances result from deliberate R&D activity that is rewarded by some form of ex post monopoly power. Because of the distortions related to public nature of the created knowledge, the resulting growth rate, although positive even in the long run, tends to be Pareto suboptimal. This opens the role of the government as a regulator, tax authority, guardian of property rights and subsidizer of R&D activities. This line of research remains active and has been applied to various aspects of economic growth, such as the scale effects (Jones, 1999), the role of competition (Aghion Harris, Howitt & Vickers, 2001; Aghion, Bloom, Blundell, Griffith & Howitt, 2005), diffusion of technology (Barro & Sala-i-Martin, 1997), and the growth rate of population (Braun, 1993).

Economic growth theory has come a long way in endogenizing the rate of aggregate growth and thus explained why some poor countries do not converge in income towards the developed economies. However, these models make strong assumptions regarding market structure to remain analytically tractable. The Dixit-Stiglitz model of monopolistic competition, for example, is adopted in the growth models based on variety expansion (e.g. Romer, 1990 and Grossman & Helpman, 1991a, ch. 3) not because it yields a plausible industrial structure, but because it is the easiest way to generate profits to finance R&D. Each firm still has a monopoly power, but it competes with all other firms in the economy as an infinitesimally small player. In a similar way, winner-takes-all patent races are employed in quality ladder growth models (e.g. Aghion & Howitt, 1992 and Grossman & Helpman, 1991a, ch. 4) because of their apparent tractability, even though they result in an obviously artificial industrial structure.

As a response to the inconsistencies between actual and theoretical industrial structures in new growth theory, some recent theoretical work began to take market structure more seriously. Thompson and Waldo (1994), Smulders and van de Klundert (1995), Peretto (1999), and Peretto and Smulders (2002) have constructed R&D-based models in the presence of horizontal product differentiation, where investments in R&D leads to cost reduction. In these models the knowledge stock is not a pure public good but can be appropriated fully or at least to a large extent by the firms themselves. These models with in-house R&D are representative for the system of "trustified capitalism", which Schumpeter considered to be as one of regimes of growth and competition in mature industries (Smulders & van de Klundert, 2004, p. 308). However, due to the deterministic and symmetrical structure of the models, these contributions provide only a partial analysis of firm growth and market structure. The empirical research at the firm level consistently highlighted the role of firm heterogeneity. It is a well-known feature of industry structure that the size distribution of firms is highly skewed and that this skewness is largely driven by stochastic processes of firm investment and growth.

In this manner, Klette and Kortum (2004) present a comprehensive list of empirical regularities that have emerged from a large number of studies using firm-level data. The following stylized facts sparkled the most recent wave of theoretical contributions on firm growth and industry dynamics that is based on firm heterogeneity and in-house R&D: (1) Productivity and R&D across firms are positively related, whereas productivity growth is not strongly related to firm R&D; (2) Patents vary proportionally with R&D across firms, while there are diminishing returns to R&D in the longitudinal dimension; (3) R&D intensity is independent of firm size; (4) The distribution of R&D intensity is highly skewed, and a considerable fraction of firms report zero R&D; (5) Differences in R&D intensity across firms are highly persistent; (6) Firm R&D investment follows essentially a geometric random walk; (7) The size distribution of firms is highly skewed; (8) Smaller firms have a lower probability of survival, but those that survive tend to grow faster than larger firms. Among larger firms, growth rates are unrelated to past growth or to firm size; (9) The variance of growth rates is higher for smaller firms; (10) Younger firms have a higher probability of exiting, but those that survive tend to grow faster than older firms (Klette & Kortum, 2004, p. 1010-1012). Several papers aimed at constructing a model of endogenous aggregate growth in which the underlying industrial structure that conditions growth is consistent with as many of the above empirical regularities as possible.

One of the first papers to characterize industrial dynamics with heterogeneous firms was that of Jovanovic (1982) which introduces firm level heterogeneity by having new firms draw their efficiency levels from a common distribution. However, efficiency is unchanging and thus no R&D occurs. Hopenhayn (1992), in contrast, provides a hybrid model in which perfectly competitive firms are subject to exogenous productivity shocks, but do not perform Bayesian learning as in the Jovanovic (1982) model since the distribution of the shocks is commonly known. Both models allow for free entry and exit, but the main difference between the two is that in Hopenhayn (1992) the selection occurs as a result of sequences of bad productivity shocks, while in Jovanovic (1982) it occurs as establishments learn about their fixed productivity. These models of industry evolution, however, assume a continuum of infinitesimally-small, perfectly competitive firms that are not allowed to conduct R&D of any kind. Moreover, Pakes and Ericson (1998) provide empirical evidence that for the manufacturing industry the effects of initial size vanish with age, consistent with active search models, but not with passive learning models such as that of Jovanovic (1982) or Hopenhayn (1992). As a consequence, a number of theoretical models emerged that combined persistent firm heterogeneity within an industry with optimizing agents conducting R&D investments in order to improve their market positions. The new generation of models differ from the older stochastic growth models in that he random growth process has been replaced by one in which firms that differ in various attributes make different profit maximizing choices. The models remain stochastic but now the source of randomness has been either shifted backwards (e.g. firms' efficiency differences) or forward into random outcomes form R&D investments (Sutton, 1997, p. 48).

The work of Klette and Griliches (2000) and Klette and Kortum (2004) are important contributions to micro-based growth theory motivated by micro-market structure features relevant to the incentives for conducting R&D. The first paper uses a differentiated products framework and the elements of the quality ladder models introduced by Aghion and Howitt (1992) and Grossman and Helpman (1991a, b). However, it abstracts from entry and exit decisions by assuming a random creative destruction process in each product line that is negatively related to the amount of R&D undertaken by the incumbent. Consequently, the incumbent monopolist chooses spending just sufficient to deter entry into the R&D race and thus eliminates the entry and exit process. Therefore, the model reduces to one of R&D and product competition across product lines as opposed to direct R&D competition between firms in the same industry as emphasized by Dasgupta and Stiglitz (1980).

Klette and Kortum (2004) allow for entry and exit through a stochastic creative destruction process, but firms are a collection of goods and thus operate in several lines simultaneously. Firms operate in an economy with a continuum of differentiated goods of unit measure. In any given market, competing firms are engaged in Bertrand competition, while the economy as a whole is of monopolistic competition type. A firm is defined as a portfolio of varieties it produces and it grows by expanding the scope of its portfolio. To add a new variety, a firm must invest in innovative effort. The innovation production function is strictly increasing and strictly concave in the level of investment in R&D, strictly increasing in its knowledge capital (the number of varieties in its portfolio), and homogeneous of degree one in R&D investment and knowledge capital. Innovations come in the form of quality improvements, allowing the most recent innovator to capture the market for a particular good. R&D success grants a firm a random draw as to which market it now dominates at the expense of the previous incumbent. This assumption results in firms never improving on their own good, which repeats, but in a different manner, an unattractive feature of the creative destruction models. In these models incumbents conduct no research towards improving their own products. Apart from being analytically tractable, the general equilibrium model has the key elements found in the existing models of firm and industry dynamics: heterogeneous firms, simultaneous entry and exit, optimal investments in innovation, explicit individual firm dynamics with stochastic elements, and a steady-state firm size distribution. It also matches a number of firm-level and industry-level empirical findings. However, the model assumes a continuum of firms and a constant unit measure of goods, leaving no room for aggregate growth of varieties. Aggregate uncertainty is ruled out as well, as in Hopenhayn (1992) and in contrast to Ericson and Pakes (1995). Perhaps most importantly, no strategic investment behaviour is allowed between competing firms.

Thompson (2001), in a similar structure to that of Peretto's (1999) but with stochastic elements, allows for replacement of existing monopolies with firms drawing random productivity levels, but the extent of within industry competition remains limited to creative destruction in the presence of horizontal product differentiation. Firms choose optimal R&D effort to increase productivity. Improvements in quality take place at random intervals with an intensity increasing in R&D expenditure. The size of the quality increment, however, is a random variable independent of R&D investment. The model generates a stationary stochastic equilibrium in which firm size fluctuates stochastically, but which converges to a stationary distribution. As Thompson notes in his concern for matching the underlying model with observed empirical regularities, the model predicts that R&D intensity is independent of firm size and it can generate firm size variation that matches the data. However, entry and exit are essentially random and the hazard rate of exit is independent of firm age and size, contradicting key empirical regularities from industry studies.

Baldwin and Robert-Nicoud (2008) study the growth effects of greater openness by embedding a heterogeneous-firms trade model (in Hopenhayn-Melitz variety generation/selection set-up) in a series of product-innovation endogenous growth models. Its main finding is that freer trade has an ambiguous impact on growth, in contrasts to most findings in the homogeneous-firms endogenous growth literature where positive effects are the standard result.

As already explained above, the empirical studies of industry dynamics based on firm-level data uncovered a remarkable degree of heterogeneity among firms in the same industry in both levels and growth rates over time. Most notable manifestations of this variability include simultaneous entry and exit, heterogeneity in firm productivity and size, and strategic interactions and considerations between the firms in their R&D investment decisions. To capture these findings, Ericson and Pakes (1995) develop a general model of industry dynamics based upon a stochastic model of the entry and growth of firms through the active exploration of their economic environment. A firm invests to enhance its capability to earn profits in an environment characterized by substantial competitive pressure from both within and outside the industry. The stochastic outcome of a firm's investment, the success of other firms in the industry, and competitive pressure from outside the industry (both in the market and through entry) determine the "success" of the firm, i.e. its profitability and value. Deterioration in the profitability of the firm can lead to a situation in which it is optimal to abandon the whole undertaking. This endogenizes exit behaviour, and provides a natural way of accounting for selection in the process of determining the evolution of the industry. The model also shows that there exists a Markov-perfect Nash equilibrium in the investment, entry, and exit decisions of each firm. This means that as firms maximize their present discounted value given expectations about the evolution of their competition, at equilibrium those expectations are fully consistent with the process generated by the optimal decisions of all firms within or entering the industry. Thus, they prove the existence of a rational expectations equilibrium with a finite number of heterogeneous agents subject to idiosyncratic shocks and with entry and exit occurring simultaneously and unabatedly. In addition, under certain general assumptions, the equilibrium process generating industry structures is proved to be ergodic, meaning that the structure of the industry, while shifting randomly in response to the idiosyncratic outcomes of optimal decisions by firms, will spend more time near "natural" states, with a "natural" number of incumbents, entrants and exits as time passes. The model is general enough to be applied in many specific models of competition and important dynamic phenomena.[49]

Ericson and Pakes (1995) model represents an important cornerstone for micro-based growth theory as it allows for strategic interactions between the firms competing head-to-head in the same market with regard to their R&D investment decisions. In addition, it also allows for endogenous entry and exit process of firms. The cost of this sophistication is that the model is analytically difficult to handle and the only way to analyze it is through simulations, while all the previous models were analytically tractable. A number of papers emerged that tried to avert the curse of dimensionality in calculating and simulating industry equilibrium with many firms (e.g. Pakes & McGuire, 1994, 2001; Judd, 1998; and Doraszelski & Satterthwaite, 2004). Weintraub, Benkard and Van Roy (2008) also propose a new approximation method for simulating Ericson-Pakes-type dynamic models of imperfect competition with many firms and their contribution has important implications for my theoretical model. They build their work upon Ericson and Pakes (1995) model, but focus on its major shortcoming: computational complexity and intensity.[50] Instead of using the industry state vector (a vector representing the number of firms with each possible value of the firm state variable) as the information about the industry condition, a typical firm can make a near optimal decision knowing only its own firm state and the long run average industry state. They name such strategy the “oblivious strategy”, and the corresponding equilibrium the “oblivious equilibrium”. The computational burden is immensely decreased as the computing algorithms now require memory that scales only with the number of firm states and not with the number of firms.

[49] The Ericson and Pakes (1995) model served as a building block in a number of studies, for example in Berry and Pakes (1993), Gowrisankaran and Town (1997), Gowrisankaran (1999), Fershtman and Pakes (2000), Judd and Schmedders (2002), Langohr (2003), Benkard (2004), Besanko and Doraszelski (2004), Doraszelski and Markovich (2004), Jenkins, Liu, Matzkin, and McFadden (2004), de Roos (2004), Goettler, Parlour, and Rajan (2005), Song (2006), and Besanko, Doraszelski, Kryukov, and Satterthwaite (2007); see also Pakes (2000) for a survey.

[50] They illustrate the intensity of computation with the following example. We would need more than 20 million gigabytes of computer memory to store the policy function for an industry with just 20 firms and 40 firm states (Weintraub, Benkard & Van Roy, 2008, p. 1375).

The model setting is close in spirit to that of Ericson and Pakes (1995). In each period, each incumbent firm observes its scrap value and decides whether to exit or continue operations. In the latter case, it determines the optimal investment expenditures to improve its quality level in the next period, based upon the observation of its own productivity and the state of the industry. Entry is allowed and after the number of entering firms is determined, each entrant pays fixed entry cost. Every period incumbent firms compete on the spot market and earn profits, while exiting firms receive their sell-off values and exit the industry. At the end of the period, investment outcomes are determined, new entrants enter and the industry takes on a new state. The results of numerical simulations show that the most important parameter that affects the approximation error bounds is the product quality parameter in the demand function. If the degree of product differentiation is small, the Markov perfect equilibria strategies are less sensitive to the industry state and the invariant distribution of industry state is very light-tailed. In this case, oblivious strategies are efficient as the approximation error bound is small. The latter also decreases if the market size and hence the expected number of firms increases. When compared to Markov perfect equilibrium, oblivious equilibrium strategy closely approximates the long-run industry variables, such as average investment, average producer surplus, average consumer surplus, average share of the largest firm, and average share of the largest two firms. Again, the approximations are better at parameter values that yield more symmetric distribution of firms and richer investment behaviour. Unlike Sutton (1991), different market structures here result from the same model after making arbitrarily small changes in a single parameter. However, similar results on the relationship between returns to investment and industry structure emerge in both frameworks: industries with higher returns on investment tend to be more concentrated.

Naghavi and Ottaviano (2006a, b and 2007) are to my knowledge the only papers to merge growth theory and theory of fragmentation into a common framework. In these models, however, R&D is always outsourced and thus not performed inside the consumer-good producer. In addition, offshoring is not permitted in Naghavi and Ottaviano (2006a, b) so the only production options considered are domestic in-house production and domestic outsourcing. In contrast, Naghavi and Ottaviano (2007) allow only arms-length variety of offshoring in addition to domestic vertically integrated production of intermediate inputs. Naghavi and Ottaviano (2006a) study the organizational choice between vertical integration and outsourcing in a dynamic environment. They merge incomplete contracts model of firm organization developed by Grossman and Helpman (2002) with the model of growth under horizontal product differentiation by Grossman and Helpman (1991a). The mode consists of two sectors: production and innovation (R&D). Innovation is performed by perfectly competitive research labs that can produce blueprints for vertically integrated production and fragmented one. The latter requires two blueprints: one for an intermediate input and the other for final assembly. Fragmented production is cheaper in terms of both fixed and marginal costs due to lower R&D costs and productivity gains from specialization, but it is associated with larger transaction costs due to incomplete contracts and search frictions between the intermediate supplier and the assembler. The relationship between the incentives to outsource and the bargaining power of intermediate suppliers follows the same inverted-U shape as in Grossman and Helpman (2002). Namely, outsourcing is preferred production mode in an industry equilibrium only if supplier bargaining power is neither too weak nor too strong. In the outsourcing mode, product development is maximized when supplier bargaining power does not take extreme values. The weakness of the model in terms of compliance with the observed industry regularities is that it produces symmetrical equilibrium with homogeneous firms and only a single, most profitable production mode present industry-wide.

In an extension to the above model, Naghavi and Ottaviano (2006b) study a tension between the static and dynamic implications of outsourcing due to the fact that firms neglect the effects of their organizational choices on innovation and growth. Depending on sectoral characteristics, the static gains from specialized production under outsourcing may at times be associated with relevant dynamic losses for consumers. In particular, it is shown that in sectors in which the R&D costs of intermediate blueprints are large with respect to the R&D cost of final blueprints, outsourcing is likely to be welfare improving if the bargaining weight of intermediate suppliers is also large with respect to the bargaining weight of final assemblers. This is in spirit of the property rights theory of the firm that asserts that higher control should be given to the relatively more important party. These results are amplified in industries with higher degree of product differentiation.

Naghavi and Ottaviano (2007) build an endogeneous growth model with heterogeneous firms that decide whether to produce intermediate inputs arms-length in a low-wage South or in-house in the North. In equilibrium, more productive firms vertically integrate input production at home whereas less productive firms engage in offshore outsourcing relationships, governed by incomplete contracts. Next, they study the effect of improvement in the prospects for offshoring in the South on innovation and growth. The transmission channels can be broadly categorized into direct and indirect effect, where the former comprises of a scale and revenue effect and the latter of a composition effect and productivity effect. An improved institutional environment (stronger upstream bargaining power of input suppliers) reduces the hold-up problem and hence increases the size of upstream plants in the South, absorbing labour from R&D sector (scale effect). As the bargaining power increases, joint profits of offshorers decrease, leading to lower incentives for the creation of new blueprints in the R&D sector (revenue effect). Improved institutions on the other hand lead to higher fraction of offshoring firms, which are smaller compared to vertically integrated firms due to incomplete contracts. The changed composition of firms leads to economy-wide upstream underproduction and releases labour to R&D (composition effect). Lastly, a lower offshoring threshold increases the average productivity of the remaining vertically integrated firms. Again, this promotes growth as more labour is released to engage in R&D in the innovation sector (productivity effect). An interesting result of the model is that positive effect of the indirect effect dominates over the negative effect of the direct effect at lower levels of institutional quality in the South but as contracts become more complete the direct negative effect starts to dominate.

The review of the growth theory highlighted a remarkable development of one of the most exciting fields of economic research. Five decades ago, Robert Solow published the first of two papers on economic growth that eventually won him the Nobel prize. He showed that accumulation of production factors alone cannot yield long lasting progress and attributed the key source of growth to technological progress. But in neither paper did he explain where it came from or how it could be accelerated. Invention, innovation and ingenuity were all exogenous influences, lying outside the scope of his theory. Solow's model was thus an impossible tease (Economist (2006a, p. 80): "what it illuminated did not ultimately matter; and what really mattered, it did little to illuminate." Starting in the second half of the 1980's, a series of contributions emerged by Romer, Lucas, Aghion, Howitt, Grossman, Helpman, and others, that tried to make technology endogenous, to explain it within the terms of the model. The structural shift in modelling aggregate growth and its determinants entailed the assumption of non-rivalry of ideas, increasing returns in production of new ideas, and some form of monopoly power to cover the cost of inventing new knowledge. The theorists writing the first-generation R&D-based growth models chose the simplest microeconomic structures capable of yielding the aggregate insights they were after. The next generation of models tried to break free from the unrealistic industry structures that constituted the first generation of endogenous growth models by introducing product differentiation and firm heterogeneity. The most complex, yet analytically intractable models of firm growth and industry dynamics added to these also the oligopolistic nature of underlying industry setting and strategic interactions of firm R&D investments. This branch of research now works hand in hand with numerical analysis theory and their collaborative effort is yet another example of the virtues of combining different scientific disciplines in a common endeavour.

3.4 Review of empirical literature

International fragmentation of production, especially offshore outsourcing of services, received a great deal of attention in public media. Strong media interest notwithstanding, there is little empirical evidence on its economic impact. Because the debate has mainly been focused on job relocation aspect of offshoring, most of the existing research on the subject is primarily centred on labour market issues. There are numerous studies that assess the number of jobs to be moved to low-cost locations (e.g. Kirkegaard, 2004, 2005), the impact on the wages of different skill groups (e.g. Geishecker, 2006; Orberg Jensen et al., 2006), employment effect of international sourcing (e.g. Harrison & McMillan, 2006; Head & Ries, 2002), and changes in the price elasticity of labour demand as a consequence of enhanced internationalization of value chains (e.g. Paul & Siegel, 2001). The impact on productivity at firm-level, however, has received only little attention. Like other sudden socio-economic developments, such as globalization and technological change, offshoring has initially been approached from a statist mentality, revivifying protectionism and collectivist values and sentiments. In my opinion, the phenomenon undoubtedly provides long-term aggregate economic benefits and sooner or later these gains will emerge in the form of increased living standards through positive productivity effects, faster technological progress, and reductions in factor costs. In this light, it is very important to focus debate and empirical research on the effects of offshoring on productivity and firm performance – the goal of the present study.

3.4.1 Empirical findings at the industry level

One of the first studies to examine the link between offshoring and productivity at the industry level is Siegel and Griliches (1992). They examine whether post-1979 improvement in measured productivity growth in manufacturing industries can be attributed to an increase in the rate of foreign and domestic outsourcing of services. Their evidence suggests only a weak link between total factor productivity (TFP) growth and outsourcing of services. They do find, however, positive and significant relationship between TFP acceleration and an industry's rate of investment in computers. The findings of ten Raa and Wolff (2001) partly replicate these results on a longer time period. They observe that service inputs into manufacturing industries have increased in importance over time alongside considerable productivity improvements, while it remains unclear whether the TFP growth recovery over 1977-1987 stem from outsourcing or a general substitution of service activities in general for material inputs. Their results suggest that domestic outsourcing explains about 20% of productivity growth, but do not consider the effects of international outsourcing.

Much of the developed countries' expansion in the 1990s can be attributed to large IT investments facilitated by falling hardware prices, and reorientation of business activities and processes to use both information and technology effectively. According to Mann (2003), globalized production of ICT hardware was key to higher productivity growth, faster income growth, lower inflation, and more employment. She argues that although technological change is the most important driver of IT price declines, global production networks and international trade made ICT hardware some 10 to 30 percent less expensive than it otherwise would have been in the period 1995-2002. These lower prices translated into 0.3 percentage points higher productivity growth that would otherwise have turned out, if globalized production of IT hardware had not occurred. In monetary terms, this amounts to accumulated \$230 billion in additional GDP during the same period. Past investments in ICT hardware spurred the demand for ICT services and ICT-related skills among the labour force. As a consequence, strong supportive industries have emerged and followed the path of globally integrated production. Mann (2003) argues that falling prices of ICT services that stem from global fragmentation will foster further productivity increases as the internet and communication technologies diffuse further throughout the US economy.

In a series of papers, McKinsey Global Institute (MGI) (2003b, 2004, 2005) estimate that savings incurred by offshoring customer services to India are substantial: through the wage-saving and taking additional telecom and management cost into account, there is at least 45-55% saving in the cost base. Direct cost reductions can further be accompanied by potential savings due to reengineering the process design, economies of scale and consolidation to 65-70% of initial costs (MGI, 2003b, p. 5). The report points out that offshoring enables many firms to create more value added from increasing revenues and opportunities rather than from sheer cost reductions.

Next, MGI (2003b) calculate potential value to the U.S. and supply country as a whole from \$1 spent offshored to India. In the U.S., savings accrued to domestic investors and/or customers amount to \$0.58, imports of U.S. goods and services by providers in India and transfer of profits by U.S. providers to parent companies bring \$0.09, and further benefits of \$0.45-0.47 arise from re-employment of workers whose jobs were lost due to offshoring. In total, offshoring is believed to create net additional value for the U.S. economy in amount of 12-14 cents on every dollar offshored. The estimate for India, the host country, is \$0.33 per corporate dollar invested in offshoring. Of the full 1.45-1.47 dollars of value created globally from offshoring \$1 of U.S. labour cost, the U.S. captures \$1.12-1.14, while the host country captures on average only 33 cents (MGI, 2003b, p. 12). MGI (2004) and MGI (2005) apply the same analysis to Germany and France, respectively. In Germany, it is estimated that aggregate economic benefits are only \$0.80 per corporate dollar spent on offshoring, while in France the corresponding figure is slightly higher at \$0.86. Negative net benefits to the economies in question appear because of lower direct cost savings stemming from the fact that the majority of offshoring deals goes to Eastern Europe where wages are much higher than in India. Furthermore, rigidities in domestic labour markets inhibit job relocation and constrain the benevolent restructuring towards higher valued activities. Despite the mentioned cost and labour market disadvantages German companies save on average 0.48€ for every euro spent on offshoring (Farrell, 2005, p. 677).

Studies by Mann (2003) and McKinsey Global Institute (2003, 2004, 2005) are useful for getting a broader picture on the issue of cross-border sourcing, but have many methodological weaknesses. MGI's estimates of net returns of offshoring crucially depend on the assumption of labour reallocation. Even for labour market as flexible as the one in the U.S., re-employment assumptions can be questionable at least in the short run.[51] Bivens (2005) highlighted some further concerns regarding the MGI estimates. First, there could be a potential bias due to self-selection of better firms into international fragmentation of production, which makes the estimates based on these companies open to serious errors. Second, offshoring could increase foreign productivity in industries in which offshoring countries are net exporters, which could eventually result in a loss of income through negative

[51] Indeed, job replacement in the U.S. is much higher than in the continental Europe, but even in the U.S. a vast majority of re-employed people are working for less than their former wage (e.g. Kletzer, 2004). Nevertheless, short-term costs should not overshadow the ability of an economy to realign over a long-term period. Namely, some workers decide to reeducate, some find jobs in an emerging industries, and eventually structural changes take place in the economy, creating better jobs in newborn sectors and business activities.

terms of trade effect.[52] Mann's (2003) study, on the other hand, assumes too large effects of increased software investments on the economy compared to hardware investments and applies parameters from the hardware industry on the offshoring of IT services (Bivens, 2005). In an attempt to reestimate the productivity impact originating from 20% reduction of IT hardware prices, Bivens (2005) discovers that in order to attain Mann's estimate of 0.3 percentage points in the yearly contribution to productivity growth from outsourcing requires a capital share of IT hardware in the US economy about five times greater than the generally accepted estimates.

Methodologically more demanding analysis of offshore outsourcing and its impact on the productivity is presented by Egger and Egger (2006). They estimated a nested CES primary production function for 12 EU countries and 21 NACE 2-digit industries over the period 1992-1997 using Feenstra and Hanson (1999) narrow measure of outsourcing. In the short-run, the results suggest outsourcing exerts a significant negative marginal effect on real value added per low-skilled worker (i.e. a one percentage increase in the outsourcing intensity would lead to a 0.18% decrease in labour productivity). In contrast, long-run parameter estimates reveal a positive impact of international outsourcing on real value-added per low-skilled worker in magnitude of 0.53%. The evidence also suggest that international outsourcing augments physical capital and high-skilled labour (relative to low-skilled labour) to approximately the same extent in the short run as well as the long run.

Egger, Pfaffermayr and Wolfmayr-Schnitzer (2001) present a single-country study of productivity effect of outsourcing on productivity. They analyze 18 2-digit NACE manufacturing industries in Austria over the period 1990-1998. Being a small and open country close to four EU accession countries makes Austria a prime example of cross-border fragmentation. Its outsourcing to the East grew at an average 10.7% per annum over the period so that in 1998 it accounted for 12% of total intermediate imports. They use a measure of offshoring similar to the narrow measure employed by Feenstra and Hanson (1999) and examine its impact on the change in TFP, measured as a Tornqvist index. The results suggest that outsourcing to the East significantly improved domestic growth in total factor productivity and that this effect is more pronounced in capital-intensive industries relative to low-skilled industries. On average, 0.2 percentage points of the 0.9% average increase in Austrian TFP can be attributed to international outsourcing. In contrast, the effect of offshoring to OECD countries on productivity growth turned out to be significantly negative, but the authors do not discuss this result.

Amiti and Wei (2006) analyze the effects of service and material offshoring on productivity in 96 2-digit manufacturing industries in the U.S. between 1992 and 2000. In contrast to Egger

[52] This argument has been elaborated by Samuelson (2004) where he stated that it is possible that a productivity gain in one country can benefit that country alone, while permanently hurting the other country by reducing the gains from trade that are possible between the two countries. The proposition was later fully downplayed by Panagariya (2004) and Bhagwati, Panagariya and Srinivasan (2004) on the basis of irrelevance and empirical impossibility, respectively.

and Egger (2006), they study the general labour productivity instead of the productivity of the low-skilled and focus on productivity growth instead of levels. The measure of outsourcing is similar to the broad measure of Feenstra and Hanson (1999). The authors find that offshoring has a positive effect on productivity: service offshoring accounts for around 10% of labour productivity growth over this period, while material offshoring contributes 5% to labour productivity. One explanation for smaller productivity effects of material offshoring compared to services offshoring might be in decreasing returns to scale. Since material offshoring has been in practice for many decades and is at higher levels than services offshoring, many of the productivity benefits from material offshoring might have been already exhausted (Amiti & Wei, 2006, p. 13). Real life evidence suggests that the most successful firms act as leaders of global value networks, providing planning, marketing, and R&D services while integrating components from outside sources. Thus, the service content of manufacturing is likely to increase further. This creates productivity improvement opportunities, additional revenues, and valuable long lasting relationships with customers. Moreover, intellectual capital and intangibles are likely to become ever more important. This will probably lead to more complex organisational approaches, with a high degree of collaboration and networking with suppliers, customers, competitors and an increased use of external sources of knowledge, such as research institutions and universities (European Commission, 2007).

3.4.2 Empirical findings at the firm level

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 offshoring, 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 has only recently begun to increase, yet the existing evidence is 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, which is the primary interest of present doctoral dissertation. Görzig and Stephan (2002) address the impact of outsourcing on gross operating surplus per employee and per total sales (the two distinct performance measures used in the empirical analysis) based on a representative panel data set of about 43.000 German manufacturing firms over the period 1992 to 2000. They employ three different measures for outsourcing activities of firms. The first is intermediate material inputs relative to internal labour costs, the second type is external contract work, and the third is external services. The general result is that in the long run (between-firm specification), all three types of outsourcing activities have positive impact on return per employee, the measure of firm efficiency. On the other hand, the long-run effect of outsourcing on return per sales, the measure of profit margins, is negative. In the short-run (within-firm specification), all but services outsourcing have a positive impact on return per employee, whereas only material outsourcing appears to affect return per sales positively in the short run. They conclude that material outsourcing has on average had beneficial effects on firm efficiency but that the level of services outsourcing and subcontracting that firms have engaged in is above the optimal level.

Girma and Görg (2004) examine the plant-level data including a sample of predominately larger establishments with more than 100 employees in the chemical, electronic, and mechanical and instrument engineering industries over the period 1980-1992, to address the link between outsourcing and firm productivity. Outsourcing in their analysis is defined narrowly as the processing of inputs that are then sent back to the plant for final assembly or sales, maintenance of production machinery, engineering, and drafting services. However, they do not distinguish between domestic and foreign outsourcing. For the productivity measure they use labour productivity and total factor productivity, derived from a simple GLS-AR(1) estimation for each of the four-digit industries in the sample separately. First, the authors analyze a plant's decision to outsource, finding that high wages are positively related to outsourcing[53] and that foreign-owned establishments outsource more intensively in all three manufacturing sectors. In the productivity analysis, they find a positive correlation between outsourcing and labour productivity in level terms in chemicals and engineering sectors, while the first differences specifications only indicate a positive correlation within foreign-owned establishments in the engineering sector. Similarly, the level of TFP seems to respond to changes in the outsourcing intensity again in the chemical and engineering sectors, while the TFP growth appears to be correlated with outsourcing only in the engineering sector, particularly in foreign plats.

Görg, Hanley and Strobl (2008) use plant level data for the electronics industry in Ireland to examine the effect of international outsourcing of intermediate inputs on labour productivity. This is the first paper to use plant-level data to investigate the impact of international outsourcing on plant level productivity. They distinguish between material and services outsourcing and between plants operating in upstream and downstream sectors. In the pooled

[53] The authors conclude that positive correlation between wages and outsourcing level »concurs with the hypothesis that high-wage establishments are more prone to outsource in order to reduce costs«, but fail to consider endogeneity problem implicit in this conclusion (Girma & Görg, 2004, p. 823). Namely, firms with better technology, skills, and managerial knowledge tend to pay higher than average wages and at the same time be the ones that utilize outsourcing more intensively. This consideration is further strengthened by their result that wages of skilled workforce effect the outsourcing intensity significantly more than wages of the unskilled.

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. They do not find any evidence of international outsourcing of material inputs in neither of the sub-groups of electronics industry. The point estimates for services outsourcing in the downstream sectors suggest that an increase in the outsourcing intensity by one percentage point will raise labour productivity in the average plant by 0.99 and 0.55 percentage points for levels and growth rates, respectively.

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. They estimate a simple Cobb-Douglas production function and include outsourcing intensity variable as a "shift parameter" in this production function. In order to capture the idea that exporters are found to be more productive that non-exporters, they also include a dummy variable indicating whether a firm exports more intensively than the median firm or not. In contrast to results in Görg, Hanley and Strobl (2008), they 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. In contrast to low export-intensity plants, the results for high export-intensive group show no statistically significant evidence for any productivity effects of international outsourcing, even when it is split on material and services. In the low-intensity group, again only material outsourcing appears to be significantly correlated with firm productivity levels.

Another study closely related to the above two is Görg and Hanley (2004), where causality between outsourcing and profitability was discussed.[54] Unfortunately, they did not distinguish between domestic and international outsourcing, but nevertheless found evidence that causality goes from outsourcing to profitability. They split the sample into small and large plants and find that plants that are substantially larger than the mean employment size benefit from outsourcing materials and services inputs, while this does not appear to be the case for small plants. The results for services outsourcing are less clear-cut, however.

[54] Profitability is calculated here like in Görzig and Stephan (2002) as the ratio of net profits (i.e., total sales – total costs) over total output. It can be a better measure than labour productivity, as noted in Grossman and Helpman (2002). Namely, higher wages, while inducing higher efficiency (value added per worker) can lower overall profitability, because the net effect of higher wages can increase the cost of labour inputs to an extent that diminishes overall profitability (Görzig & Stephan, 2002 p. 5). In this regard, TFP is even a better measure of productivity since it accounts for capital contribution in addition to labour and therefore represents net economic surplus. For example, it can happen that a firm increased profitability by scaling down its production and reducing material and labour costs even intensively but failed to adjust fixed assets correspondingly, creating a downward drag on net surplus (TFP). Similar result would appear in the other direction if a firm overinvested.

Görg, Hanley and Strobl (2004) conduct a study very similar to Görg, Hanley and Strobl (2008) 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. The hypothesis states that foreign-owned establishments and exporters are expected to benefit from outsourcing more likely than domestic firms because they can be expected to face lower search costs as they are embedded into international production networks with more foreign contacts than purely domestic firms (as argued also in Sjöholm, 2003). The measure of outsourcing intensity differs slightly from the one used in Görg, Hanley and Strobl (2008) in that it is defined as the ratio of imported materials (or services) over total wage bill. The measure of productivity, though, remained labour productivity (output per employee). GMM estimation according to Arellano and Bond (1991) provides 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. Point estimates suggest that an increase in the outsourcing intensity by one percentage point leads to a 1.2 percent increase in productivity at the level of the plant. Splitting the sample further according to ownership status revealed that international outsourcing of materials exhibits productivity enhancing effects for domestic and foreign exporters, with a coefficient of similar magnitude, while there are no such effects of materials outsourcing for non-exporters.

Criscuolo and Leaver (2006) focus on international outsourcing of services and study its impact on firm productivity in manufacturing and services sectors. Three different data sources provide the information on about 37,000 UK firms from 2000 to 2003. They are able to distinguish between domestic and foreign ownership, whether a firm is a part of a MNC network, whether and how much it exports services, and what types of services and from which country it imports. Offshoring intensity is measured as the value of imported services over the total services purchased by the firm, but the authors use also the definition of Görg, Hanley and Strobl (2004) for the robustness check. They estimate an extended version of production function, expressing variables in per employee terms and – following Klette (1999) – in terms of logarithmic deviations from the 4-digit industry-year mean firm's values. They also control for offshoring, ownership, multinationality, exporting, age, industry, region, and time.

Descriptive evidence in Criscuolo and Leaver (2006) 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 & Yeaple, 2004; Antras & 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. The results for the firms in the services sector reveal an even higher figure 0.68%. When distinguishing among different dimensions of global engagement, the offshoring coefficient is larger for domestic, for non-multinational, and for non-exporting firms. Finally, the authors exploit detailed information on the type of services traded (ICT and R&D services) and the partner countries firms trade with. However, they do not find any robust evidence of the offshoring-productivity association being driven by a particular type of service or partner country.

Calabrese and Erbetta (2005) employ static and dynamic ANOVA analysis on the sample of 465 Italian plants in the automotive suppliers sector over the period 1998-2001. Fragmentation activities have been measured using three variables, all expressed relative to total operative expenditures. The first variable relates to materials outsourcing, the second to services outsourcing and the third is an integration variable, that is, cost of personnel, depreciation and amortization. Unfortunately, no distinction is made between domestic and international outsourcing. Different outsourcing strategies have been compared on the basis of the following indicators: growth rate of sales and fixed assets, labour productivity, inventory ratio, debt ratio, return on investment, return on sales, and turnover on capital. The analysis has been carried out by splitting the observations into quartiles corresponding to different levels of integration (static approach). Furthermore, the sample has been divided into firms that followed a vertical integration or fragmentation process over time (dynamic approach), both in terms of materials and services. Outsourcing turns out to be a key condition for growth in the automotive sector since deverticalized firms show higher growth rates than their integrated counterparts both in terms of sales and tangible and intangible fixed assets. The labour productivity index was always in decline throughout the sector. The worst performance relates to the case where no strategy was pursued, whereas the outsourcing/insourcing alternative strategies lessened the decrease significantly, through the industrial reorganization that they brought about.

Lui and Tung (2004) examine causality of labour productivity and export outsourcing in 1,336 export manufacturing firms in Chinese Taipei in 2001. Whereas all previously mentioned empirical papers study import outsourcing, the authors here consider export outsourcing, that is, when a firm receives export orders and subcontracts part of the order to foreign countries. Productivity is defined as the sales per employee and is expressed relative to the industry average. Results of the descriptive statistics reveal that export-outsourcing firms are more productive than non-outsourcing firms, while firms with outward FDI may be les or similarly productive than domestic firms. In the regression analysis, export outsourcing is found to have a positive and significant impact on both levels and growth of labour productivity. Causality is backed up by linking the decision to outsource to lagged labour productivity. Highly productive firms in the previous year are more likely to choose export outsourcing in a current year, and when they do, their productivity is further improved.

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. The base hypothesis that learning from imports will occur among local suppliers upstream of industries that rely more on imports is tested by estimating translog production function controlling for static plant-level unobservables by using fixed effects estimation. Estimation equation is augmented with the constructed index measuring the extent of imports in industry's downstream sectors according to coefficients from the national input-output tables and the value of material imports at the industry level. Unlike Amiti and Konings (2007), 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%. The results are robust to inclusion of downstream FDI variable (capturing the degree of foreign direct investment in downstream sectors), own-sector import variable, a squared term on downstream imports (testing the idea that positive impact on productivity may have a declining marginal effect), and the interaction of the industry Herfindahl concentration index and downstream imports variable (to control for the possibility that downstream imports would have a greater effect on less competitive domestic industries). Finally, learning from downstream imports is more pronounced in larger firms and firms in intermediate goods sectors as opposed to final goods sectors.

A study by Van Biesebroeck (2008) 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. In Colombia, import status is not associated with significant growth effect, probably because the sector studied, textiles, enable little scope for technological advances to be embedded in imported input. For Zimbabwe, the results suggest that importing inputs tends to be associated with higher productivity growth. As is the case in the rest of the empirical studies, we should bear in mind that these results are merely correlations, bundling together the effect of self-selection into importing status and possible causal shifts of firm productivity.

Keller and Yeaple (2005) estimate international technology spillovers to US manufacturing firms via imports and FDI in the period 1987-1996. The measure of productivity is total factor productivity calculated by Olley and Pakes (1996) method, while the degree of foreign activity through imports is measured by the share of US imports in imports plus total shipments of the industry to which a firm belongs. Consequently, they do not control for heterogeneity across firms with regard to value of imports and the imports involved are imports of the same product category and thus not necessarily in any relation to what firms in the same industry use as inputs.[55] In contrast to positive and strong evidence on FDI-related spillovers, they find weak association between imports and productivity growth.

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 (Griliches and Mairesse (1990) approximation with fixed capital share, simple OLS production function estimation, and extended Olley and Pakes (1996) algorithm (EOP))[56], 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. Foreign intermediates are found significantly more productive only in one out of 27 sectors under EOP algorithm, in 11 under OLS, and in 8 sectors under fixed effect estimation (FE). Negative estimates in some of the significant results under OLS and FE estimation are interpreted as evidence that the average firm in a given sector fails to adjust its production process accordingly and cannot exploit immediately the potential benefits of high quality equipment or intermediate inputs. Moreover, higher quality or efficiency of foreign inputs likely shows up in higher price so that firms need to use them more efficiently in order to avoid productivity loss.

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. Correcting the selection bias by propensity score matching, the author finds that firms cite more foreign patents after beginning to import. Firms that began importing experience an increase of 0.027 citations to patents from the country of origin relative to non-importing firms over the same period. Although seemingly small increase, this represents an increase in citations of 42% relative to non-importers. In

[55] In fact, their aim is to find evidence for higher productivity of domestic firms in industries where there is more foreign activity in terms of FDI and imports, while the exact mechanism of spillovers is left unspecified.
[56] An interesting finding is that while the three methods yield different coefficients and hence productivity levels, resulting productivity estimates exhibit largely the same covariation with other variables. This fact is demonstrated also in Amiti and Konings (2007, Figure 2).

sum, importing appears to have a significant causal effect on both backward and forward citations.

Using Indonesian manufacturing data from 1991-2001, Amiti and Konings (2007) 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. They modify the Olley and Pakes (1996) approach to control for the endogeneity of import decision as in Kasahara and Rodrigue (2008) and regress the obtained TFP measures on final good tariffs and intermediate inputs tariffs at the 5-digit ISIC level, import dummy (and import share), interaction between input tariff and import dummy (and import share), and other control variables. The results are robust to many specifications and alternative productivity measures and 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.

Using firm- and plant-level U.S. manufacturing data, Kurz (2006) examines whether organizations can be assorted into offshorers and non-offshorers on the basis of their productivity levels and whether outsourcers exhibit higher rates of productivity growth than non- offshoring counterparts. The results show that offshoring 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. They 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 offshoring organizational form. An increase of productivity by one standard deviation raises probability of engaging in outsourcing from 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 offshorers (from 0.53% to 1.5% per year), whereas this result does not hold at the plant level.

Halpern, Koren, Szeidl (2006) examine the effects of imports on productivity at the firm level using a panel of Hungarian exporters[57] 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 & Helpman, 1991a). To overcome the endogeneity of import decision and other simultaneity issues, they apply empirical methodology developed by Olley and Pakes (1996) and Levinsohn and Petrin (2003) to estimate extended production function. The results

[57] 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.

corroborate positive effect of imports on productivity. An increase of imported intermediates from 0 to 100 percent of total intermediate inputs increases 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.

Kasahara and Rodrigue (2008) study the effect of importing intermediate inputs has on the improvement of plant performance. They propose a novel estimation procedure through which they address the issue of simultaneous productivity shocks and decision to import inputs. This empirical specification is explained in more detail in Chapter 5.2 of this dissertation as I use it as the preferred approach to estimate production functions and calculate total factor productivity. The results demonstrate that imported intermediates improve a plant's productivity as it is found that by switching from being a non-importer to an importer of foreign intermediates a plant can immediately improve productivity. The estimates of the effect range from 12.9 to 16.1 percent, while the long term improvement of productivity is estimated to be on average 23.5 percent. They also find some evidence of a positive dynamic effect from the use of imported materials, the finding I aim to confirm and extend even further on the Slovenian manufacturing data.

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 growing 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 is summarized once again in Table 10. It 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 and only a few of them delve deeper into the workings of fragmentation-to-productivity transmission mechanism. In the following chapter, I present a simple extension of Antras (2005a) and Antras and Helpman (2004) models of international sourcing that proposes one such mechanism in which internationally acquired intermediate inputs allow for greater specialization in resource use, leading to higher firm productivity.

Table 10: Summary of the empirical evidence on offshoring and productivity

Source	Country	Industry	Period	Type of fragmentation	Productivity measure	Remarks	Productivity effects from fragmentation		
Sectoral level							M	S	SC
Siegel & Griliches (1992)	US	Manufacturing	1979-1982	Offshore	TFP growth	General	0	0	n/a
ten Raa & Wolff (2001)	US	Manufacturing	1977-1987	Any	TFP growth	General	n/a	+	n/a
Egger & Egger (2006)	EU12	Manufacturing	1992-1997	Offshore	Low-skill labour level	Short-run effect	-	n/a	n/a
						Long-run effect	+	n/a	n/a
Amiti & Wei (2006)	US	Manufacturing	1992-2000	Offshore	Labour growth	General	+	++	n/a
					TFP growth	General	+	++	n/a
Egger et al. (2001)	Austria	Manufacturing	1990-1998	Offshore	TFP growth	General	+	n/a	n/a
Plant level							M	S	SC
Görzig & Stephan (2002)	Germany	Manufacturing	1992-2000	Any	Return per employee	Short-run effect	++	-	+
						Long-run effect	++	+	+
Görg, Hanley & Strobl (2008)	Ireland	Manufacturing	1990-1998	Offshore	Labour growth	Electronics sector	0	0	n/a
					Labour level		0	0	n/a
					Labour level and growth	Upstream firms	0	0	n/a
						Downstream firms	0	+	n/a
							M	S	MS
Görg & Hanley (2005)	Ireland	Manufacturing & services	1990-1995	Offshore	TFP level	Electronics sector	n/a	n/a	+
							+	0	n/a
Görg, Hanley & Strobl (2004)	Ireland	Manufacturing	1990-1998	Offshore	Labour level	General	+	0	n/a
						Exporting firms	+	0	n/a
						Domestic firms	0	0	n/a
Criscuolo and Leaver (2005)	UK	Manufacturing & services	2000-2003	Offshore	TFP level	General	n/a	+	n/a
						Manufacturing	n/a	0	n/a
						Services	n/a	+	n/a
						Domestic	n/a	+	n/a
						Foreign	n/a	0	n/a
						MNEs	n/a	0	n/a
						Non-MNEs	n/a	+	n/a
						Exporters	n/a	0	n/a
						Non-exporters	n/a	+	n/a
Calabrese and Erbetta (2005)	Italy	Manufacturing (car parts suppliers)	1998-2001	Any	Labour growth	Outsourcing	+	+	n/a
						Insourcing	+	+	n/a
							M		
Van Biesebroeck (2005)	Colombia	Textile sector	1977-1991	Offshore	TFP growth	General	0		
	Zimbabwe	Manufacturing	1993-1995			General	+		
Keller and Yeaple (2005)	US	Manufacturing	1987-1996	Offshore	TFP	General	0		
Muendler (2004)	Brazil	Manufacturing	1986-1998	Offshore	TFP growth	OLS	+ in 11 of 27 ind		
						EOP	+ in 1 of 27 ind		
						FE	+ in 8 of 27 ind		
Amiti and Konings (2007)	Indonesia	Manufacturing	1991-2001	Offshore	TFP level	Input tariff ↓	++		
						Final good tariff ↓	+		
					TFP growth	Input tariff ↓	+		
						Final good tariff ↓	+		
Halpern et al. (2006)	Hungary	Manufacturing	1992-2003	Offshore	TFP level	General	+		
Kasahara and Rodrigue (2008)	Chile	Manufacturing	1979-1996	Offshore	TFP level	Disc. Import (static)	+		
						Disc. import (dynamic)	+		
						Cont. import (static)	+		
						Cont. import (dynamic)	+		
							MS	MS*FO	
Girma & Görg (2004)	UK	Manufacturing (subsectors)	1980-1992	Any	Labour/TFP level	Chemicals	+/+	+/+	
						Engineering	++/++	++/++	
						Electronics	0/0	0/0	
					Labour/TFP growth	Chemicals	0/0	0/0	
						Engineering	0/+	+/+	
						Electronics	0/0	0/0	
							Export outsourcing		
Lui and Tung (2004)	Chinese Taipei	Manufacturing	2000-2001	FDI	Labour level	General	-		
				Offshore		Export outsourcing	+		
				FDI	Labour growth	General	-		
				Offshore		Export outsourcing	+		

Notes: M=material outsourcing, S=service outsourcing, MS=material + service outsourcing, FO=foreign ownership. A + (-) indicates positive (negative) significant effect, 0 indicates insignificant effects. Double signs indicate that the effects are larger relative to single signs in the same study.

Source: own review and K. B. Olsen, Productivity Impacts of Offshoring and Outsourcing: A Review, 2006, p. 24.

4 THEORETICAL PART

Firms fragment and internationalize their production chains because the advances in technology and other external factors allow them to and because the increased global competition forces them into. They can do it because of the falling transportation costs, improved ICT, and better legal framework in host countries. Apart from technological advances and legal environment improvements, there has been an immense downward pressure on prices of numerous goods and services around the world due to excess production capacity in most industries.[58] Another fact has further spurred offshoring incentives. Increasing integration of emerging economies into the world economy has held down wages in the developing and developed countries. Because of constant supply of cheap labour and rapid pace of productivity gains, unit labour costs have been falling in China, India, and other emerging economies.[59]

On the other hand, direct and implicit competition on a global scale forces firms to review their competitive advantages and exploit comparative advantages of different sourcing markets and organizational modes. Competitive advantages shape the decision on which activities and technologies a company should focus on and which value-adding processes could be efficiently handed over to outside providers. Nevertheless, even though the push and the pull factors boil down to cost reduction as the principal reason for vertical specialization, firms decide to do it for several distinct reasons. The Outsourcing Institute (OI) runs annual surveys on their members, among other things asking them about the reasons they chose to outsource. The figure below shows the reasons new OI members outsource by declining importance.

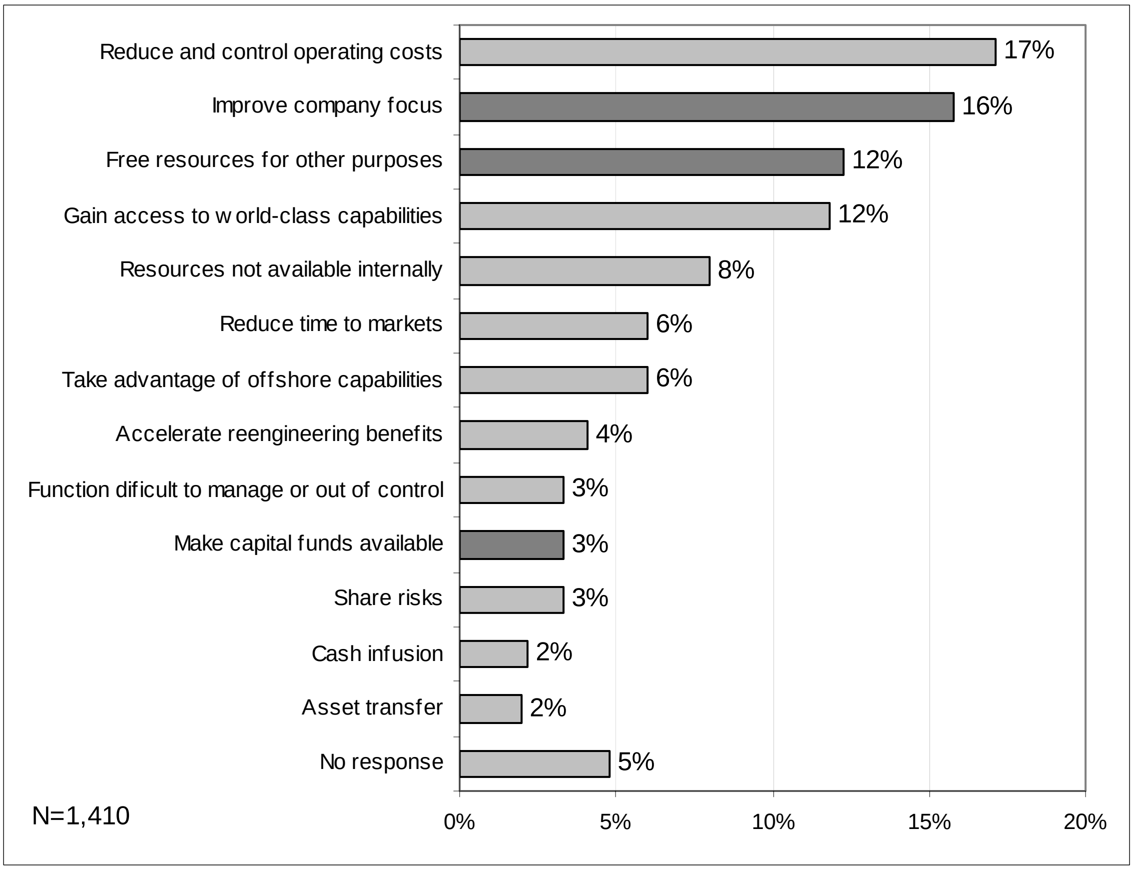
Majority of firms state the reduction and control of operating costs to be the most important reason they chose to outsource part of their production process. If the outsourcing industry were a pyramid, the broad base would still consist of traditional commodity-like cost-cutting outsourcing arrangements (Millman 2003, p. 56). In spite of being listed at the top, cost reduction however seems not to be the most important reason if we structure some similar reasons together. On the second and the third place appear 'company focus improvement' and 'untying resources for other purposes' with 16 and 12%, respectively. Adding the reason

[58] The Economist (2006c) reports that since 1996 Chinese export prices have fallen by more than 10%, US import prices from developing Asia by almost 30%, and Chinese unit labour costs in manufacturing by 60%. The reduction in prices of goods is believed to be considerably undervalued due to a shift in the mix of exports towards higher-value goods.

[59] For example, McKinsey (2003a) reports an Indian software developer costs only \$6 an hour compared to his \$60 equivalent in the U.S. Likewise, a data entry agent costs \$20 an hour in U.S. - ten times more than his counterpart in India.

'making capital funds available' with 3%, we obtain a broadly defined common denominator for all the three just mentioned reasons, that is, 'shifting the focus on core business'.[60]

Figure 15: Reasons for Outsourcing



Source: Outsourcing Institute, 8th Annual Outsourcing Index: Money Matters, 2005.

Outsourcing hence helps almost a third of all firms primarily to reposition their focus from peripheral activities toward the ones with the highest return. Every business has limited resources so it is better for firms to spend money on their own core capabilities than internalizing marginal business processes. Falling transaction costs make a larger number of non-core activities profitable for delegation to an outside vendor, be it vertically integrated or independent, and in the home country or abroad. This allows firms to improve their nucleus by devoting freed resources and managerial attention to optimizing production processes, performing R&D, improving customer relationships, and thus achieving process and product innovations. Focusing on core competence also makes firms less vulnerable in comparison to

[60] Other surveys also corroborate the alleged importance of focusing on core business as an important reason for outsourcing. The 2001 Outsourcing World Summit reports the cost reduction (36%) and focusing on core (36%) as the two most important reasons for firms deciding to offshore outsource. NEHRA's survey on outsourcing reports that the first two important reasons for outsourcing within US are that the outsourced function is not considered a core competency of the organization (42.4%) and labour costs (34.8%). Relating to offshore outsourcing the two reasons received 7.1% and 28.6%, respectively. An ongoing research by the Offshoring Research Initiative reports that 73% of offshore deals prop companies' growth strategies, with 32% of those arrangements involving product innovation and design, R&D, or engineering (Lewin (2006), p. 22).

highly diversified companies. For example, Kimura and Fujii (2003) found empirically that efficient concentration on core competences increased the probability of survival in Japanese firms, and, secondly, that global commitment helps firms be more competitive and more likely to survive.

Equally important effect of vertical specialization is the fact that production and services being offshored can be purchased at a lower price and/or at better quality. Like final-good producers, outside partners can specialize in a production of a certain input or service, achieving larger degree of specialization and sophistication, and making its production more efficient than their buyer's inhouse production. In other words, an outside provider's cost structure and economies of scale can give a final-good producer an important competitive advantage. For example, Ivo Boscarol, the founder and director of light airplanes producer Pipistrel,[61] explains in Muršič (2008, p. 16) that the most important decision in the airplane construction business is which production processes a manufacturer retains in its own production and which activities will be outsourced or purchase on market. Pipistrel decided to retain its core competencies that include: design, prototype construction, testing, incoming components quality control, outgoing final quality control and marketing. On the other hand, production of components is always outsourced to supply partners. In similar manner, Wipro's Seetharaman says that outsourcing is increasingly being used to provide companies with an edge in their respective fields: "The main benefit is the ability to be in tune with the latest processes and technologies in the industry, helping you gain competitive advantage and increase focus on core competencies." (Brooks, 2004, p. 6).

To put some flesh on the theory, let's briefly illustrate the idea with some real-life examples of using outsourcing as a tool to sharpen the focus on what a firm does uniquely well.

BOX 1: Examples of using outsourcing as a tool to focus on core competence

In 2002, American Express decided to sign a 4 billion 7-year contract, consolidating the customer service call centre operations in India. It was one of several multinational pioneers, along with Citigroup, GE, and British Airways that first committed to India as a key location for back-office support (A.T. Kearney, 2003, p. 4). Its service costs per customer fell by 20-30%, improving response time and boosting the percentage of satisfied customers by 20 points (McGovern and Quelch, 2005). Offshoring allowed the company to focus on the issuing side of the credit card business and enhance its core capabilities in marketing and risk management.

[61] Pipistrel prides itself for being one of the best producers of ultralight airplanes in the World. Its Sinus model was the absolute winner of the World Championship in 2001 and came runner-up in 2005. In 2004 Sinus was the first light aircraft to fly around the World. In 2007, NASA awarded Pipistrel's Virus airplane as the World's best aircraft. Taurus model is the World's first side-by-side ultralight powered glider whereas Apis-Bee airplane is a top performer and holds several World Records in its class (Pipistrel, 2008).

In 2001 Procter & Gamble began a pilot global sourcing program for its information technology work, particularly software development. Through the pilot, about 600-people worth of work was relocated to lower-cost P&G locations in places like Manila in the Philippines and Warsaw, Poland. Today, over 650 employees complete P&G tax returns for its global operations in the Philippines, a country that is ideally suited for such processes given its oversupply of accountants trained in U.S. accounting standards (A.T. Kearney, 2003, p. 7). "All the processing can be done here, with just final submission done to local tax authorities in the U.S. and other countries", says Arun Khanna, P&G's Manila-based Asia accounting director (Engardio, Bernstein & Kripalani, 2003). Additionally, another few hundred contractor positions were consolidated and taken offshore through outsourcing. Overall, during the first twelve months of the pilot, P&G saved an estimated $28 million dollars (Corbett 2003). In 2003, P&G signed a ten-year $400 million deal with IBM to manage P&G's employee services. As a result, IBM Business Consulting Services supports 98,000 P&G employees in nearly 80 countries, providing services that include payroll processing, benefits administration, compensation planning, expatriate and relocation services, travel and expense management, and human resources data management. P&G decided to outsource these activities in order to improve responsiveness in services, reduce HR costs, ant to focus at what it does best (Abramovsky, Griffith & Sako, 2004).

Hungary's MOL Group outsourced its finance and accounting, treasury, tax, and information technology processes in 2001 to Accenture. Apart from substantially reducing costs, outsourcing has made it possible for MOL to grow more quickly and efficiently by successfully incorporating the accounting functions of two MOL acquisitions, Slovnaft and TVK. Michel-Marc Delcommune, MOL's CFO said that outsourcing its support activities allowed company's managers to sidestep the distraction of aligning accounting systems and integrating staff during acquisitions and to stay focused on MOL's core operations and aggressive acquisition strategy (Linder, 2005). In 2002, MOL won CFO-Europe magazine's Best-Practices Award for Internal Efficiencies.

Leaving other factors aside, I will focus on cost reduction and focus shift as the main driving forces in a vertical specialization process.[62] The model will build upon the works of Antras (2005a) and Antras and Helpman (2004), taking the property rights approach to the theory of a firm. The models allow a rich variety of organizational forms, multicountry production, vertical and arms-length relationships, firm heterogeneity, incomplete contracts, and changing standardization of final-good production. In addition, I allow for endogenous firm-level innovation which will introduce dynamics in the setting. Firms will choose an optimal organizational mode, location of intermediate input production, and an optimal level of R&D resources devoted to productivity enhancement. The model will show that firm's advancement

[62] Risk reduction, for example, was implicitly incorporated in several theoretical papers in the incentive systems approach to the theory of the boundary of the firm. In Grossman and Helpman (2004) for example, independent contractors bear the up-front cost of inputs and hence the risk of unsuccessful production.

to cross-border procurement of inputs or peripheral processes boosts productivity by transferring more resources to core capabilities building.

4.1 Theoretical model of international fragmentation

Let the world consist of two countries, the North and the South, indexed by *N* and *S*, respectively. There are two types of goods, both produced only with labour: homogeneous good *Z* and horizontally differentiated industrial good *X*. Consumers have the following identical preferences:

$$U = Z + \frac{X^{\mu}}{\mu}, \qquad 0 < \mu < 1, \tag{1}$$

where *Z* is consumption of a homogeneous good and *X* is an index of consumption of the varieties of the differentiated product. The elasticity of demand for the group of differentiated products (with respect to an ideal price index) is $1/(1-\mu)$. Aggregate consumption of the industrial good is a constant elasticity of substitution function of individual varieties $x(i)$:

$$X = \left[\int_0^n x(i)^{\alpha}\, di\right]^{\frac{1}{\alpha}}, \qquad 0 < \alpha < 1, \tag{2}$$

where the measure *n* of differentiated goods will be endogenously determined. With this specification, the elasticity of substitution between any two varieties is $1/(1-\alpha)$. I assume that $\alpha > \mu$, so that the varieties substitute more closely for one another than does the group of differentiated products substitute for the numeraire good. I normalize the measure of consumers to equal one. Then the inverse demand function for each variety *i* is described by:

$$p(i) = X^{\mu-\alpha} x(i)^{\alpha-1}, \tag{3}$$

where $p(i)$ is the price of variety *i*. A firm's revenue from selling brand *i* is therefore $R(i) = X^{\mu-\alpha} x(i)^{\alpha}$.

I assume that the wage rate in the North, w^N, and the wage rate in the South, w^S, are fixed and that $w^N > w^S$. These two assumptions can be justified in general equilibrium by assuming that labour supply is large enough in both countries so that the homogeneous good is produced in both countries, and that w^l is the productivity of labour in producing *Z* in country *l*, *l=N,S*.

Production of good X requires two types of variety-specific inputs, $h(i)$ and $m(i)$. Firstly, special high-tech input $h(i)$ has to be developed in order to provide managerial, financial, marketing, and other similar headquarter services. Input $h(i)$ can also represent a set of processes that are highly proprietary and unique within or outside the industry. These are the processes with which a firm can generate measurably more value than its competitors can deliver and the company would suffer a high degree of strategic damage if rivals could imitate that capability. I assume that production of one unit of $h(i)$ demands the employment of one unit of Northern labour. The South has much higher unit cost for producing the high-tech input. I assume that the disadvantage of the South is so large that only North can provide the headquarter services.[63] Low-tech input $m(i)$ is associated with mere manufacturing or assembly of the good. Again, it can also represent a set of processes or functions that are less proprietary and more common across industries. I also assume that low-tech inputs or processes do not require physical proximity and can therefore be produced or carried out at a distance without any loss of quality. The production of one unit of this input requires one unit of labour in both countries, giving a head-start advantage of its production to the South. Either of the two inputs can be of good quality or bad quality. If any of them is bad quality, the output of the final good is zero. If both specialized inputs are of good quality, the output of i-th variety is given by:

$$x(i) = \theta_t(i)\left[\frac{h(i)}{1-z_t}\right]^{1-z_t}\left[\frac{m(i)}{z_t}\right]^{z_t}, \qquad 0 < z_t < 1, \tag{4}$$

where the $\theta_t(i)$ is firm-specific productivity parameter at time t and z_t is production parameter at time t. I allow the parameters θ and z to vary in time, but I will model their time-dependency explicitly in the following sections.[64] In general, the higher the output elasticity of the low-tech input, z_t, the less intensive the industrial sector in headquarter services.

Relating to the production inputs, there are two types of agents involved in production: headquarters division that provides managerial services and high-tech inputs, and manufacturing plant that supply the low-tech inputs. I denote them with H and M, respectively. H is always located in the North, while M can operate in the North or in the South.

---

[63] Recent business practices show that this assumption may sometimes prove to be too restrictive. Outsourcing is becoming so sophisticated that even supposedly core functions like R&D, engineering, and marketing can be moved outside firm's boundary. Nevertheless, I maintain it to avoid intractable increase in the number of possible location-ownership modes a firm can choose among.

[64] For simplicity, I assume α to be time-invariant and exogenous although it would be interesting to study the case where it was an increasing function of z, as suggested by Vernon (1966): "the price elasticity of demand for the output for individual firms is comparatively low. This follows from the high degree of product differentiation, or the existence of monopoly in the early stages. One result is, of course, that small cost differences count less in the calculations of the entrepreneur than they are likely to count later on."

A potential entrant to the industrial sector first needs to bear a fixed entry cost of f_E units of northern labour. In the next step, a firm draws a productivity level $\theta_0(i)$ from a known distribution $G(\theta)$, like in Melitz (2003) and Helpman, Melitz and Yeaple (2004). After observing the productivity level, the firm decides whether to exit or start the business. In the latter case, it has to bear additional fixed organizational costs that assure smooth production process. These costs can be shared with *M*. In fact, as will be shown later, *M* eventually bears all fixed organizational costs provided they are not too high.[65] Based on the level of wages in both countries, the level of four alternative fixed organizational costs, and the productivity level drawn, *H* chooses the optimal location and organizational form. She can search for a manufacturing agent in the North or in the South, and select either vertical integration, *V*, or outsourcing, *O*.

The additional fixed organizational costs are a function of assembly location and ownership type. I denote them by f_k^l, where $l \in \{N,S\}$ and $k \in \{V,O\}$. Namely, $f_k^l = f(\Omega)$, where $\Omega \in \{\{NV\},\{NO\},\{SV\},\{SO\},\{\varnothing\}\}$. In particular, I assume that fixed organizational costs are higher when the manufacturing phase takes place in the South, regardless of the organizational structure. In the relationship with southern agent, *H* faces higher monitoring, communication, and other costs that accrue due to physical, legal, and cultural distance between the North and the South. Žabkar and Makovec Brenčič (2004) for example document that even between two neighbouring countries such as Croatia and Serbia, sharing common history and language, differences in culture and values are notable and create different business-to-business relationships outcomes. Liu and McGoldrick (1996, p. 18) classify the range of constraints on international sourcing as either hard or soft costs, the former including transit time, political risks, trade barriers, culture, language, quality control, supervision procedures, while the latter compose of international transport costs, inland freight, insurance, tariffs, export taxes, foreign exchange costs, rejects, letters of credit, and damage in transit. All these costs contribute to higher fixed costs in operating abroad. Next, I assume that, given the location of *M*, the fixed organizational costs of a vertically integrated firm are higher than the costs of an unaffiliated firm. The ranking of the fixed organizational costs are therefore as follows: $f_V^S > f_O^S > f_V^N > f_O^N$.

Even though the ranking is arbitrary and, hence, some of the model implications as well, the evidence from the field support my choice. In a review of international versus domestic outsourcing within the retail sector, Liu and McGoldrick (1996, p. 28) listed the benefits of domestic sourcing as including "the shorter lead and transit times, the ability to monitor closely the total production process and the lower costs in terms of management time and

[65] The fixed organizational costs must not exceed *M*'s operating profits evaluated at northern wage in order for *H* to fully levy the costs to *M*: $f_k^l < \left(\left(1-\beta_k^l\right)R(i) - w^l m(i)\right) / w^N$.

communications”. Based on their work with clients that are offshoring to captive and third-party vendors plus in-depth interviews with many offshoring vendors, Booz Allen Hamilton (2003, p. 3) affirm: “Although captive offshoring provides the greatest rewards and control, it is more difficult to manage and will become increasingly so as the market matures. Outsourcing to an established offshore vendor is the easier option, though less profitable.” With regard to domestic versus international purchasing costs, Frear, Metcalf and Alguire (1992, p. 11) found that “problems with performance, delivery, and technical capabilities existed for more than 50 percent of the respondents” in a survey of purchasing professionals with offshore outsourcing experience.

The relationship between *H* and *M* is governed by incomplete contracts. Following the seminal work of Williamson (1985) and Grossman and Hart (1986), I demonstrate how the inability to write and enforce an ex-ante contract specifying the procurement of a certain amount and quality of low-tech input for a certain predetermined price creates hold-up problems. Namely, both parties provide suboptimal amounts of inputs which leads to overinflated price of a final good. In this paper, unlike Antras (2005a) but rather following Antras and Helpman (2004), contracts are incompletely enforceable even in the North. This means that in neither country and under neither organizational form can *H* verify ex-ante the quality of low-tech inputs being manufactured by *M*, nor can he hire a third party to do that. Provided only good quality inputs have been supplied, they can start bargaining over the surplus from their relationship. I represent this ex-post bargaining as a generalized Nash bargaining game in which *H* obtains a fraction $\beta \in (0,1)$ of the ex-post surplus from their relationship.

Hold-up problems arising from incomplete contract setting can be alleviated by *H* choosing vertical integration instead of arms-length relationship. In this model, I follow the property rights approach to the theory of the firm as elaborated by Grossman and Hart (1986) and Hart and Moore (1990). In line with the theory, ownership in case of vertical integration is associated with the entitlement of some residual rights over low-tech inputs. The scope of residual rights turns out to be extremely important for the outside option of *H* and consequently for the anticipated outcome of each location-relationship type. The outside option of *H* depends on the organizational type of its relationship as well as on the location of its manufacturing division. If *H* hires an independent contractor (*O*-type relationship), her outside option is zero regardless of *M*'s location. Because the relationship governed between them is strictly contractual, *H* can claim no property rights over low-tech inputs and ends up empty-handed.[66] Outside option for *M* is zero as well, since the investment made to produce required inputs is variety-specific, so that they have no value outside this relationship. On the other hand, vertical integration grants *H* with certain rights to seize the inputs. In case of in-

[66] There is a lot of real-life anecdotal evidence on hold-up problem. Aron and Singh (2005) for example mention a vendor that archives, documents, and analyzes insurance claims raising its price by 65% when a contract was due for renewal. The buyer couldn't cancel the contract with the service supplier because it had already eliminated its processing capacity.

house production, H can freely cancel the relationship with M after the inspection of the delivered inputs and still use them in the production, though at a certain cost. After firing M, only a fraction $\delta^N, \delta^l \in (0,1)$, of potential final-good production comes out fine. This can be justified by the fact that H has incomplete knowledge of the assembly process and bears additional costs for putting the business back on track. In case of FDI relationship (vertical integration with a manufacturing producer in the South), we have an analogous situation: after breaking the relationship with southern M supplier, a fraction $(1-\delta^S)$ of final-good output is lost due to H's ineffective use of seized inputs. I assume that the costs of discontinuing the H-M relationship are higher when M is in the South, because there is better legal protection in the North. Therefore, $\delta^N > \delta^S$ is assumed.

After H examines all four possibilities given by the two distinct locations and two organizational forms, she chooses the one that brings her the highest ex-ante profits. Each H then initiates a public reverse auction whereby he issues a request for quotations to obtain specialized low-tech inputs. Infinite number of potential suppliers then assures that H gets the most favourable deal. For M this implies that his profits from the relationship net of the contract value equals zero, presumably his outside option. Contract value, denoted by T, can be regarded also as a participation fee that M has to pay to H before the production process starts. After the contract has been signed, M pays H the agreed upon amount that assures H the participation in the relationship by forcing M to deliver good quality inputs of H's type. In return, H provides M with blueprints for the specialized low-tech inputs.

4.1.1 Choice of location and organizational structure

If the parties agree on the bargaining and both provide good quality inputs, we can write the potential revenue from the sales of i-th variety, using equations (3), (4), and the identity $R(i) = p(i)x(i)$:

$$R(i) = X^{\mu-\alpha}\left[\theta_t(i)\right]^{\alpha}\left[\frac{h(i)}{1-z_t}\right]^{\alpha(1-z_t)}\left[\frac{m(i)}{z_t}\right]^{\alpha z_t}. \qquad (5)$$

As discussed in the previous section, the outside option of M is always zero, so that she has no incentive to withdraw. On the other hand, the outside option of H depends upon the location and ownership structure. I will examine each of the possible events in turn:

- When H outsources (M is of type M_O^l) his outside option is zero as well, so it is best for the parties to negotiate ex-post on the shares of their relationship output, $R(i)$. In line with their negotiating powers, H gets $\beta R(i)$ and M receives $(1-\beta)R(i)$.

- If H organizes in-house production of manufacturing phase (M is of type M_V^N), he receives his outside option, $\delta^N x(i)$, plus the negotiated fraction of the quasi rent, that is $\beta\left(1-\delta^N\right)x(i)$. In terms of revenues, the gain for H is then $(\delta^N)^\alpha R(i)+\beta\left[1-\left(\delta^N\right)^\alpha\right]R(i)$. The rest goes to M: $(1-\beta)\left[1-\left(\delta^N\right)^\alpha\right]R(i)$.

- By the same logic, when H makes an FDI relationship (M is of type M_V^S), she obtains $\left(\delta^S\right)^\alpha R(i)+\beta\left[1-\left(\delta^S\right)^\alpha\right]R(i)$ of the total revenue while M acquires $(1-\beta)\left[1-\left(\delta^S\right)^\alpha\right]R(i)$.

Since the payoffs are proportional to the revenue, we can express different payoff rates (β_k^l) in terms of β and δ^l, and order them according to their size:

$$\beta_V^N=\left(\delta^N\right)^\alpha+\beta\left[1-\left(\delta^N\right)^\alpha\right]\geq\beta_V^S=\left(\delta^S\right)^\alpha+\beta\left[1-\left(\delta^S\right)^\alpha\right]>\beta_O^N=\beta_O^S=\beta. \tag{6}$$

Clearly, H faces a trade-off between three types of givens. First, wage rate differential makes the location of M in the South more attractive than in-house production and outsourcing in the North. Next, fixed organizational costs favour northern production over southern assembly and arms-length relations over vertical integration. Third, distortions caused by incomplete contracting encourage vertical integration in the North and South to the loss of outsourcing. Apart from the productivity level not mentioned by now, there is yet another factor that influences the choice of location and organizational structure: the level of standardization given by the output elasticity of the low-tech input, z_t. Before I analyze the relationship between the level of standardization and the organization of a firm more thoroughly, profit maximization needs to be presented.

Incomplete contracts imply that, ex-ante, the parties cannot explicitly determine the amount of inputs to be delivered. They know only in what kind of a relationship they are when signing a contract and what is each ones bargaining power. By backward induction, each one maximizes his expected profit from the relationship and determines the optimal quantity of inputs accordingly. H sets $h(i)$ to maximize $\beta_k^l R(i)-w^N h(i)$, while the manufacturing plant M simultaneously chooses $m(i)$ to maximize $(1-\beta_k^l)R(i)-w^l m(i)$, where w^l depends on M's country of origin. Plugging the first order conditions of M and H into equation (5) we can write the total operating profits for firm i as

$$\pi_k^l(\theta_t,X,z_t)=X^{\frac{\mu-\alpha}{1-\alpha}}\theta^{\frac{\alpha}{1-\alpha}}\Lambda_k^l(z_t)-w^N f_k^l, \tag{6}$$

where

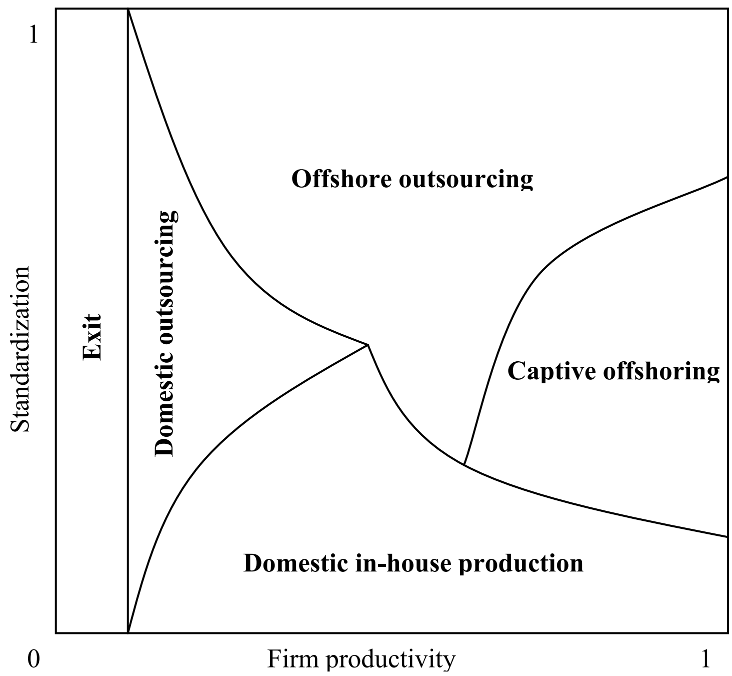
$$\Lambda_k^l(z_t) = \frac{1-\alpha\left[\beta_k^l\left(1-z_t\right)+\left(1-\beta_k^l\right)z_t\right]}{\left\{\left(1/\alpha\right)\left(w^N/\beta_k^l\right)^{1-z_t}\left[w^l/\left(1-\beta_k^l\right)\right]^{z_t}\right\}^{\alpha/(1-\alpha)}}. \qquad (7)$$

Figure below shows the preferred type of production at different productivity levels and different phases of standardization. As can be seen, five sequences of production modes exist at different points in the product life-cycle, listed by increasing productivity levels:

- Outsourcing North and Vertical integration in the North
- Outsourcing North, Vertical integration in the North, and FDI
- Outsourcing North, Vertical integration in the North, Outsourcing South, and FDI
- Outsourcing North, Outsourcing South, and FDI
- Outsourcing North and Outsourcing South.

The order of the production types is the same in each of the five sequences which will become important in the dynamic part of the setting.

Figure 16: Optimal organizational type



Note: standardization refers to parameter *z* in the model: value 0 implies that only high-tech input or headquarter services are creating value to the product, whereas the value 1 relates to the other extreme where only low-tech input or manufacturing services are important.

Source: Own calculations.

BOX 2: Captive offshoring strategy - the case of Intel

The semiconductor industry is a good example of a global value chain that is driven by carefully protected technological advantages. Because production process can technically be broken up into several successive tasks, each with its own labour-intensity and skills, and the cost of transport is low relative to the value of output, producers are able to fragment production internationally according to the availability of local pool of talent, production costs, the quality of infrastructure, supplier capabilities, and proximity of markets.

Starting in the mid 1980's and intensifying in the 1990's, Intel exploited falling barriers to international transactions to create a complex international production system by establishing a network of wholly-owned subsidiaries. In this way it located particular activities in the value chain to the places most suitable for them. Strategic, sensitive, and skill-intensive activities such as R&D and software design were kept in the home country, while non-core elements such as assembly, testing, and systems manufacturing were transferred to lower-cost sites. Of course, this is a generalized and simplified description of its production fragmentation pattern. Part of the R&D and software design is performed also in Israel, UK, and Japan, as well as in low-cost locations like China, India, Philippines, Russia, and Malaysia. Almost 55% of its 92.562 worldwide workforce is employed in the US, 11% in Malaysia, 8% in China, 7% in Israel, 6% in Philippines, and the rest in the remaining 22 countries. With regard to internationalization and production reorganization, Intel's operations are structured to guard itself from competitors by protecting knowledge inside subsidiaries strategically located in its home country or in Ireland and Israel, counties with strong protection of intellectual property. For operations that are less knowledge-sensitive, it has expanded globally to incorporate several carefully selected sites in low-cost locations but always in fully owned and tightly controlled ventures. Intel's network of own manufacturing, assembly and test facilities is a source of a competitive advantage that enables them to have more direct control over their processes, quality control, product cost, volume, timing of production, and other factors (Intel, 2006a).

Despite choosing direct investments as its preferred model of global multi-stage production, Intel uses third-party manufacturing companies to manufacture wafers for certain components. They primarily use subcontractors to manufacture board-level products and systems, and purchase certain communication networking products from external vendors, primarily in the Asia-Pacific region. To augment capacity, they also use subcontractors to perform assembly of certain products, primarily less advanced technology such as flash memories, chipsets, and certain networking and communication products (Intel, 2006a). These subcontractors may also offer intellectual property, design services, and other goods and services to Intel and allow it to reduce its capital expenditure in the non-core segments of the business.

Intel sites with more than 50 employees as of December 2006

Location	**A**	**C**	**F**	**L**	**OS**	**RD**	**SD**	**SM**	**Employees**
Argentina								•	51
Australia								•	52
Belgium					•			•	86
Brazil					•			•	140
Canada					•			•	90
China	•	•			•	•	•	•	7.143
Costa Rica	•								3.239
Denmark	•	•							66
France		•			•			•	138
Germany		•					•	•	420
India					•	•	•	•	2.644
Ireland			•		•		•	•	4.374
Israel		•	•		•	•	•		6.251
Italy								•	53
Japan						•	•	•	573
Malaysia	•			•		•		•	10.282
Mexico		•			•			•	289
Netherlands				•					204
Philippines	•	•		•		•		•	5.154
Poland					•			•	355
Russia						•	•	•	1.356
Singapore					•			•	211
South Korea							•	•	170
Spain								•	68
Taiwan					•			•	451
UK						•		•	1.031
US	•	•	•	•	•	•	•	•	50.188

Key: A – assembly and test; C – communications; F – fabrication; L – logistics; OS – other support; RD – research and development; SD – software design; SM – sales and marketing.

Source: Intel 2006 Global Responsibility Report, 2006, p. 8.

A firm usually opts for retaining an activity within the boundaries when strict control of that activity is considered crucial, when high transaction costs are involved (Buckley & Casson, 1976) or when proprietary knowledge and information is sensitive, tacit, expensive to produce, complex or idiosyncratic, but easy to replicate (Dunning, 1989). The more strategic the economic activity and the closer it is to the core competence of a firm, the less likely it is to be outsourced. For example, most offshored R&D operations in India are performed by foreign affiliates. Examples include Oracle's and Texas Instruments' design and development centres and GE's R&D laboratory in Bangalore. Other TNCs such as Cisco, Hewlett-Packard, IBM, Lucent and Microsoft have also made investments in R&D centres in India (Kapur & Ramamurti, 2001).

BOX 3: Offshore outsourcing strategy - the case of Limited Brands and Tommy Hilfiger Group

Textile and clothing sectors are considered one of the most mature manufacturing industries. This industry appears to provide a classic and archetypal case study of segmentation and relocation of production, initially on a domestic scale and then on an international scale. In comparison to complex technology and scale intensive industries like electronics and automobile industry, clothing production is technologically undemanding and has low barriers to entry. The vital part of the industry is in fact design and marketing, where the barriers are much higher. The value chain is thus dominated by brand holders and retailers whereas the supply of garment makers is ample. Because the core elements of the value chain (product design, marketing, and retailing) can effectively be unleashed from the rest of the chain and because of the relatively low weight-to-value ratio, the fragmentation of the production process is very advanced. Companies from the industrialized countries nowadays retain only upmarket and niche production requiring special expertise or emergency-orders production facilities, while outsourcing the garment assembly to low-wage countries. Indeed, studies show that subcontracting has been the most important type of redeployment in the textile and clothing industry, much more so than foreign direct investment (see for example Graziani, 1998).

Limited Brands is a leading retailer of intimate and other apparel and non-apparel products. Its best-known brand is Victoria's Secret. Through its more than 2,900 stores, the company employs more than 100,000 people and recorded sales of $11 billion in 2006. Brand management and retail sales are the two principal competitive advantages that influence its global network supply. Although it uses both captive offshoring and purely arms-length supply relationships to manage the non-core part of the supply chain, each of the two approaches involve a great deal of outsourcing arrangements.

Its independent division, Mast Industries, is one of the world's largest contract manufacturers, importers and distributors of apparel (Mast, 2008). It delivers over 300 million garments a year to Limited Brands and to other fashion brands. Its global network includes more than 400 factory relationships in 35 countries and more than 800 associates around the world and has business offices in 12 countries. Its competitive advantage lies in the widespread global network of contract suppliers, manufacturers, associates and shippers through which it is able to respond to rapid market changes and provide quality, speed, and flexibility.

Limited Brand's external suppliers include a host of firms, the most important being Li & Fung, an example of external full-package provider that manages the entire supply chain – from product design and development, through raw material and factory sourcing, production planning and management, quality assurance and export documentation, to shipping.

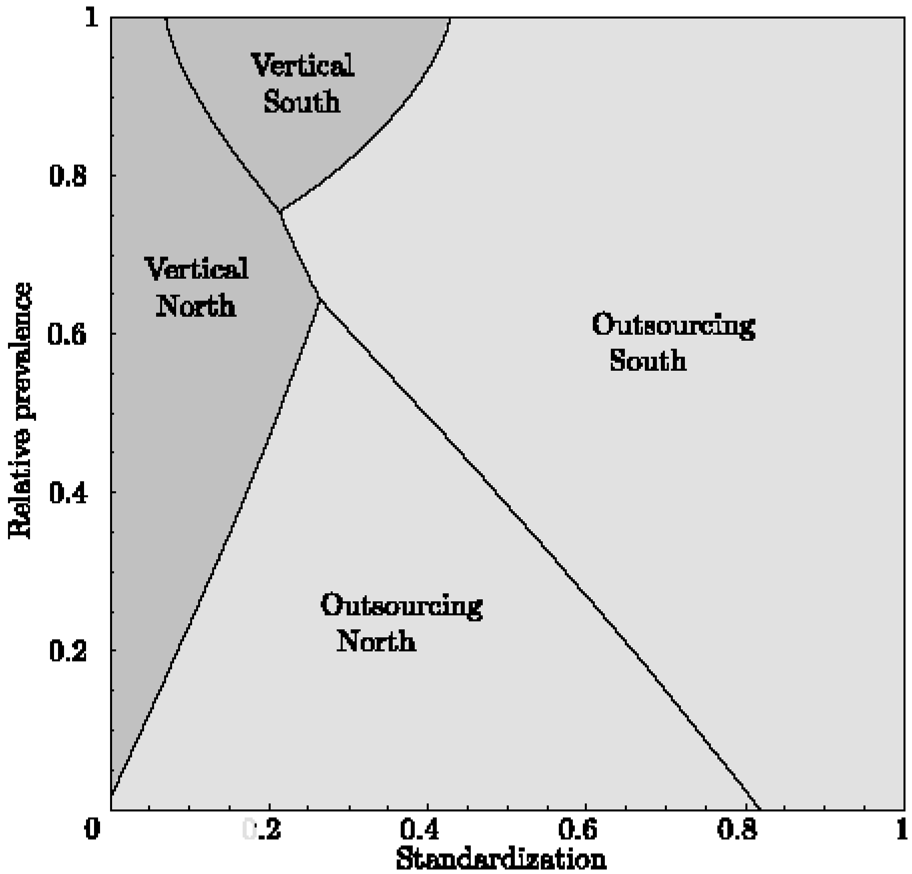
Headquartered in Hong Kong, the company's extensive global sourcing network of over 70 offices covering over 40 economies around the world and a growing global network of approximately 10,000 suppliers, Li & Fung explores the world to deliver the full package from product development to on-time delivery. An interesting policy of Li & Fung is also that it seeks to use between 30% and 70% of the total capacity of its suppliers in order to get the priority attention from the partner on one hand and not to make the other company over-dependent on the other hand (Hagel & Brown, 2005, p. 90). Recently, the company bought the sourcing operations of Tommy Hilfiger for $247.8 million. The sourcing operations of Tommy Hilfiger used to find and contract with factories to make its apparel and deal with the logistics of getting them into retail stores. Through the spin-off deal, Hilfiger’s sourcing offices were integrated into Li & Fung’s sourcing arms in Hong Kong, Taiwan, India, Bangladesh and Sri Lanka. Meanwhile, the brand holder untied the resources from its production and logistics arm and released them to its core business: design and marketing.

Mr. Fred Gehring, Chief Executive Officer of Tommy Hilfiger Group, commented on the business deal: "Our own operated buying offices have contributed tremendously to the development of our business to date, but we believe that to take things forward we can benefit tremendously from the integration of these offices within the greater network of Li & Fung with over 70 offices in over 40 countries and territories, including as many as 19 offices in China alone. The continued dedication of our respective sourcing teams in combination with Li & Fung’s tremendous strength in product development and overall buying power will be an important asset while we continue to develop our brand towards an ever more elevated position." Tommy Hilfiger is a typical but only one of the numerous examples of firms in the clothing industry that used international outsourcing to cut costs and improve product quality by enhancing the quality of services that accompany it: careful respect of just-in-time delivery, short delays between the design and final consumer market, low inventories, high quality of production, and the focus on the fashion content of their products (Tommy Hilfiger, 2007).

In the previous Box it was shown how Intel has created an international production network in which ownership links form the basis for common governance of the entities of the system, while Limited Brands has created a production system based on contractual relationships. Vertically integrated governance systems internalize control and allow stronger protection of firm-specific advantages like technology, as in the case of Intel. Where these advantages lie in brand names and marketing and not so much in production– as in the case of Limited Brands – more externalized forms of control are appropriate.

Two complementarities between the ownership structure and the location of production arise in the model, similar to what Grossman, Helpman and Szeidl (2005) observe in their model. At the early stages of product maturity when a larger fraction of firms engage in a vertically integrated type of production, a larger fraction of firms insource the manufacturing phase in the North. Headquarter services play a decisive role in the production process of an unstandardized product, which makes *H*'s holdup problem too large to tilt the bargaining power in favour of the manufacturing plant by giving away the residual rights. On the other hand, lower variable costs do not offset the distortions caused by incomplete contracts because the value-reducing underinvestment of manufacturing manager is relatively unimportant. Vernon (1966, p. 195) states similar reason for the preferred proximity of headquarters and assembly in the early stages of introduction of a new product: "First, producers at this stage are particularly concerned with the degree of freedom they have in changing their inputs. Of course, the cost of the inputs is also relevant. But as long as the nature of these inputs cannot be fixed in advance with assurance, the calculation of cost must take into account the general need for flexibility in any locational choice." In addition, he lists two other reasons: low price elasticity of demand that eases the pressure for low-cost production, and the need for swift and effective communication between the producer, customers and input provider.

Figure 17: Relative prevalence of organizational forms at different stages of final-good maturity



Source: Own calculations.

The complementarity is evident from the Figure 17, where the relative prevalence of each organizational form is depicted. On the horizontal axis, lower value of standardization parameter indicates young industries with nonstandardized goods while values to the right indicate matured industries with standardized goods. Conditional on the chosen standardization industry phase, vertical distances measure the expected share of firms belonging to each organizational type. I assumed a Pareto distribution of θ, according to which the share of firms with productivity less than θ is given by $G(\theta)=1-\left(b/\theta\right)^{a}$ for $\theta \geq b > 0$ and a is large enough to ensure finite variance. In this case, the distribution of surviving firm's productivity levels is also Pareto, and their modified probability measure $\theta^{\frac{\alpha}{1-\alpha}}$ is also Pareto distributed.[67] In addition, because of the form of firm revenue as a function of θ (see Equation 5), the distribution of sales is also Pareto. This theoretical construct is consistent with empirical evidence on size distribution of firms as shown in Axtell (2001) and Helpman, Melitz and Yeaple (2004). The slopes and the position of boundaries between organizational types indicates the prevalence of vertical integration at the early stages of maturity of a final-good and the corresponding dominance of Northern in-house manufacturing.

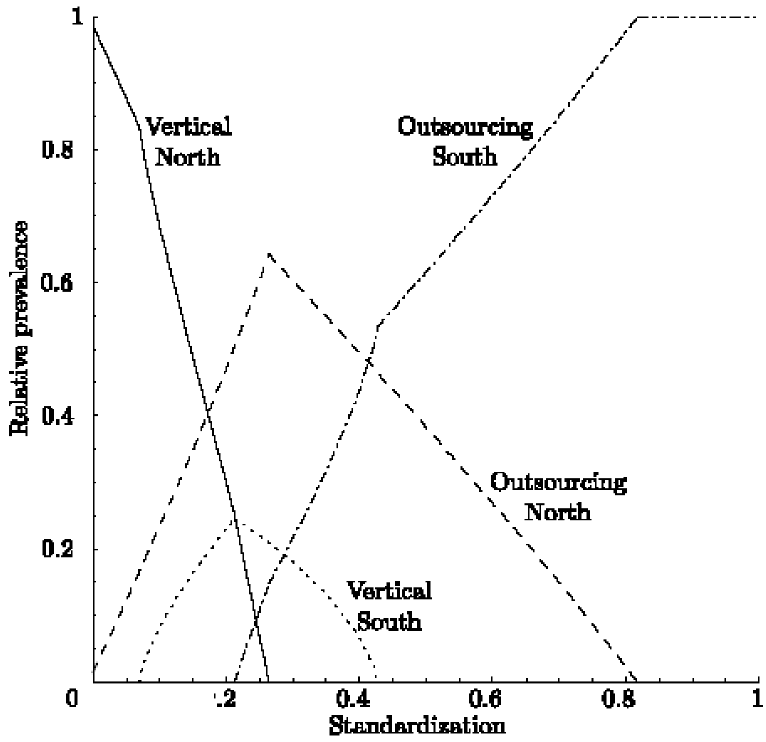
The second complementarity between the ownership structure and the location emerges in the standardized phase of product life-cycle. At that stage, larger share of firms in an industry outsource the assembly and manufacturing segment of production, and among these a larger fraction offshore to the South. Outsourcing is dominant to vertical integration because ex-ante efficiency dictates that residual rights should be consigned to the party undertaking a relatively more important investment in a relationship (see Grossman & Hart, 1986). When the good is mature and requires relatively little headquarter services, the benefits of low-cost production in the South prevail over the distortions from incomplete contracts and higher fixed operational cost. Offshore outsourcing therefore supersedes outsourcing in the North as the good matures. In addition, more productive firms also choose Southern manufacturing over the Northern production because high productivity begets higher profits and higher incentive for low-cost manufacturing. Observing industries in different standardization phases produce a positive correlation between the share of firms that outsource and the share that offshore their intermediate inputs in the South. Again, the increasing prevalence of independent manufacturing and the corresponding expansion of offshore outsourcing in the process of final-good standardization can be seen from the Figure 17.

Figure 18 shows the dynamics of prevalence of alternative ownership-location production modes in an industry as the final-good becomes standardized (rightward move along the horizontal axis). Not all industries mature at the same speed and the process is idiosyncratic as it depends on many external factors such as breakthrough technologies, incremental product and process innovations, changes in consumer tastes, etc. The first complementarity is caused by closing gap between vertical integration in the North and vertical integration in the South in the non-standardized stages of product life-cycle. The second complementarity emerges

[67] Productivity measure on the horizontal axis of Figure 3 is $\theta^{\frac{\alpha}{1-\alpha}}$ instead of θ, but for the reasons just mentioned this does not change results at all.

due to the share scissors formed by the fraction of firms that outsource in the North and firms that offshore their manufacturing process.

Figure 18: Relative prevalence of organizational forms as the industry matures.



Source: Own calculations.

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 new-to-the-market 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 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, apparel and furniture industry as corroborated by Bernard, Jensen and Schott (2004, p. 24), 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 or tasks in which offshoring is prevalent international mode of production.[68]

4.1.2 Firm's dynamic problem

In the midst of the debate regarding the cost and employment effects of offshoring, it is easy for its positive effects on productivity and innovation to be lost or overlooked, whereas that is the focus of this section. Up to now, we have analyzed firm's optimal choice in a static context. Given the level of productivity and exogenous parameters, a firm first decided whether to exit or enter, and – in the latter case – where and how to obtain low-tech inputs and standardized producer services. This static equilibrium turns out to be a very useful concept for the dynamic setting since it represents the starting point for firms' decisions in the following periods. It also gives us half of the dynamic problem each firm in industry X faces.

The other half, which I introduce now, is the decision about the level of investment in enhancing firm core competence, in this model expressed as a productivity parameter θ. Unlike a core product, a core competence (or capability)[69] is not a stand-alone, sellable commodity or service but an integral element in a firm's value chain. Examples of possible core capabilities include innovation, embedded skills, high-quality manufacturing, short product development cycles, good supplier relations, service excellence, well-motivated employees, a brand, a marketing culture, or a strong service reputation. The challenge is to think of the firm not just in terms of its visible end products but also in terms of its invisible assets and core capabilities (Shoemaker 1992, p. 75). In many instances, core competence is not augmented purposely but comes about as a coincidence or exogenously from the environment of the firm. Barney (1986), for instance, points out that many resources are acquired more by luck than the exercise of managerial judgement. However, as argued by Prahalad and Hamel (1990, p. 81), in the long run, competitiveness derives from the ability to build the core competencies more speedily and efficiently than competitors. The real sources of advantage are in the management's ability to consolidate corporatewide technologies and production skills into competencies. Later on, they claim that competencies need to be nurtured and protected, in other words, constantly developed and perfected Prahalad and Hamel (1990, p. 82).

[68] Footwear industry represents another typical example of mature industry. According to Tisdale (1994, p. 11), Nike employed about 75,000 workers in Asia mainly through contractual arrangements, whereas only 2,500 people are employed in the USA. Building such an extensive network of independent subcontractors enabled the company to improve one of its core competence: responsiveness to changes in fashion. Rearranging what each supplier does on its network, Nike can change its product mix almost overnight (Welch, Benito & Petersen, 2007 p. 180).

[69] Marino (1996) makes a distinction between competencies and capabilities. According to him, competencies are firm-specific technologies and production related skills. On the other hand, capabilities are firm-specific business practices, processes, and culture. In my dissertation, I group the technical and tacit advantages into a common term and use the expressions interchangeably.

Every period, a final-good producer *H* can invest certain amount of resources into applied research which makes its production in the next period more efficient. With decreasing productivity in research activities there exists an optimum level of present investment for every organizational form in the following period, when the firm enjoys the fruits of the improved productivity. Different location and contractual types of *H-M* relationship corresponds to different optimum levels of current investment and hence different expected profits in the following period. Comparing alternative profit outcomes, *H* chooses at time *t* also the organizational form for the next period: $\Omega_t \in \left\{\left\{NV_{t+1}\right\},\left\{NO_{t+1}\right\},\left\{SV_{t+1}\right\},\left\{SO_{t+1}\right\},\left\{\varnothing_{t+1}\right\}\right\}$, where $\varnothing$ denotes firm's exit. Having decided upon the organizational form, a firm and its low-tech input provider simultaneously and noncooperatively decide the optimum levels of inputs. Apart from the headquarters input, a northern firm *i* sets also an optimum level of investment, $q_t(i)$, which improves its productivity in the next period in the following way:

$$\dot{\theta}_t = q_t^{\zeta} - \delta\theta_t, \text{ with } 0 < \zeta < 1. \tag{8}$$

R&D capital depreciates at the rate δ and the gross return of investment is independent of firm's current productivity level. Had the firm made no investment in productivity enhancing activities, its productivity and relative position in the industry would gradually deteriorate. The specification exhibits positive but diminishing returns of investment on the productivity growth rate. Productivity growth follows deterministic path, conditional on the level of investment and current productivity level. I could also allow for stochastic dynamics of this process, but this would not change the main results of the dynamic optimization, since the introduction of random productivity shock would leave the expected return on R&D investment unchanged by definition.

Let the input requirement of one unit of investment is one unit of labour, so the total research costs are $q_t(i)w^N$. The optimum level of investment in the current period is the level that maximizes firm's expected discounted profits in the following periods, conditional on the planned production mode in the future. The second control variable of the dynamic problem is therefore the organizational form in the next period. For each of the four possible location-organization types optimal $q_t(i)$ is calculated and the corresponding net present value of the expected future profits are then compared in order to pinpoint the optimal production mode in the next period. Each northern firm maximizes the net present value of operating profits (Equation 6) minus current investment costs:

$$\max_{\substack{\{q_t\}_{t=0}^{\infty} \\ \{\Omega_t\}_{t=0}^{\infty}}} \sum_{t=0}^{\infty} \rho^t \left[X_t^{\frac{\mu-\alpha}{1-\alpha}} \theta_t^{\frac{\alpha}{1-\alpha}} \Lambda_t - w^N \left(f_t + q_t \right) \right] \qquad (9)$$

s.t. $\Delta\theta_t = q_t^{\zeta} - \delta\theta_t$ for all t, and

$\Lambda_t = \Lambda(\Omega_{t-1})$, or more precisely:

$$\beta_{t+1} = \begin{cases} \beta_V^N \text{ if } \Omega_t = \{NV\} \\ \beta_O^N \text{ if } \Omega_t = \{NO\} \\ \beta_V^S \text{ if } \Omega_t = \{SV\} \\ \beta_O^S \text{ if } \Omega_t = \{SO\} \end{cases},$$

$$w_{t+1}^l = \begin{cases} w^N \text{ if } \Omega_t = \{NV\},\{NO\} \\ w^S \text{ if } \Omega_t = \{SV\},\{SO\} \end{cases}, \text{ and}$$

$$f_{t+1} = \begin{cases} f_V^N \text{ if } \Omega_t = \{NV\} \\ f_O^N \text{ if } \Omega_t = \{NO\} \\ f_V^S \text{ if } \Omega_t = \{SV\} \\ f_O^S \text{ if } \Omega_t = \{SO\} \end{cases},$$

with $\theta_0 > 0$ given and Ω_{-1} predetermined (chosen by the firm before the start of operation) at t=0.

At this point I have to limit my analysis substantially by omitting the possibility of endogeneous entry and exit from the industry and abstracting away from delving into industry equilibrium issues. This is done for two major reasons, the first being the fact that although the industry dynamics and equilibrium are indeed very interesting issues, they greatly exceed the research questions set forth in my dissertations. My aim on the theoretical ground is to propose a simple theoretical structure that rationalizes the phenomenon of focusing on core competence and its subsequent productivity improvements. In this light, it will be enough to study a simplified partial equilibrium setting, highlighting a typical firm's optimal actions and assuming that its activity has negligible effect on the industry. Given that only a small fraction of firms in my data switch from domestic to offshore input sourcing at any year and in any industry, I can reasonably assume that their subsequent actions have negligible effects on the industry as a whole.

The second reason is technical, since the richness of the model fundamentals precludes analytical solutions of the equilibrium. In fact, even numerical analysis of similar models with heterogeneous firms in a differentiated product market that allow for entry, exit and firm-level investments in capability enhancements, but still without the possibility of choosing between alternative organizational modes, is extremely complicated and computationally involved. For example, Pakes and McGuire (1994) develop an algorithm for computing Markov-perfect Nash equilibria for a differentiated product version of the Ericson and Pakes (1995) model of industry dynamics and report that the policies and value functions for a six-firm equilibrium typically take about five hours to compute on Sun Sparc workstation. The reason is that the heterogeneous agent problems we are interested in are by nature multidimensional, the dimensionality of the state vector for any given firm increasing rapidly with the number of other agents active in the market. The technique used to calculate the results for only six firms required calculating the value function by iteration at 639.000 points. Adding a single firm extended computational time by factor five, because the number of distinct points at which value function are to be evaluated increases exponentially with the number of firms.[70] Including alternative organizational types in the state vector immensely increases computational burden because not only the firm's own state vector increases, but also the vector state of the competitors.

To make the problem tractable, I make some simplifications that are not crucial for the point I want to make. First, I drop out the location-ownership variable as one of the choice variables and hence initially hold the chosen production mode fixed in time. Since I am not interested in the exact switching points between the modes of production but only the way the reorganizations of production value chain affects the level of R&D investment and the steady state productivity level, I can avoid solving a complicated hybrid dynamic problem[71] but still show the basic idea. Secondly, I assume the aggregate consumption of the industrial good, X_t, is constant in time, although it is expected to change due to productivity improvements and entry/exit process in the industry. By definition, X_t (as well as investment and exit functions) is a function of all firms' outputs that change during the evolution of the industry. By allowing the index to change, the problem would become even more complicated since each firm's decision would have to consider the information about all the firms in the industry. For the purpose of simplicity, I assume that the industry is so large that single firm's decisions do not affect industry's aggregates. In addition, I also assume that the industry has shifted to some recurrent structure with a unique, invariant probability measure on the set of recurrent industry states. Building on Ericson and Pakes (1995) model of firm and industry dynamics, Weintraub et al. (2008) develop an oblivious equilibrium approximation method for analyzing such dynamic models in which each firm makes decisions based only on its own state and use long run average industry state instead of the complete information about competitors' states. They show that under certain conditions about the distribution of firm states and as the market becomes large, the oblivious equilibria closely approximates Markov perfect equilibria proposed by Ericson and Pakes (1995). In other words, if there are enough firms in the industry – and in empirical data I am using there are – I can justifiably presume the aggregate

---

[70] There are some successfull attempts that try to overcome the curse of dimensionality problem. For example, Pakes and McGuire (2001) propose an algorithm "that can convert problems that would have taken years on the current generation of supercomputers to problems that can be done in a few hours". However, even with accelerated methods (e.g. Judd, 1998; Pakes & McGuire, 2001; Doraszelski & Judd, 2004, 2005) it seems likely that it will never be possible to solve for an Markov perfect equilibrium exactly in many problems of interest (Weintraub et al., 2008).

[71] Hybrid dynamic problems are dynamic problems where some transition dynamics is continuous and some discrete. In my case the continuous variable is productivity level, while the discrete one is the choice of production type.

consumption X_t to be assumed constant by a firm deciding upon R&D investment and future organization of production.

Simplified continuous version of the above dynamic problem of optimal investment holding the production mode fixed in time is written below:

$$H_t\left(\theta_t, q_t, \lambda_t\right) = X_t^{\frac{\mu-\alpha}{1-\alpha}} \theta_t^{\frac{\alpha}{1-\alpha}} \Lambda_t - w^N\left(f_t + q_t\right) + (\lambda_t q_t^{\zeta} - \delta\theta_t), \qquad (10)$$

where λ_t is the co-state variable or the current-value shadow price. It represents the shadow-value at time t of being one unit of θ more productive at time t. In addition, $\theta_0 = \bar{\theta}$ and the following transversality condition has to hold: $\lim_{t\to\infty}\left[\lambda_t e^{-rt}\theta_t\right] = 0$. Furthermore, the sufficient condition for the maximum of the Hamiltonian function is, that it is concave in the state variable, i.e. $\frac{\partial^2 H_t}{\partial q_t^2} \le 0$. This condition is again satisfied in our case, since we set 0<ζ<1. The maximum principle calls for the following optimality conditions:

$$\frac{\partial H_t}{\partial q_t} = 0 \Rightarrow \frac{w^N}{\zeta} q_t^{1-\zeta} = \lambda_t \qquad (11)$$

$$\frac{\partial H_t}{\partial \theta_t} = r\lambda_t - \dot{\lambda}_t \Rightarrow \dot{\lambda}_t = (r+\delta)\lambda_t - \frac{\alpha}{1-\alpha} X_t^{\frac{\mu-\alpha}{1-\alpha}} \Lambda_t \theta_t^{\frac{2\alpha-1}{1-\alpha}} \qquad (12)$$

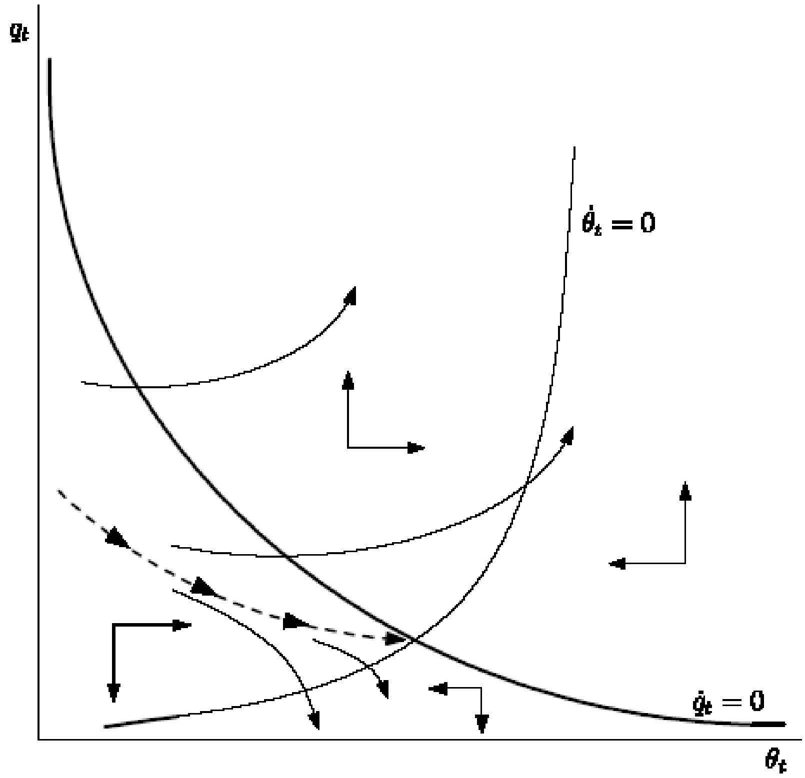
$$\frac{\partial H_t}{\partial \lambda_t} = \dot{\theta}_t \Rightarrow \dot{\theta}_t = q_t^{\zeta} - \delta\theta_t \qquad (13)$$

Differentiating the equation (11) with respect to t and substituting the derived expression for $\dot{\lambda}_t$ and the equation (11) into (12) yields:

$$\dot{q}_t = \frac{r+\delta}{1-\zeta} q_t - \Psi\Lambda_t q_t^{\zeta} \theta_t^{(2\alpha-1)/(1-\alpha)}, \qquad (14)$$

where $\Psi \equiv \frac{\zeta}{1-\zeta}\frac{1}{w^N}\frac{\alpha}{1-\alpha} X_t^{(\mu-\alpha)/(1-\alpha)}$ is a positive constant as X_t is assumed to be time-invariant in order to simplify the problem. Equation (14) and the transition relation in equation (13) form an autonomous system of first-order nonlinear ordinary differential equations in θ and q. First, let's draw a phase diagram for a single firm's investment and productivity paths at a certain unchanging production mode.

Figure 19: Optimal path of firm's R&D expenditures at a given location-ownership mode (depreciable R&D stock)



Note: The dashed line with arrows represents the saddle path of optimum investment level of a firm.

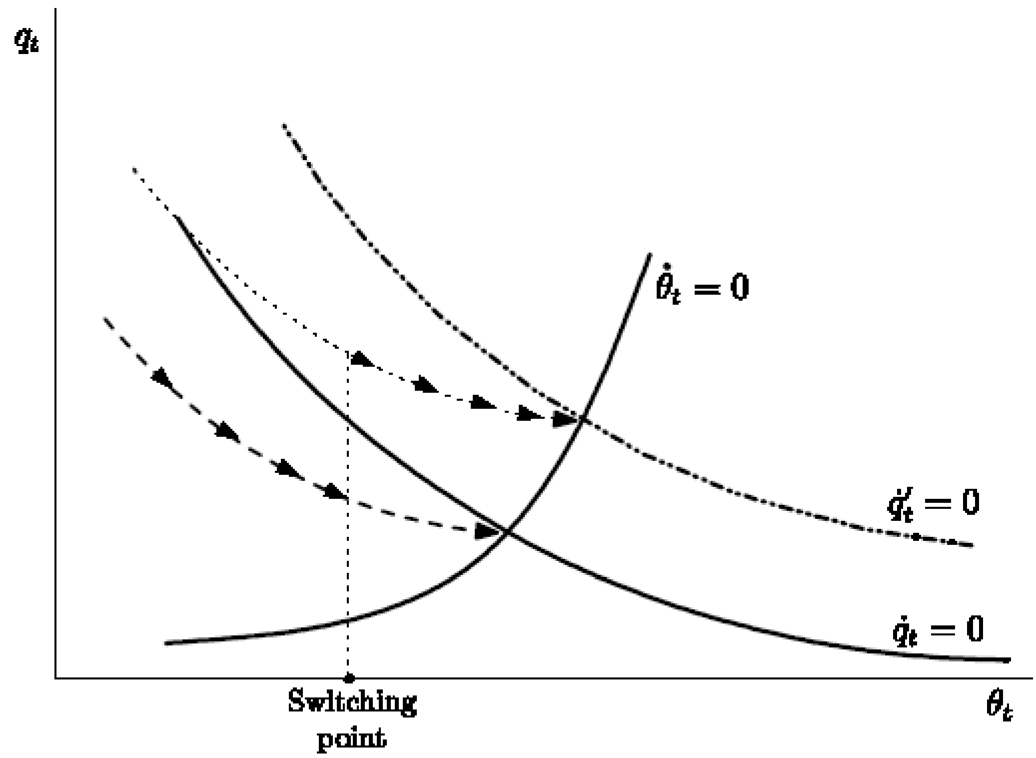
Source: own calculations.

Figure 19 depicts the optimal investment path of a firm at a given location-organization type. Now let's look at what happens when there is a switch in the production mode. By the construction of the two differential equations, equations (13) and (14), the change in production mode only affects the differential equation for R&D investment through the parameter Λ_t. Note that the organizational costs, f_k^l, do not appear in the definition of Λ_t and hence do not affect the optimal level of investment since they are fixed costs. In the Appendix A, I show that the following proposition holds:

Proposition 1: Whenever a firm advances to the next feasible stage of production mode, the parameter $\Lambda_t(\Omega_{t-1}, z_t)$ increases regardless of the standardization phase of the final-good production (z_t).

The equation (14) tells us that an increase of Λ_t will shift the $\dot{q}_t = 0$ isocline upwards while leaving the $\dot{\theta}_t = 0$ loci unaffected. The optimum investment path will also move upwards accordingly, inducing higher optimal level of R&D investment at any level of productivity and giving rise to higher steady-state productivity level. After a firm decided to reorganize its specialized input production either in terms of outsourcing arrangement or vertically integrated foreign subsidiary, there will be an upsurge of its investment going to the core business functions. Higher R&D investments will also foster productivity growth, bringing it to higher levels in the following periods.

Figure 20: Optimal path of firm's R&R expenditures when a change in organizational type occurs (depreciable R&R stock)



Source: own calculations.

Figure 20 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 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. As a consequence, 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 foreign 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.

5 Methodology of the empirical analysis

5.1 Research hypotheses

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

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

The theoretical rationale for this hypothesis lies in the formulation of the theoretical model which predicts that only more productive firms are able to profitably conduct foreign sourcing of inputs. From equation (5) and (6) it unambiguously follows that higher productivity (and hence pervasiveness of offshoring) is positively associated with firm size and profitability, respectively. Although my setting is Ricardian, Antras (2003) shows in a setting with two production factors (labour and capital) that captive offshoring firms are on average more capital intensive and that the share of intrafirm imports in total imports is significantly higher the higher the capital-labour ratio of the exporting country (on average more developed and demanding markets). The following hypothesis investigates the relationship between productivity and the extent of involvement in foreign sourcing. In particular, I will study the association between firm productivity and the share of foreign in total intermediate inputs, the range of varieties procured abroad and the geographical spread of production process fragmentation.

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

The next four 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.

H6: Captive offshorers stochastically dominate non-importing firms in terms of 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.

H7: Self-selection into foreign sourcing: more productive firms choose to purchase some of its intermediate inputs abroad.

H8: 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 dissertation 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. If the causality from offshoring to productivity increase and innovation enhancement is indeed corroborated, there is a clear message to policymakers to create such an environment in which firms will find no administrative, legal, and institutional barriers for international sourcing. For firms themselves, the result would suggest that pursuing global production strategies delivers rewards in the form of increased productivity, enhanced competitive advantages, improved market share, and better strategic position. However, globalisation of value chains represents also important challenges. It is crucial for firms to become aware and understand the structure and dynamics of global value chains. This also applies to the potential for firms becoming themselves specialised suppliers serving different global value chains. Gainful participation in value chains often requires substantial investments to acquire or develop superior production technologies and logistics systems, invest in human capital, or certify newly required standards. Participation in global value chains may be demanding, to the extent that a threshold of capabilities is necessary to successfully enter value chains. However, participation can accelerate firms' upgrading of human and technological resources, through technology and knowledge transfer and the implementation of new business practices.

H9: Foreign sourcing of intermediate inputs increases productivity level and productivity growth.

H10: 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.

5.2 Specification of econometric model

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 confront with some crucial endogeneity issues. The next section provides the solutions to some of the issues and describes the estimation procedure with a view to provide proper production function estimates and total factor productivity figures.

5.2.1 Identification of production functions

Production functions project output on productive inputs, such as capital, labour, and materials. Economists have been trying to estimate production functions since the early 1800's, yet as many of the econometric problems that hampered early estimation are still an issue today. Despite largely improved econometric techniques, availability and quality of data and vastly enhanced computational speed, one issue particularly remains unresolved. Namely, the problem of unobserved inputs deals with the fact that some factors are known only to the firm but not observed by an econometrician. If the unobserved inputs are correlated with any of observed inputs (unobserved inputs affect the choice of an observed input) then I am confronted with an endogeneity problem and OLS estimates of the coefficients on the observed inputs will be biased.

A vast body of literature has emerged trying to resolve the endogeneity problem. The earliest attempts to tackle the issue were techniques using instrumental variables (IV) and fixed effects estimation (FE). For IV estimation to be effective, one has to find variables that are correlated with observed inputs but uncorrelated with the unobserved inputs. Because finding valid instruments is extremely hard, this technique has by and large been unsuccessful. FE estimation requires the assumption that the unobserved input is constant over time so that it can be controlled by firm-specific time-constant effect and handled by within transformation (also called fixed-effect transformation). One potential problem with FE estimator is that it uses only within-firm variations in the data, possibly leading to weak identification of coefficients if the time dimension is short. As is the case for IV estimator, FE approach fails to account for selectivity: smaller and less capital-intensive plants may be more likely to shut down following a negative productivity shock, which would induce a downward bias on the capital coefficient (see Griliches & Mairese, 1995). In practice, this method has not been successful at solving the endogeneity problem either.

Two strands of literature emerged in pursuit of finding a solution to the endogeneity problem. The first followed the dynamic panel data literature as of Chamberlain (1982), Arellano and Bond (1991), Arellano and Bover (1995), Blundell and Bond (1998), and Blundell and Bond (2000). The estimator, however, requires a large number of cross-section observations to obtain reliable estimates. Furthermore, lagged values of the endogenous input factors in levels and in differences are often weak instruments as their validity depends on the absence of serial correlation in production. The second group of techniques was put forward by Olley and Pakes (1996) and Levinsohn and Petrin (2003) (hereafter OP and LP, respectively). They are more structural in nature as they make use of observed input decisions to control for unobserved productivity shocks. Next, I will present the modified estimation procedure proposed by Kasahara and Rodrigue (2008) that extends the OP and LP techniques by including import status as an additional state variable in the firm's optimization problem. The reason for augmenting the estimation function with the import variable, as was done previously for exporting (e.g. Van Biesebroeck, 2005), is that it can rightfully be assumed that importing firms face different market conditions than non-importing firms, that their exit, material demand and investment decisions differ and that intermediate goods importing entails bearing some fixed sunk cost that prevents firms to freely switch on and off foreign sourcing.

Let *i*'s firm gross output in period *t* be given with the following function:

$$Y_{it} = K_{it}^{\beta_K} L_{it}^{\beta_L} \left[\int_0^{N(d_{it})} x(j)^{\frac{\theta-1}{\theta}} dj \right]^{\frac{\beta_X \theta}{\theta-1}} e^{\omega_{it}}, \qquad (1)$$

where K_{it} is firm's capital stock, L_{it} is labour input, *x(j)* is horizontally differentiated intermediate input, and ω_{it} is a serially correlated productivity shock that affects firm decisions. The number of available varieties of intermediate materials depends on firm's discrete choice $d_{it} \in \{0,1\}$ whether to procure inputs from abroad or not. The range of intermediates is thus given by $N(d_{it}) = (1-d_{it})N_t^H + d_{it}N_t^F$, where N_t^H is the range of intermediates available in home country and N_t^F is the range available in the rest of the world. The elasticity of substitution between varieties of intermediate inputs is given by $\theta>1$. In my theoretical model, most productive firms decided to offshore or outsource inputs from abroad because of lower variable cost of production that exceeded additional fixed costs due to internationalization. Here, production efficiency abroad will be approximated by the increased scope of available intermediates, so that the ratio $\frac{N_t^F}{N_t^H} \geq 1$. Although not specifically addressing production sharing, Ethier (1982) and Feenstra, Markusen, and Zeile (1992) provide important frameworks in which productivity changes correspond to input selection. Feenstra, Markusen, and Zeile (1992) identify the contributions to growth arising from increased quantities of inputs and from increased range of input selection and find empirical support for broader range of inputs as an explanation for the productivity growth.

Supposing that in the equilibrium all intermediate inputs are produced symmetrically at level $\bar{x}$, the equation (1) can be written as follows:

$$Y_{it} = K_{it}^{\beta_K} L_{it}^{\beta_L} N(d_{it})^{\frac{\beta_X}{\theta-1}} X_{it}^{\beta_X} e^{\omega_{it}}, \qquad (2)$$

where $X_{it} = N(d_{it})\bar{x}$. Now we can define total factor productivity (TFP) in order to show that it is a function of import decision. Combining the definition of TFP, $A_{it} = \frac{Y_{it}}{K_{it}^{\beta_K} L_{it}^{\beta_L} X_{it}^{\beta_X}}$, and equation (2) leads to

$$a(d_{it}, \omega_{it}) = \frac{\beta_X}{\theta - 1} n(d_{it}) + \omega_{it}, \qquad (3)$$

where $a(\cdot)$ and $n(\cdot)$ denote natural logarithms of $A(\cdot)$ and $N(\cdot)$. This expression for TFP indicates that productivity increases with the range of intermediate inputs. This effect is static and therefore describes potential one-time increase in firm's productivity level that comes from better organization of its production chain. Further on I will formalize also the dynamic effect of internationalizing value chain.

At the beginning of every period a firm observes current productivity shock ω_t and makes the following decisions. First, it decides whether to exit or stay in business by comparing the expected net present value of future net cash flows and a sell-off value (Φ_t). Rising scrap-value, for example, signals better opportunities in some other industry compared to the current one. If it the firm decides to continue, it chooses optimal production mode, which entails the decision to import (d_{it}). In the next step, it chooses perfectly variable inputs L and X, and a dynamic input K subject to the following investment process: $K_{t+1} = (1-\delta)K_t + I_t$. It is assumed that every period a fraction δ of firm's capital stock depletes and that the current investment (I_t) increases capital stock in the following period.

To examine the possibility of long-term positive impact of importing on the evolution of productivity, we allow the distribution of ω_{t-1} conditional on information available at t to be dependent not only on the past productivity shock, ω_t, but also on the past import status, d_t.

Using import status instead of optimum R&D investment expenditures from the theoretical model, the dynamic effects of foreign outsourcing and offshoring can be formalized with the condition that $E[\omega_{it}|\omega_{i,t-1}, d_{i,t-1}=1] > E[\omega_{it}|\omega_{i,t-1}, d_{i,t-1}=0]$ for every $\omega_{i,t-1}$.

In the theoretical model, internationalization increased fixed organizational costs, but now I will assume that current fixed costs can be decomposed into fixed cost of internationalization (or importing in this econometric section), $f^S > f^N$, and fixed cost of vertical and outsourcing organization, $f_V > f_O$. Adding sunk start-up cost of importing to per-period fixed cost, we can express the fixed import cost by $\Gamma(d_{t-1}, d_t)$. Past import status enters the cost function since sunk start-up cost are depreciated over longer time span. Firm's dynamic optimization problem can be simplistically written in the following Bellman equation:

$$V_t(\omega_t, k_t, d_{t-1}) = \max\left\{\Phi_t, \max_{d_t, i_t}\{\pi_t(\omega_t, k_t, d_t) - c_t(i_t, k_t) - \Gamma(d_{t-1}, d_t) + \beta E[V_{t+1}(\omega_{t+1}, k_{t+1}, d_t)|J_t]\}\right\}$$

where Φ_t is the scrap value of the firm, $\pi_t(\cdot)$ is the profit after maximizing out the variable factors, $c_t(\cdot)$ is the cost of investment, $\Gamma(d_{t-1}, d_t)$ is the fixed cost of importing materials, and J_t represents information available at time t. State variables associated with this optimization are current productivity shock, ω_t, current stock of capital, k_t, and past import status, d_{t-1}. Choice variables are a discrete decision to exit, χ_t, current import status, d_t, and current investment level, i_t. The policy functions associated with these choice variables are:

i) exit rule:

$$\chi_t = \begin{cases} 1, & \text{for } \omega_t \geq \underline{\omega}_t(k_t, d_{t-1}) \\ 0, & \text{otherwise} \end{cases} \tag{4}$$

ii) import decision rule:

$$d_t = d_t^*(\omega_t, k_t, d_{t-1}) \tag{5}$$

iii) investment demand equation:

$$i_t = i_t^*(\omega_t, k_t, d_{t-1}). \tag{6}$$

$\underline{\omega}_t(k_t, d_{t-1})$ denotes the threshold value below which continuation of business activity is meaningless and is a decreasing function of both arguments. Firms with larger capital stocks can expect larger future returns for any given level of current productivity and thus will continue in operation at lower realizations of ω_t. Similarly, importing firms are expected to yield higher returns for any given productivity level above the switching threshold, so they are likely to sustain lower realizations of productivity shocks. What is novel to OP and LP estimation procedure is that Kasahara and Rodrigue (2008) introduced an additional state variable, namely past import status. d_{t-1} enters in value function argument space not only because fixed import cost depend on past import status but also because we allow the distribution function of ω_t to depend on ω_{t-1} and d_{t-1}, that is $\omega_t \sim F(\omega_t | \omega_{t-1}, d_{t-1})$.

Two alternative specifications can be formed from equation (2) with regards to variable $N(d_{it})$: the model with only continuous and the model with only discrete import variable. Let's firs consider the former. Taking logarithms of equation (2) yields:

$$y_{it} = \beta_K k_{it} + \beta_L l_{it} + \beta_X x_{it} + \underbrace{\frac{\beta_X}{\theta - 1} \ln(N(d_{it})) + \omega_{it}}_{\ln A(d_{it}, \omega_{it})} + \eta_{it}, \tag{7}$$

where small letters represent logs of variables and η_{it} is either measurement error or an i.i.d. shock that is not known to the econometrician or firms at the time of decision making. Let the function $N(d_{it})$ be expressed as $N(d_{it}) = N(0)\left(1 + d_{it}\frac{N(1) - N(0)}{N(0)}\right)$. Taking logarithm of this expression yields the following expression for firm's output:

$$y_{it} = \frac{\beta_X}{\theta - 1}\ln(N(0)) + \beta_K k_{it} + \beta_L l_{it} + \beta_X x_{it} + \frac{\beta_X}{\theta - 1}\ln\left(\frac{N(1)}{N(0)}\right) + \omega_{it} + \eta_{it} \tag{8}$$

If I continue to assume symmetric production of input varieties, I can use the following equalities $\frac{N(1)}{N(0)} = \frac{N(1)\overline{x}}{N(0)\overline{x}} = \frac{X_{it}}{X_{it}^H}$ to rewrite equation (8):

$$y_{it} = \beta_K k_{it} + \beta_L l_{it} + \beta_X x_{it} + \beta_m m_{it} + \omega_{it} + \eta_{it} \;, \tag{9}$$

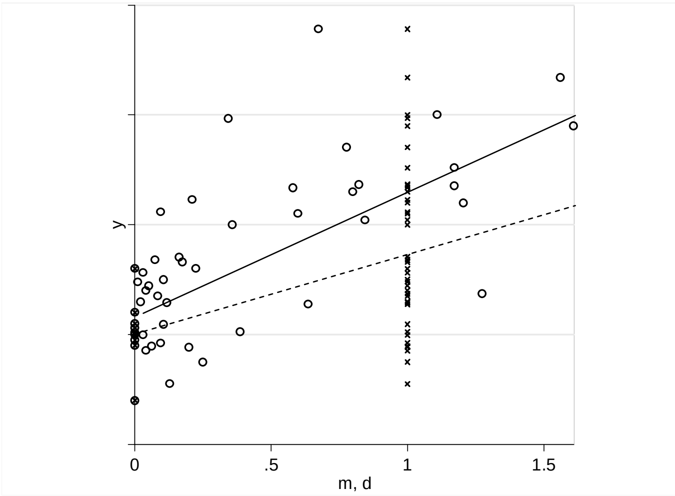
where I have omitted the constant term and denoted $\beta_m \equiv \frac{\beta_X}{\theta - 1}$ and $m_{it} \equiv \ln(X_{it} / X_{it}^H)$. Equation (9) is my first estimating specification. If a firm produces or buys all the intermediate inputs at home, the value of m_{it} equals 0, and is positive if input procurement is internationalized. From the estimates of β_m and β_X I can derive the elasticity of substitution across different varieties of intermediate goods, using the above definition of β_m.

Alternative specification can be expressed as:

$$y_{it} = \beta_K k_{it} + \beta_L l_{it} + \beta_X x_{it} + \beta_d d_{it} + \omega_{it} + \eta_{it}. \tag{10}$$

Now, instead of using continuous variable m_{it} with domain $[0, \infty)$, I utilize discrete decision to import, d_{it}. The implied transformation of import status variable from m_{it} to d_{it} involves both bottom and top coding since the values of m_{it} in the range (0,1) are transformed into 1, while the values of m_{it} in the range $(1, \infty)$ translate downwards into d_{it}=1 as well. In other words, firms with positive import shares below the value of 63,2% increase the value of import variable from bellow 1 to 1, while firms with import share values higher than 63,2% decrease it to 1.[72] In case of positive correlation between output and import status, we can expect $ß_d$ to be lower than $ß_m$ because there are more firms with import shares lower than 63% (Figure 21).[73]

Figure 21: Estimation bias from the use of discrete import variable instead of continuous import variable



Source: made-up data.

Notes: The figure depicts imaginary data on output (y) and import share (m). Continuous import data is denoted by circles and decoded to dichotomous import variable (d), indicated by black dots. Black line represents linear projection of y on m, while the dotted line corresponds to the relationship between y and d.

Source: own calculations.

The value of parameters $ß_m$ and $ß_d$ will reveal whether there is a positive static productivity effect of the use of imported intermediates. Positive estimates will provide firm-level evidence that internationalization of input supply-chain leads to productivity shifts. However, the parameter does not measure the causal effect of importing on productivity growth, but includes self-selection effect and dynamic effect of import status on productivity. As such it measures only the correlation between import status and firm's output. Both effects were incorporated in the theoretical model, where it was shown that only more productive firms offshore or perform foreign outsourcing (self-selection process) and that such organizational changes bring about persistent productivity increases (dynamic effect). These dynamic effects can be a consequence of either focus effect (as presented in my theoretical model) or any

[72] For m to be smaller than 1, $X/X^H < e$ and hence $X^F/X < (e-1)/e = 0.632$.

[73] If censoring of the regressor were from one side only, we could expect OLS estimates to produce expansion bias. Namely, estimated effect of import status would be too large in absolute terms (Rigobon and Stoker 2004).

other effect, such as learning by importing. In the first part of the empirical analysis, I will try to identify the presence of broadly-defined dynamic effects of import status on productivity improvements, while in the second part I will attempt to find evidence for the existence of focus effect in particular.

To identify the presence of dynamic effect of importing on productivity, I consider the following stochastic process of unobserved productivity shock ω_{it}:

$$\omega_{it} = \gamma d_{i,t-1} + \rho\omega_{i,t-1} + \xi_t + u_{it}, \qquad (11)$$

where ξ_t is a year-specific productivity shock, common to all the firms in a given industry and u_{it} is an i.i.d. shock. For a firm with no intermediate input imports at any year, the above process is just a standard AR(1) process, whereas for importing firms a positive value of γ confirms dynamic effects of import status on productivity. Suppose that t=1 is the first year of importing for a firm that then continues importing ever since. Productivity shock at time t can thus be written as $\omega_t = \gamma + \rho\gamma + \rho^2\gamma + ... + \rho^{t-1}\gamma + \rho^t\omega_0 + \varepsilon_t$. Long run effect of importing can be deduced from the above expression of ω_t as t→∞: $\omega_t \underset{t\to\infty}{=} \frac{\gamma}{1-\rho} + \varepsilon_\infty$.

5.2.2 The estimation procedure

Any estimation approach dealing with production function estimation has to contend with some crucial endogeneity issues. Estimation of equations (9) and (10) is problematic for several reasons. First, by definition of ω_{it}, part of the productivity shock 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 & Andrews, 1944).

Next, there is a problem of self-selection due to endogenous exit of firms. A firm will continue operations, χ_{it}=1, if and only if current realization of productivity shock is no smaller than the threshold productivity value that induces exit, $\omega_{it} > \underline{\omega}_{it}(k_{it}, d_{i,t-1})$. If the profit function is increasing in k and 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 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 and equation (11) would not be valid. 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 & 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 builds 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 and specified in equation (11).

As in OP, I assume that only labour and intermediate inputs are freely variable inputs, while capital and import decision are state variables. The reason for *k* being a state variable is that we suppose it takes one time period for current investments to become operational and affect firm’s capital stock. Each period, a firm sets optimal investment level corresponding to the observed productivity shock, present capital stock and other state variables. The investment demand function is given as $i_{it} = i_t^*(k_{it}, \omega_{it}, d_{it})$, where the function $i_t^*(\cdot)$ is time-dependent because state of the industry (prices, industry structure, time-specific common shocks) changes from one period to another. Import decision is treated as a state variable because, as explained above, I expect there are sunk-up start cost of importing material inputs and that importers face different material inputs price vector. Therefore, the material demand function can be expressed as $x_{it} = x_t^*(k_{it}, \omega_{it}, d_{it})$, where for the same reasons as above, $x_t^*(\cdot)$ is time dependent.

For the purposes of estimation approach, intermediate inputs will be used as a proxy variable for unobserved, time-varying productivity. The investment proxy suggested by OP is only valid for firms reporting positive investment. Due to many instances of zero investment in our sample, OP methodology suffers from the problem of truncation since all observations with zero investment have to be omitted from the calculation. Levinsohn and Petrin (2003) point out another possible weakness of OP method. Namely, if adjustment costs (that are also responsible for lumpy investment) produce non-monotonic points in the investment demand function, firms may not entirely respond to some productivity shocks, and correlation between the regressors and the error term can persist.[74] I rightfully assume that it is costlier for a firm to adjust intermediate consumption than investment activity. For these reasons intermediate inputs will proxy unobserved firm-specific productivity process.

Levinsohn and Petrin (2003) express the conditions under which the demand function for intermediate inputs is strictly increasing in productivity. Here, I assume that the conditions are fulfilled so that $x_t^*(\cdot)$ is strictly increasing in ω_{it}. Then, material's demand function can be inverted to obtain the productivity shock ω_{it} as a function of (k_{it}, x_{it}, d_{it}):

$$\omega_{it} = \omega_t^*(k_{it}, x_{it}, d_{it}) \tag{12}$$

Inserting (12) into the equation (10) yields partial linear function:

$$y_{it} = \beta_L l_{it} + \phi_t(k_{it}, x_{it}, d_{it}) + \eta_{it}, \tag{13}$$

where $\phi_t(k_{it}, x_{it}, d_{it}) = \beta_K k_{it} + \beta_X x_{it} + \beta_d d_{it} + \omega_t^*(k_{it}, x_{it}, d_{it})$.

In the first stage I am only able to obtain consistent estimates of β_L because the remaining variables appear in linear and nonlinear form in $\phi_t(k_{it}, x_{it}, d_{it})$. Making expectation of (13) conditional on (k_{it}, x_{it}, d_{it}) and subtracting it from (13), I obtain

$$y_{it} - E(y_{it}|k_{it}, x_{it}, d_{it}) = \beta_L(l_{it} - E(l_{it}|k_{it}, x_{it}, d_{it})) + \eta_{it}. \tag{14}$$

In order to estimate β_L, I have to obtain consistent estimates of conditional expectations, $E(y_{it}|k_{it}, x_{it}, d_{it})$ and $E(l_{it}|k_{it}, x_{it}, d_{it})$. To this end, a third order polynomial with a full set of interactions between the variables (k_{it}, x_{it}, d_{it}) will be used to approximate otherwise unknown functions of conditional expectations. OLS regressions of y_{it} and l_{it} on the power series of (k_{it}, x_{it}, d_{it}) will provide us with the estimates of the conditional expectations in place of actual conditional expectations in (14). Then, equation (14) will be estimated by OLS with no intercept, yielding an estimate of β_L, $\hat{\beta}_L$.

In the second stage I use the moment conditions to identify β_K, β_X, and β_d. Our first moment condition identifies β_K by assuming (as in OP and LP) that capital does not respond to the innovation in productivity, v_{it}. The second moment condition identifies β_X by using the fact that last period's materials choice should be uncorrelated with the innovation in current

[74] Doms and Dunne (1998) describe nonconvexities in manufacturing investment data from the U.S. census.

productivity. The last moment condition identifies β_d and comes from the fact that the past import decisions are uncorrelated with the innovation in productivity this period. The population moment conditions are given by

$$E[v_t k_t] = E[(v_t + \eta_t)k_t] = 0 \tag{15}$$
$$E[v_t x_{t-1}] = E[(v_t + \eta_t)x_{t-1}] = 0 \tag{16}$$
$$E[v_t d_{t-1}] = E[(v_t + \eta_t)d_{t-1}] = 0 \tag{17}$$

where v_{it} is the innovation in productivity and η_{it} is either measurement error or an i.i.d. shock not known to firms at the time of decision making. Error term v_{it} is the part of productivity shock (observable to the firm at period t) that the firm did not anticipate. In other words, it is the difference between the actual and the expected productivity: $v_{it} = \omega_{it} - E[\omega_{it} | \omega_{it-1}, d_{it-1}, \chi_{it} = 1]$.

Conditioning on χ_{it}=1 means that forming the expectation of current productivity is only reasonable if the i^{th} plant continues in business at t and not if it decides to exit the industry (χ_{it}=0). Furthermore, I am only interested in the unanticipated part of observed productivity, because the expected productivity shock is already included in firm's current business decisions. Hence, I could not have demanded the above orthogonality conditions unless the expectations were subtracted.

To minimize the objective function based on the above moment conditions, I need the values of the composite error term, $v_{it}+\eta_{it}$. However, to be able to determine the value of $v_{it}+\eta_{it}$ I would already have to know the parameter values we are actually trying to identify in this estimation step. Like in LP, this problem will be solved by iterating some estimation steps until the paramaters β_K, β_X, and β_d converge. For each candidate vector $\beta^* = (\beta_K^*, \beta_X^*, \beta_d^*)$ I will first construct estimate for the composite error term, identify new parameter vector ß* by minimizing the GMM criterion function and use new estimates for the next step in the iteration procedure. Using (10) and the definition of v_{it}, the expectation of the composite error term can be expressed as:

$$(v_{it} \hat{+} \eta_{it})(\beta^*) = y_{it} - \hat{\beta}_L l_{it} - \beta_K^* k_{it} - \beta_X^* x_{it} - \beta_d^* d_{it} - \hat{E}[\omega_{it} | \omega_{it-1}, d_{it-1}, \chi_{it} = 1]. \tag{18}$$

Following from (18), I will first have to obtain the estimate of $E[\omega_{it} | \omega_{it-1}, d_{it-1}, \chi_{it} = 1]$. Inserting (11) in (4), I can define the threshold value of u_{it} that induces a plant to exit at t by $\underline{u}_{it} \equiv \underline{\omega}_t(k_{it}, d_{it-1}) - \gamma d_{it-1} - \rho\omega_{it-1}$. Analogous to condition in (4), a plant continues in operation if $u_{it} \geq \underline{u}_{it}$, so the survival probability is given by

$$\Pr\{\chi_{it} = 1 | \omega_{it-1}, d_{it-1}, \underline{u}_{it}\} = \Pr\{\chi_{it} = 1 | \underline{u}_{it}(k_{it}, d_{it-1}, \omega_{it-1})\} = 1 - F_u(\underline{u}_{it}) \equiv P_{it}, \tag{19}$$

where $F_u(\cdot)$ is the cumulative distribution of u_{it}. From the definition of $\underline{u}_{it}$ above and equation (12), the survival probability (19) is $P_{it} = 1 - F_u\left(\underline{\omega}_t\left(k_{it}, d_{it-1}\right) - \gamma d_{it-1} - \rho\omega^*_{t-1}\left(x_{it-1}, k_{it-1}, d_{it-1}\right)\right)$ and is therefore a nonlinear function of (k_{it}, k_{it-1}, d_{it-1}, x_{it-1}). The survival probability will be estimated by the probit with a third-order polynomial series in (k_{it}, k_{it-1}, d_{it-1}, x_{it-1}) as regressors.

By inverting (19) I can express $\underline{u}_{it}$ as a function of P_{it}: $\underline{u}_{it} = \underline{u}^*\left(P_{it}\right)$. Taking expectation of (11) conditional on ω_{it-1}, d_{it-1}, and χ_{it}=1 yields the expression for the conditional expectation of ω_{it}:

$$E\left[\omega_{it} \middle| \omega_{it-1}, d_{it-1}, \chi_{it} = 1\right] = \gamma d_{i,t-1} + \rho\omega_{i,t-1} + \xi_t + E\left[u_{it} \middle| u_{it} \geq \underline{u}^*\left(P_{it}\right)\right]. \tag{20}$$

To obtain the estimate of $E\left[\omega_{it} \middle| \omega_{it-1}, d_{it-1}, \chi_{it} = 1\right]$ I first have to estimate equation (20). The regressand can consistently be approximated with the estimate of composite error term in (9) or (10), $\omega_{it}+\eta_{it}$. I use the estimate for β_L from the first stage and candidate values for β_K, β_X, and β_d to calculate the estimate of the composite error as follows: $\left(\omega_{it} \hat{+} \eta_{it}\right)\left(\beta^*\right) \equiv y_{it} - \hat{\beta}_L l_{it} - \beta^*_K k_{it} + \beta^*_X x_{it} + \beta^*_d d_{it}$. These estimates are then regressed by pooled OLS on the past import status d_{it-1}, the estimate of the previous period's productivity shock ω_{it-1}, time dummies ξ_t, and a third-order polynomial series of the survival probability (19) which approximates the term $E\left[u_{it} \middle| u_{it} \geq \underline{u}^*\left(P_{it}\right)\right]$. The estimate of ω_{it-1} is obtained using the definition of $\phi_t\left(k_{it}, x_{it}, d_{it}\right)$: $\hat{\omega}_{it-1}\left(\beta^*\right) \equiv \hat{\phi}_{t-1}\left(k_{it-1}, x_{it-1}, d_{it-1}\right) - \beta_K k^*_{it-1} + \beta^*_X x_{it-1} + \beta^*_d d_{it-1}$. The term $\hat{\phi}_t(\cdot)$ is the estimate of of $\phi_t(\cdot)$ obtained by the OLS regression of $y_{it} - \hat{\beta}_L l_{it}$ on a third-order polynomial series of $\left(k_{it}, x_{it}, d_{it}\right)$ as implied by equation (13). Temporal constant terms control for the time-specific productivity shocks that are common to all the firms in a given industry.

Having the estimate of the conditional expectation of ω_{it} at hand, I can proceed in calculating the estimate of composite error term $v_{it}+\eta_{it}$ according to equation (18). Next, I can exploit three moment conditions (15)-(17) to identify the parameters of interest. I also include six overidentifying conditions, yielding in total seven population moment conditions combined together in the vector of expectations $E\left[\left(v_{it} + \eta_{it}\right)Z_t\right]$, where Z_t is the vector given by Z_t={k_{it}, k_{it-1}, d_{it-1}, d_{it-2}, x_{it-1}, x_{it-2}, l_{it-1}}. The parameters $\beta^* = \left(\beta^*_K, \beta^*_X, \beta^*_d\right)$ are estimated by minimizing the GMM criterion function

$$Q(\beta^*) = \min_{\beta^*} \sum_{h=1}^{7} \left(\sum_{i} \sum_{t=T_{i0}}^{T_{i1}} (v_{it} \hat{+} \eta_{it})(\beta^*) Z_{ith} \right)^2 \qquad (21)$$

where i indexes firms, h denotes the seven instruments, and T_{i0} and T_{i1} index the third and last period firm i is observed. Standard errors are obtained by bootstrap.

5.3 The choice of econometric methods

This section describes econometric methods that will be used in the empirical part of my dissertation and have not yet been described in the previous chapter. First, an empirical model based on the theoretical model was presented in order to set stage for estimating the effect of importing through production function estimation. In this setting, standard regression methods such as ordinary least squares and fixed-effect estimation will be employed. These benchmark results will then be compared to Kasahara-Rodrigue estimator that deals with important estimation issues such as simultaneity, selection and endogeneity of import status by extending OP and LP methods. In the following section, propensity score matching technique will be introduced as a complement for parametric estimation and as a valuable tool for estimating the size and persistence of the effect of intermediate input imports on firm productivity and innovation activity. Before turning to these two principal econometric approaches, the empirical part will first present a series of descriptive statistics that will introduce the data, test some hypotheses and sequentially lead us from one estimation issue to another in order to make ground for the use of the extended production function estimation procedure and propensity score matching estimation. Now, I will briefly describe propensity score matching that will complement the production function estimation results and two methods from the first part of the empirical analysis. The first one uses OLS regression to calculate the premium of importers in a chosen performance measure with respect to non-importers. The second method is about establishing existence of stochastic dominance using two alternative tests: Kolomogorov-Smirnov and Mann-Whitney test.

5.3.1 Matching

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.[75] To be able to use all firm observations and not just the ones used in the Kasahara-Rodrigue procedure, I will assume stability of coefficients across the entire sample period. Estimated TFP will then be used to

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

test my hypothesis whether the use of imported intermediate inputs leads to productivity 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.[76]

The reason propensity score matching is my preferred econometric method lies in the characteristics of the evaluation problem which is to measure the impact of a structural change (in our case a firm starting to import intermediate inputs instead of acquiring it at home) on observational unit performance (productivity growth in our example). In other words, I would like to know the difference between the productivity growth of a new importer and the productivity growth of the same firm had it not started to import. This can be regarded as a missing data problem since at any moment in time each firm is either importing inputs or not, but never both:

$$Y_i = Y_i^C + D_i \left(Y_i^M - Y_i^C \right), \qquad (1)$$

where Y_i^M is an outcome variable (for example *TFP*) of denovo importer, Y_i^C is an outcome of non-importing firm and D_i is an indicator denoting the actual choice about internationalizing input procurement (D=1) or not (D=0).
If the performance of a denovo importer had it not started to import (Y_i^C) could be observed, there would in fact be no evaluation problem. Constructing the counterfactual is thus the central issue in matching methodology. I can write the outcomes as a function of observables (X) and unobservables (u^M and u^C):

$$\begin{aligned} Y_{it}^M &= g^M \left(X_{it} \right) + u_{it}^M \\ Y_{it}^C &= g^C \left(X_{it} \right) + u_{it}^C . \end{aligned} \qquad (2)$$

By assumption, $E\left(u^M \middle| X\right) = 0$ and $E\left(u^C \middle| X\right) = 0$ while g^M and g^C are nonstochastic functions. Note that I allow for different outcome functions according to the participation decision. For each individual denovo importer, I am interested in finding the causal effect of starting to import, $\alpha_i = Y_i^M - Y_i^C$. But since Y_i^C is not observed, I have to turn to population averages. The most commonly used evaluation parameter is the average treatment effect on the treated:

$$\alpha_T = E\left(Y^M - Y^C \middle| X, D = 1 \right) \qquad (3)$$

Matching techniques estimate the above average treatment by assuming that conditional on X, (Y_i^M, Y_i^C) and D are independent:

[76] For matching techniques in general, see Heckman, Ichimura and Todd (1997 and 1998); for propensity score matching in particular, refer to Rosenbaum and Rubin (1983 and 1984).

$$(Y_i^M, Y_i^C) \perp D | X \qquad (4)$$

This assumption, often labelled as the unconfoundedness assumption (a term coined by Rosenbaum & Rubin, 1983)[77], states that the productivity levels of the non-importers are independent of the import status, D, once we control for the observable variables X. If (4) is true, then $F(Y^C|X, D=1) = F(Y^C|X, D=0)$ and if a mean exists, $E(Y^C|X, D=1) = E(Y^C|X, D=0) = E(Y^C|X)$. That is, conditional on X, non-importers' productivity levels (the second terms in the above equalities) are what the importer's productivity levels (the first terms) would have been had they not decided to start importing. Selection thus occurs only on observables (Rosenbaum & Rubin, 1985). The essence of matching lies in finding for each denovo importer, Y^M, a non-importing (set of) firm(s), Y^C, with the same X-realization. Apart from the above assumption, the method also assumes that $0<\text{Prob}(D=1|X)<1$ in order to guarantee that each denovo importer has its corresponding counterpart in the control population.[78] Matching method does not specify a specific form of outcome equation, decision process or either unobservable term. All that has to be fulfilled is that given the proper observables, X, the outcomes of control firms are statistically what the outcomes of the importers would be had they not started to import intermediate inputs. Equation (3) can in fact be written in the following way:

$$\begin{aligned} \alpha_T &= E\left(Y^M - Y^C \middle| X, D=1\right) = \\ &= \left\{E\left(Y^M \middle| X, D=1\right) - E\left(Y^C \middle| X, D=0\right)\right\} - \left\{E\left(Y^C \middle| X, D=1\right) - E\left(Y^C \middle| X, D=0\right)\right\} \end{aligned} \qquad (5)$$

The last term in curly brackets represents the bias conditional on X, which is assumed to be zero. Expected value of the outcome (e.g. productivity level) of a denovo importer had it not started importing, $E\left(Y^C \middle| X, D=1\right)$, is assumed to be equal to the expected value of a non-importing firm, $E\left(Y^C \middle| X, D=0\right)$, both conditional on X. Assuming the bias goes to zero, the technique is to replace the unobserved outcomes of denovo importers had they not started to import with the outcomes of non-importers with the same X-characteristics.

The bias term can be decomposed into three distinct components:

$$Bias = \left\{E\left(Y^C \middle| X, D=1\right) - E\left(Y^C \middle| X, D=0\right)\right\} = B_1 + B_2 + B_3, \qquad (6)$$

[77] Lechner (2001) named it the »conditional independence assumption«, while Heckman and Robb (1985) refer to it as the »selection on observables«.
[78] Rosenbaum and Rubin (1983) describe it as the assumption that every unit in the population has a chance of receiving each treatment (being in or out of the programme). If the overlap assumption is violated at X=x, it would be infeasible to estimate both $E\left[Y_i \middle| X_i = x, D_i = 1\right]$ and $E\left[Y_i \middle| X_i = x, D_i = 0\right]$ because at those values of X there would be either only treated (de novo importers) or only control units (non-importing firms).

where B_1 is the bias due to non-overlapping support of X,[79] B_2 represents the bias component due to misweighing on the common support of X as the resulting empirical distributions of treated and non-treated are not the same even when restricted to the same support, and B_3 is the true econometric selection bias resulting from selection on unobservables. Matching process corrects for the first two bias components through the process of choosing and reweighing observations, while the third term is assumed to be zero (Blundell & Costa Dias, 2000, p. 450).

When X consists of a wide range of variables, finding a match on so many dimensions becomes extremely difficult. In order to circumvent this dimensionality problem, Rosenbaum and Rubin (1983) proposed to match on a function of X, namely, the propensity to start importing: $P(X_{it})=\text{Prob}(D_{it}=1|X_{it})$. This term is called the propensity score and it is shown that under the matching assumptions (equation (4) and the overlap assumption $0<\text{Prob}(D=1|X)<1$) the conditional independence remains valid if controlling for $P(X)$ instead of simultaneously on all covariates X:

$$(Y_i^M, Y_i^C) \perp D | P(X). \tag{6}$$

By aligning the distribution of observed characteristics in the non-importing population of firms with that in the importing population, matching mimics one feature of randomized experiments. Propensity score matching thus begins with the estimation of probabilities to start importing for the whole population and proceeds with using the propensity scores to find for each denovo importer the comparison group based upon a pre-defined criterion of proximity. Control firms within the neighbourhood are then given appropriate weights to associate the selected set of non-importing firms with each denovo importer. General form of the matching estimator is given by:

$$\hat{\alpha}_{MM} = \sum_{i \in M} \left(Y_{it} - \sum_{j \in C} W_{ij} Y_{jt} \right) w_i \tag{7}$$

where W_{ij} is the weight given to control firm j for denovo importer i and w_i accounts for the reweighing that reconstructs the outcome distribution for the sample of denovo importers. Here, M denotes the group of denovo importers and C is the corresponding control group.

In longitudinal datasets it is possible to estimate the treatment effect consistently by applying difference-in-differences (diff-in-diffs) estimator. It measures the excess outcome growth for the treated (denovo importers) compared with the non-treated (non-importers):

[79] In empirical studies one often cannot find similar propensity score for all the treated observations, which means that the common support is just a subset of the complete treated support. Such violation of the second matching assumption poses problems in the case of heterogeneous responses to the treatment. The estimator is then consistent only for the common support and can have weak relation to the mean outcome of the programme (Blundell & Costa Dias, 2000, p. 449-450).

$$\hat{\alpha}_{DID} = \left(\overline{Y}^{M}_{\tau_{post}} - \overline{Y}^{M}_{\tau_{pre}}\right) - \left(\overline{Y}^{C}_{\tau_{post}} - \overline{Y}^{C}_{\tau_{pre}}\right), \qquad (8)$$

where $\overline{Y}^{M}$ and $\overline{Y}^{C}$ are the mean outcomes for the importers and comparison groups, respectively, and I have introduced technical time τ_{pre} and τ_{post}, denoting the pre- and post-import-decision periods, respectively. In the rest of the dissertation, τ_{-1} will denote the period preceding the starting year of importing, τ_0, while τ_s will indicate a period s>0 years after the start of importing. The advantage of using diff-in-diffs estimator is in its robustness, since it does not require such strong assumptions about the error term in (2). If matching is combined with diff-in-diffs, there is scope for an unobserved determinant of selection into importing as long as it can be represented by separable individual- and/or time-specific components of the error term (Blundell & Costa Dias, 2000, p. 450). Error terms from (2) can be decomposed into firm-specific unobservable component (ϕ_i), aggregate time-specific shock (θ_t), and an i.i.d. error term (μ_{it}). The latter two error components are even allowed to be different for the importers and non-importers. Outcome functions in (2) can thus be rewritten as:

$$\begin{aligned} Y_{it}^{M} &= g_t^{M}\left(X_{it}\right) + \phi_i + \theta_t^{M} + \mu_{it}^{M} \\ Y_{it}^{C} &= g_t^{C}\left(X_{it}\right) + \phi_i + \theta_t^{C} + \mu_{it}^{C}. \end{aligned} \qquad (9)$$

Notice that we also allow the function g to change over time. The conditional independence assumption (6) can now be replaced by ($Y^{C}_{\tau_{post}}$ - $Y^{C}_{\tau_{pre}}$)$\perp D|$P(X), which is equivalent to:[80]

$$\left(g^{C}_{\tau_{post}}(X) - g^{C}_{\tau_{pre}}(X)\right) + \left(\theta^{C}_{\tau_{post}} - \theta^{C}_{\tau_{pre}}\right) \perp D | P(X). \qquad (10)$$

The above assumption is verified if both terms of the sum in (10) are conditionally independent of the participation decision, meaning that controls have evolved from a pre- to a post-import-decision period in the same way treatments would have done had they not been treated (Blundell & Costa Dias, 2000, p. 451).

The effect of the treatment on the treated (denovo importers) can now be estimated over the common support of X using:

$$\hat{\alpha}_{MMDID} = \sum_{i\in M}\left(\left(Y_{i\tau_{post}} - Y_{i\tau_{pre}}\right) - \sum_{j\in C} W_{ij}\left(Y_{j\tau_{post}} - Y_{j\tau_{pre}}\right)\right)w_i, \qquad (11)$$

where MMDID denotes method of matching with difference-in-differences. From an economic standpoint it is an attractive estimator, because unlike conventional matching estimators (3), it permits selection to be based on potential programme outcomes[81] and allows

[80] Here, the weaker mean independence version is stated as it is shown by Heckman et al. (1998) that the ignorability conditions (4) and 0<Prob(D=1|X)<1 are overly strong for estimation of (3).

[81] Matching can be performed on pre-treatment outcome variables in addition to propensity scores. This advantage will indeed be exploited in our empirical part, where we will match on pre-import-decision productivity levels and propensity scores.

for selection on unobservables (Heckman et al., 1997, p. 614). The latter can be revealed from cancellation of individual-specific unobservables (ϕ_i) in the assumption (10).

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[82], 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 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

[82] 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.

effect of starting to export (e.g. De Loecker, 2007; Damijan & 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.

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:

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

$\Phi(\cdot)$ 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*. Relative variables are expressed as deviations from the corresponding 3-digit industry average. 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.[83] 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}.

To guarantee that both matching assumptions are fulfilled, I first test the balancing hypothesis which states that firms with the same propensity score must have the same distribution of observable characteristics independently of treatment status. Regressors in (14) thus have to include all the relevant factors that influence firm's decision to start importing so that eventually denovo importers and control (i.e. similar according to propensity score) non-importers should be observationally identical. In other words, for a given propensity score,

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

decision to import is random (Becker & Ichino, 2002, p. 359). If the hypothesis is not satisfied, that is if the means of one or more characteristics differ, less parsimonious specification of *h* in the probit model is needed. To satisfy the second assumption, I impose a common support. This restriction implies that only the observations whose propensity score belong to the intersection of the supports of the propensity score of treated and controls are used.

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 non-importing 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 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 ($\tau_{-2}, \tau_{-1}, \tau_1, \tau_2, \tau_3$).

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).

According to *nearest neighbour matching within caliper*, a single non-importing firm j is selected on the following criteria:

$$C(P_{it}) = \left\{ j : \delta > \left| P_{it} - P_{jt} \right| = \min_{k \in C} \left(\left| P_{it} - P_{kt} \right| \right) \right\}. \qquad (13)$$

If none of the possible control firms lies within the prespecified caliper δ, i is left unmatched and the weight W_{it} in (11) is set to zero. In case of successful match, W_{ij}=1. In *K-nearest neighbour matching*, K control units with estimated propensity scores falling within a radius δ from P_{it} are matched to the treated unit i:

$$C(P_{it}) = \left\{ j : \left| P_{it} - P_{jt} \right| < \delta \right\}. \qquad (14)$$

The weights for radius matching are defined as $W_{ij} = 1/N_i^C$ if $j \in C(P_{it})$ and W_{ij}=0 otherwise, where N_i^C denotes the number of controls matched with denovo importer i and $N_i^C \leq K$.

Mahalanobis matching is an upgrade of *kernel-based matching* that uses all the firms from a pool of non-importers as a control group ($C(P_i)=\{j:D_j=0\}$) but weighs them according to the distance from the treated observation ($W_{ij} = K\left(\frac{P_i - P_j}{h}\right)$). I will use Epanechnikov kernel of the form $K(u)=(1-u^2)$ if $|u|<1$ and $K(u)=0$ otherwise. It therefore uses a moving window within the group of potential controls as it treats only those non-importers that lie within a fixed caliper h from P_i: $|P_i - P_j|<h$. 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). Match is performed on a metric distance derived from the following expression:

$$d(i,j) = \left(\mathbf{P}_i - \mathbf{P}_j\right)' \mathbf{S}^{-1} \left(\mathbf{P}_i - \mathbf{P}_j\right), \qquad (15)$$

where $\mathbf{P}_{i(j)}$ is the 2×1 vector of scores of unit *i(j)*, $(P_{i(j),t-1}\ \omega_{i(j)})'$, and **S** is the pooled within-sample 2×2 covariance matrix of **P** based on the sub-samples of the treated and complete non-treated pool (Sianesi 2001, pp. 14).

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 non-importing 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 β_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 β_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 length of the period in which new importers are tracked is arbitrary, but is influenced by the number of observations that decline steadily as we move away from the first year of importing (s=0). With $s\in[0,3]$ I can observe four years in which new importers sourced intermediate inputs from abroad. In my opinion, this is long enough period for potential changes in the firms to materialize and to asses the medium term effects of foreign sourcing on firm performance. 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.

5.3.2 Calculation of offshorer premium

Previous work on exporters (for example Bernard & Jensen, 1995, 1999, 2004; Damijan & Kostevc, 2006) and multinationals (for example Doms & Jensen, 1998a, 1998b) is related to research on offshoring. The exporting and multinational firms exhibit a premium in a variety of firm characteristics relative to non-exporters and non-multinationals: they are larger, have higher value added per employee, output, pay higher wages and are more capital- and skill-intensive. Similar to exporting and multinational literature, I will test whether such premia exists for offshoring firms, while controlling for additional firm-specific characteristics and time and industry controls. The following controlled OLS regressions will be run for each firm characteristic of interest in order to test for differences between outsourcing and non-outsourcing organizations:

$$x_{it} = \alpha_0 + \alpha_1 D_{it} + \alpha_2 l_{it} + \alpha_3 EX_{it} + \alpha_4 iFDI_{it} + \alpha_5 oFDI_{it} + \mathbf{X}_{it}\theta + \varepsilon_{it},$$

where x_{it} is the log of the measure of firm performance of interest, D_{it} is an indicator for offshoring activity, EX_{it}, $iFDI_{it}$, and $oFDI_{it}$ are export, inward FDI and outward FDI dummies, and $\mathbf{X}_{it}$ is a matrix of time and industry dummies. Because of the likely correlation between offshoring and exporting/FDI, I include exporting and FDI dummies in order to make sure that the activity of outsourcing is the primary cause for performance premium and that the results are not driven by a possible omitted variable bias. The coefficient α_1 will reveal the average percentage premium of offshorers over non-offshorers in a chosen firm characteristic. The percentage effect of offshoring and any other dummy variable is calculated with $100*\left(e^{\alpha}-1\right)$ (Halvorsen and Palmquist, 1980, p. 474).

5.3.3 Tests for stochastic dominance

In order to test for productivity supremacy of firms that source inputs from abroad, I employ two tests of stochastic dominance that take into account not only means of different groups of firms but also higher moments of distribution. The Kolmogorov-Smirnov test (KS-test) tries to verify if two datasets differ significantly. An attractive feature of this test is that the distribution of the KS test statistic itself does not depend on the underlying cumulative distribution function being tested. Another advantage is that it is an exact test (the chi-square goodness-of-fit test depends on an adequate sample size for the approximations to be valid).

However, this generality comes at some cost, since other tests (for example Student's t-test) may be more sensitive if the data meet the requirements of the test. Let H and F denote cumulative distribution functions for domestic and foreign sourcing firms, respectively. First-order stochastic dominance of F with respect to H is defined as F(z) − H(z) ≤ 0 uniformly in z∈**R**, with strict equality for some z. In order to implement the comparison I follow Wagner (2006), Delgado et al. (2002), and Girma, Görg and Strobl (2004) and adopt the nonparametric two-sided Kolmogorov–Smirnov (KS) test which tests the hypothesis that both distributions are identical. The null and alternative hypotheses can be expressed as:

$H_0 : F(z) - H(z) = 0 \;\; \forall z \in \Re$ vs. $H_1 : F(z) - H(z) \neq 0$ for some $z \in \Re$.

The KS test statistics for the two-sided test is given by:

$$KS = \sqrt{\frac{n*m}{N}} \max_{1 \le i \le N} \left| F_n(z_i) - H_m(z_i) \right| ,$$

where n and m are the sample sizes from the empirical distributions of F and G, respectively, and $N = n + m$. Note that this tests not only for differences in the mean productivity of both groups (like in almost all other papers in the literature on trade and productivity) but for differences in all moments of the distribution. The two-sample Kolmogorov-Smirnov test uses the maximal distance between cumulative frequency distributions of these two samples as the statistic. If the difference is larger than the critical value, the null hypothesis can be rejected and we can claim that the distributions differ (for details, see Conover, 1999, p. 456).

The Mann-Whitney U test (hereafter MW-test; otherwise also called Wilcoxon rank-sum test, or Wilcoxon-Mann-Whitney test) is a non-parametric test for assessing whether two samples of observations come from the same distribution. The null hypothesis is that the two samples are drawn from a single population, and therefore that their probability distributions are equal. It requires the two samples to be independent, and the observations to be ordinal or continuous measurements. Unlike t-test, Normal distribution of the data is not necessary for use of this test, as was the case in KS-test. The test is very simple and consists of combining the two samples, n_1 and n_2 into one sample of size n_1+n_2, sorting the result, assigning ranks to the sorted values (giving the average rank to any `tied' observations), and then letting U_1 be the sum of the ranks for the observations in the first sample. Under the null hypothesis, if the two populations have the same distribution then the sum of the ranks of the first sample and those in the second sample should be close to the same value. The null hypothesis of the equality of distributions between the two samples is rejected if sum of the ranks in one sample are significantly larger than that in the other sample.

5.4 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. The biannual innovation data was linked with the rest of the yearly data so that changes in import status were not lost if they happened to lie in the year between the CIS survey years. 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. In classifying products into intermediate inputs, I use UN Comtrade classification of goods in SNA in the categories of BEC (Broad Economic Activities). However, I exclude Food and beverages, primary and processed categories (BEC codes 111 and 121, respectively), primary Fuels and lubricants category (BEC code 31), and primary Industrial supplies not elsewhere specified (BEC code 21). All value data are in Slovene tolars[84] and are deflated with corresponding 2-digit NACE industry producer price indices, while the capital stock was deflated by consumer price index. In the empirical analysis only the data of firms larger or equal to 5 employees was used in order to partially clean the dataset from outliers. The other

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

outliers were removed after the inspection of the most important variables (sales, employment, capital) industry by industry.

6 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 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 the augmented Olley-Pakes/Levinsohn-Petrin proposed by Kasahara and Rodrigue (2008) and propensity score evaluation methods according to Blundell and Costa Dias (2000) and Smith and Todd (2001).

6.1 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 11 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.

Table 11: 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: own calculations.

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 Table 11, 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 12).

Table 12: 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: 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 13). 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.[85] 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 20% and 70% 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.

[85] 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.

Table 13: 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: own calculations.

Table 14 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 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.

Table 14: 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: own calculations.

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 group of domestic sourcers and importers with outward FDI. However, since offshore outsourcers represent the majority of firms in Slovene manufacturing, their average relative productivity improves only marginally in the analysed time interval.

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 15 shows that the above concerns were redundant as importing firms remain more productive even in more narrowly defined sectors.

Table 15: 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: own calculations.

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

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 16 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 & Kostevc, 2006 and Blalock & 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 16: 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: 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 17). 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 17: Relative labour productivity of manufacturing firms with respect to their share of intermediate inputs imports in total material costs by sector, 1994-2003 average.

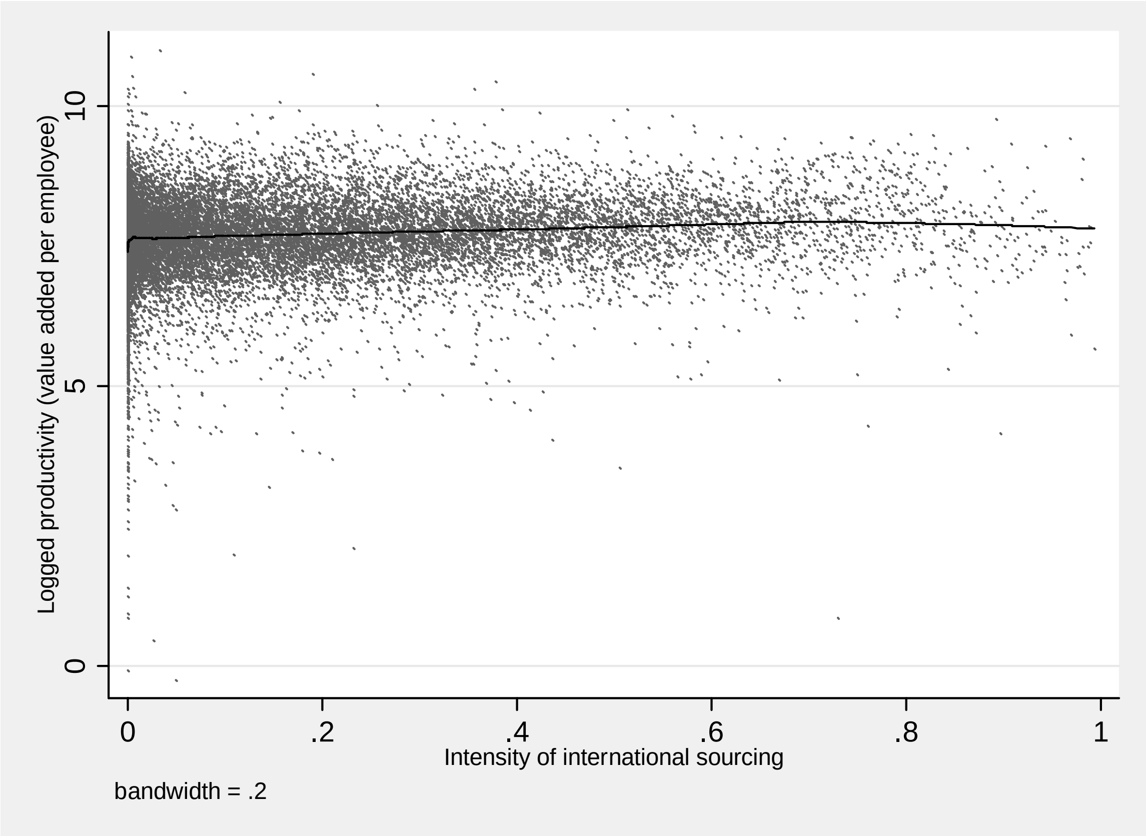
nace2	m=0	N	0<m<0.30	N	0.30<m<0.50	N	0.50<m<1	N
15	0.789	700	1.147	998	1.110	22	-0.546	1
16			1.000	10				
17	0.646	139	0.922	446	1.225	233	1.165	216
18	0.814	369	1.086	600	1.214	92	1.059	33
19*	0.719	60	1.022	205	1.182	32	1.284	24
20	0.878	538	1.057	841	1.237	79	0.869	25
21	0.581	77	0.977	231	0.900	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: 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 16 and Table 17 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 22). Indeed, the relationship between the variables appears to be concave with the maximum productivity level achieved at around 75% share of imported inputs.

Figure 22: 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: 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 18 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.

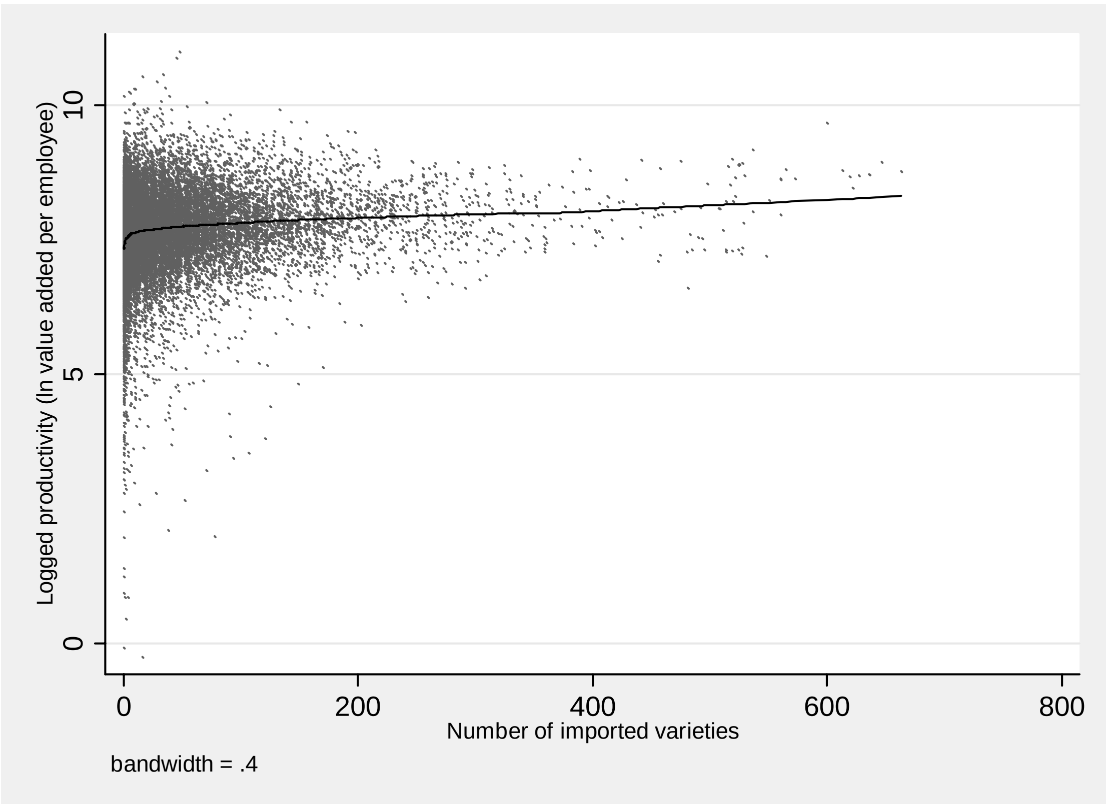
Table 18: Relative labour productivity, capital-labour ratio, employment and sales with respect to the number of imported varieties, 1994-2003 average.

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: own calculations.

Figure 23: 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: own calculations.

Figure 23 confirms the finding from Table 18 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.

Heterogeneity in importing behaviour is also reflected in the relationship between the number of import markets and firm characteristics (Table 19). 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 19: Relative labour productivity, capital-labour ratio, employment and sales with respect to the number of import markets, 1994-2003 average.

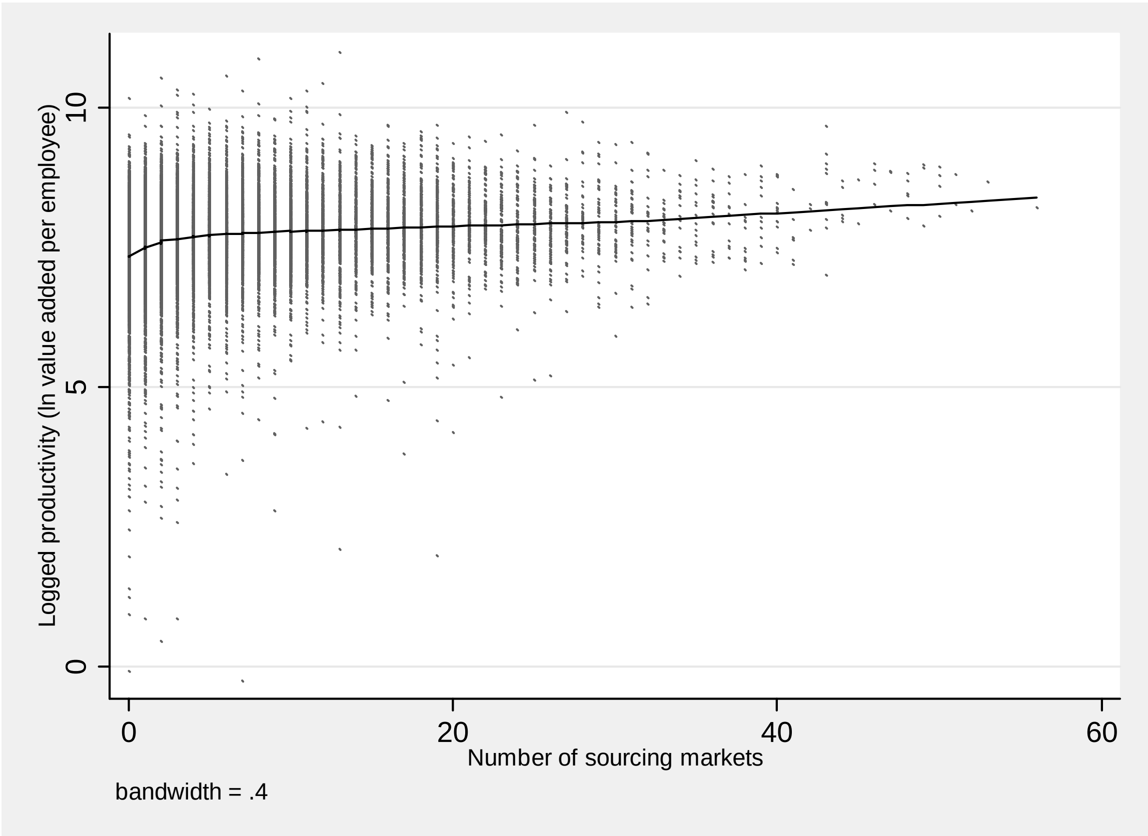
No. of import markets (n)	rval	rkl	rl	rsales	N
n=0	0.779	0.660	0.337	0.234	4,034
n=1	0.891	0.848	0.368	0.306	2,933
n=2	0.972	0.977	0.449	0.402	2,222
n=3	1.015	1.098	0.546	0.522	1,916
4≤n<6	1.079	1.146	0.697	0.704	2,799
6≤n<8	1.078	1.081	0.906	0.911	1,993
8≤n<10	1.119	1.159	1.159	1.187	1,436
n≥10	1.154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

In Figure 24, 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. In the Appendix B, I present the relationship between the size and the import range and geographical dispersion of input sourcing for offshoring firms with and without outward FDI. The figures reveal the positive link between firm size in terms of employment and the number of imported varieties and the number of import countries as they both sharply increase in size.[86] Furthermore, even after controlling for size, multinationals tend to import around 20-50 varieties more than importers without foreign subsidiaries and maintain supplier relationships with 4 more countries than non-multinational importers. These facts are consistent with anecdotal evidence that multinational firms have better business network abroad and hence face lower fixed costs of importing.

Figure 24: 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: own calculations.

Finally, I present the dynamics of entry and exit in and out of import market (Table 20). 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

[86] The reader should bear in mind that productivity values on the graph are logged, which optically moderates the positive association.

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 20: 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.

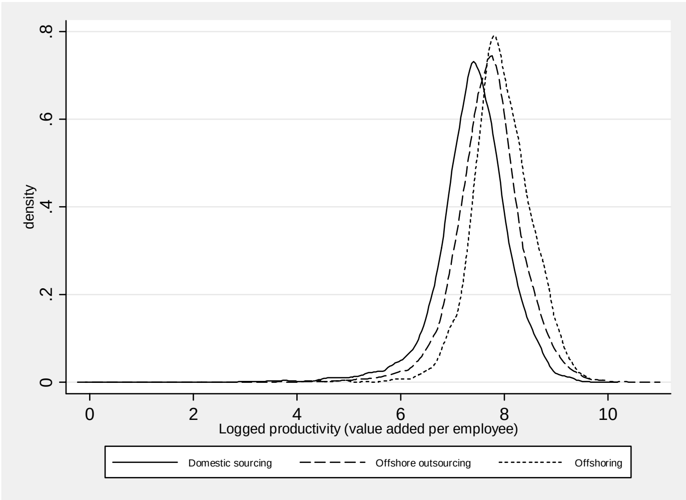
Source: own calculations.

6.2 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 described in chapter 5.3.3, let me first present graphically the distributions to be tested. Figure 25 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 25: 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: own calculations.

To test whether the observed differences in Figure 25 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 25, 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 I 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 II), followed by the results of the tests on the Hypothesis III which states that foreign sourcers with outward FDI stochastically dominate the distribution function of firms performing cross-border outsourcing of intermediate inputs. Finally, I employ the two stochastic dominance tests to see whether the distribution function of offshore outsourcers in terms of the relative value added per employee stochastically dominates that of the firms sourcing inputs only domestically (Hypothesis IV).

Table 21-Table 24 undoubtedly confirm the Hypothesis I that importers of intermediate inputs stochastically dominate non-importers in terms of the productivity distribution. Both pooled (Table 21) 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-statistics 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 21 is further confirmed in the year-by-year KS-tests (Table 22), since in every single year the distribution of importers stochastically dominates the distribution of domestic firms.

Table 21: Kolmogorov-Smirnov test of stochastic dominance for Hypothesis I 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: own calculations.

Table 22: Kolmogorov-Smirnov test of stochastic dominance for Hypothesis I 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: own calculations.

Table 23 and Table 24 present the results of the Mann-Whitney test of Hypothesis I 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 I 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 23: Two sample Mann-Whitney test on Hypothesis I 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: own calculations.

Table 24: Year-by-year results of the two sample Mann-Whitney test on Hypothesis I 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: 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 II compares the distribution of non-importers to that of non-multinational foreign sourcers and the results of the tests are reported in Table 25-Table 28. 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 25: Kolmogorov-Smirnov test of stochastic dominance for hypothesis II 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: own calculations.

Table 26: Kolmogorov-Smirnov test of stochastic dominance for hypothesis II 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: own calculations.

Table 27: Two sample Mann-Whitney test on Hypothesis II 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: own calculations.

Table 28: Year-by-year results of the two sample Mann-Whitney test on Hypothesis II 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: own calculations.

Testing for the validity of Hypothesis III results in equally strong confirmation as the tests for the previous two hypotheses (Table 29-Table 32). 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.

Table 29: Kolmogorov-Smirnov test of stochastic dominance for hypothesis III 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: own calculations.

Table 30: Kolmogorov-Smirnov test of stochastic dominance for hypothesis III annually for each year in the period 1994-2003.

Year	D	P-value	Corrected
1994	0.3005	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: own calculations.

Table 31: Two sample Mann-Whitney test on Hypothesis III 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: own calculations.

Table 32: Year-by-year results of the two sample Mann-Whitney test on Hypothesis III 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: own calculations.

The last hypothesis – probably redundant a propos the previous results, but nevertheless included for the sake of completeness – checks whether firms that outsource inputs from abroad and have at least one foreign direct investment exhibit different distribution of relative productivity than firms that source their inputs exclusively domestically. Not surprisingly, all the tests reject the null hypothesis of equal distribution functions between the two samples at a high level of significance (Table 33-Table 36). 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.[87] These include – apart from higher marginal costs already compensated by lower production costs abroad – fixed costs of coordination, communication, control, management, and transportation.

[87] A limited but very useful organizing framework for inquiring into the nature of these advantages was proposed by John 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 33: 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	0.3482	0.000	
Captive offshorers	-0.0012	0.996	
Combined K-S:	0.3482	0.000	0.000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.

Source: own calculations.

Table 34: Kolmogorov-Smirnov test of stochastic dominance for hypothesis IV annually for each year in the period 1994-2003.

Year	D	P-value	Corrected
1994	0.4298	0.000	0.000
1995	0.3918	0.000	0.000
1996	0.3310	0.000	0.000
1997	0.3906	0.000	0.000
1998	0.3334	0.000	0.000
1999	0.3727	0.000	0.000
2000	0.4030	0.000	0.000
2001	0.3580	0.000	0.000
2002	0.3270	0.000	0.000
2003	0.3400	0.000	0.000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.

Source: own calculations.

Table 35: Two sample Mann-Whitney test on Hypothesis IV that captive offshoring firms are relatively more productive than domestic sourcing firms over the entire period of observation, 1994-2003.

Firm type	Obs	Rank sum	Expected
Offshore outsourcing	5,165	16,008,331	18,173,053
Captive offshoring	1,871	8,747,836	6,583,114
Combined	7,036	24,756,166	24,756,166

unadjusted variance	5.67e+09
adjustment for ties	-286.993
adjusted variance	5.67e+09

Ho: rval(dom_off =0) = rval(dom_off =1)

z = -28.756

Prob > z = 0.0000

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.

Source: own calculations.

Table 36: Year-by-year results of the two sample Mann-Whitney test on Hypothesis IV that captive offsoring firms are relatively more productive than domestic sourcing firms.

Year	Prob > |z|	Obs
1994	0.0000	452
1995	0.0000	527
1996	0.0000	636
1997	0.0000	651
1998	0.0000	713
1999	0.0000	739
2000	0.0000	740
2001	0.0000	812
2002	0.0000	911
2003	0.0000	855

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.

Source: 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.

6.3 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-importers. 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 37 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. The results of the year-by-year analysis are somewhat less reassuring (Table 38). Although the KS-statistic is positive in every period, it is only significant in three of the nine observed years. The reason probably lies in the lack of data in the given years, which seriously reduces the degrees of freedom involved in calculation of the test statistic and therefore reduces the significance level.

Table 37: 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: own calculations.

Table 38: Kolmogorov-Smirnov test of stochastic dominance for self-selection into foreign sourcing hypothesis annually for each year in the period 1994-2002.

Year	D	P-value	Corrected
1994	0.2569	0.169	0.113
1995	0.2698	0.127	0.082
1996	0.2639	0.035	0.022
1997	0.1552	0.485	0.402
1998	0.3234	0.004	0.002
1999	0.1497	0.681	0.593
2000	0.1699	0.349	0.275
2001	0.1342	0.685	0.605
2002	0.1266	0.272	0.224

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.

Source: own calculations.

The results of the Mann-Whitney test of stochastic dominance for self-selection into foreign sourcing (Table 39) confirm the findings of the KS-test for the entire period 1994-2002, but again fail to unambiguously reaffirm the results on the year-by-year basis (not reported here). What is reassuring is the fact that in both year-by-year series of tests, D-statistics and rank sum values are systematically speaking in favour of prospective importers being more productive than non-importers that stay confined to domestic market. Despite the weak results in the year-by-year analysis and in view of the data shortage, the hypothesis of self-selection into foreign sourcing can (at least partially) be confirmed.

Table 39: 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: 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 40-Table 42 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 40: 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: own calculations.

Table 41: Kolmogorov-Smirnov test of stochastic dominance for self selection into captive offshoring hypothesis annually for each year in the period 1994-2002.

Year	D	P-value	Corrected
1994	/	/	/
1995	/	/	/
1996	0.8598	0.451	0.333
1997	0.3089	0.046	0.027
1998	0.1950	0.382	0.294
1999	0.2303	0.026	0.017
2000	0.2046	0.023	0.016
2001	0.1207	0.360	0.303
2002	0.3868	0.042	0.022

Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees.

Source: own calculations.

As seen from Table 40, 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 (Table 41). 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 42: 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: own calculations.

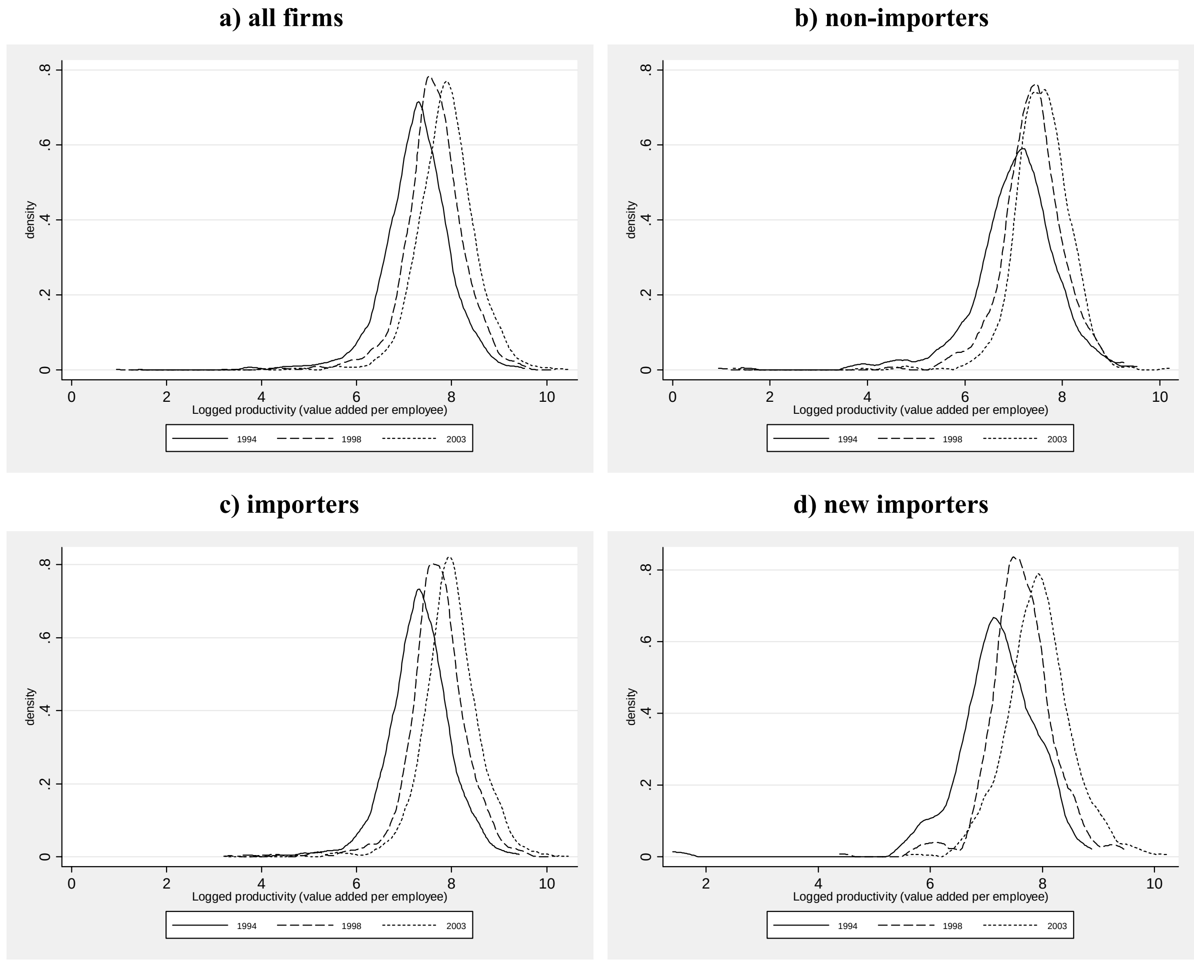
The evidence at hand leads me to confirm the second self-selection hypothesis with even greater confidence than the first one. I can therefore attest the predictions of my theoretical model that more productive firms choose to purchase intermediate inputs abroad and that the most productive of intermediate 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.

6.4 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 26a-Figure 26d 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 26a-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.



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: own calculations.

Figure 26a 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 26b and Figure 26c 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 11 for a similar finding).

Finally, Figure 26d depicts the evolution of productivity distribution of new importers. Unlike Figure 26b and Figure 26c, where only observations without and with positive imports are present, respectively, Figure 26d 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 27a-Figure 27g present the progress of eight performance measures in 917 new importers available in my sample. A firm is 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.

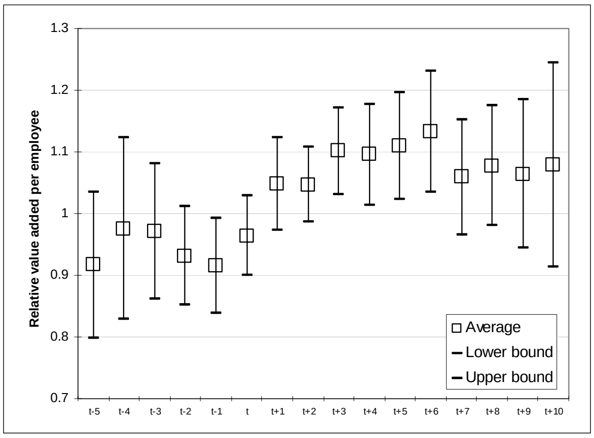
Figure 27a and Figure 27b depict the development of relative productivity as measured by value added per employee and total factor productivity, respectively. Both measures experience very similar movement in time, but they differ in the relative position. While average relative labour productivity of 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 27a and Figure 27b 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 27e). It turns out that new importers not only increased the number of employees relative to the industry average (Figure 27f), 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.

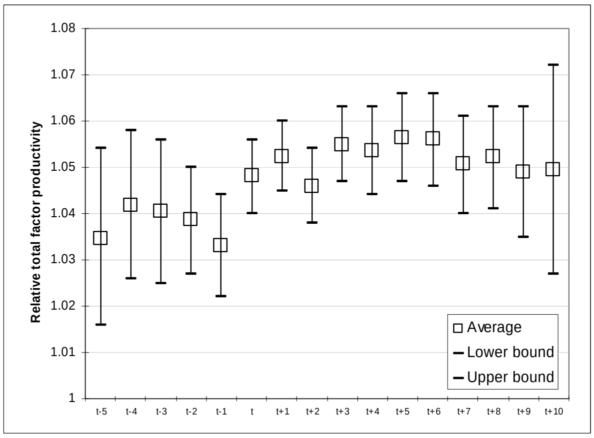
Figure 6c uncovers the fact that the largest improvement of performance in the period of importing comes in the form of significantly larger relative sales that escalate from less than 50% of the industry average a year before import start to roughly the industry average by the 7th or 10th subsequent 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.

Figure 27a-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.

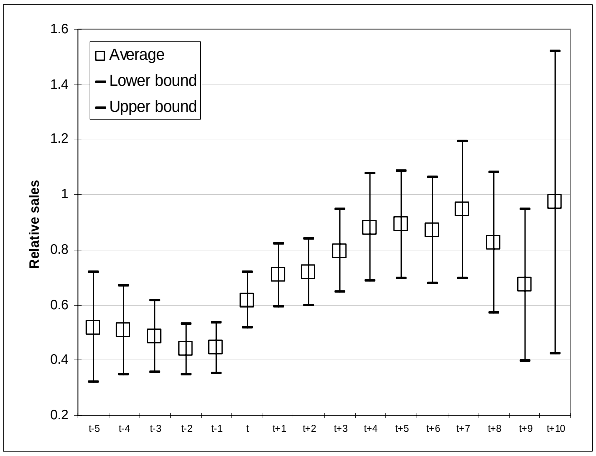
a)



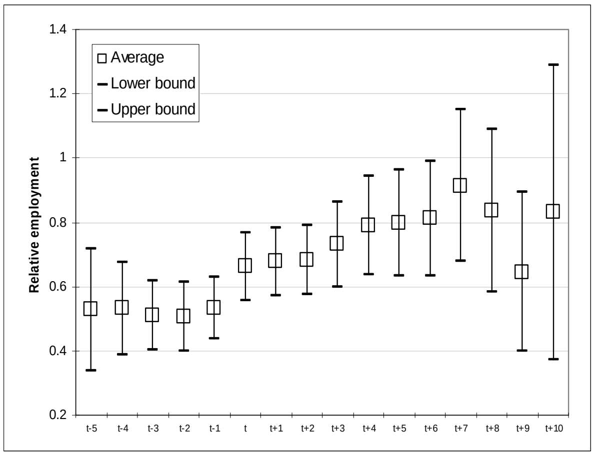
b)



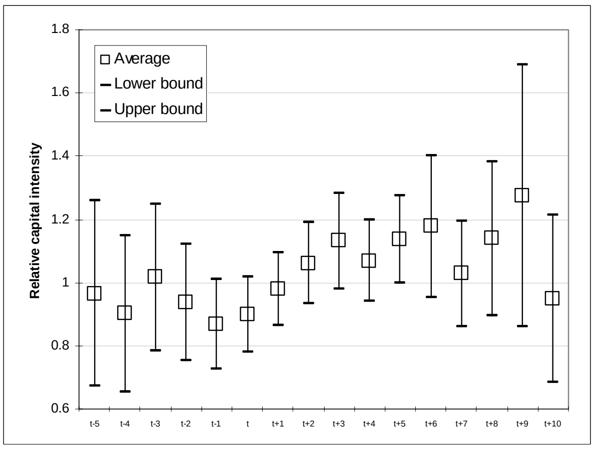
c)



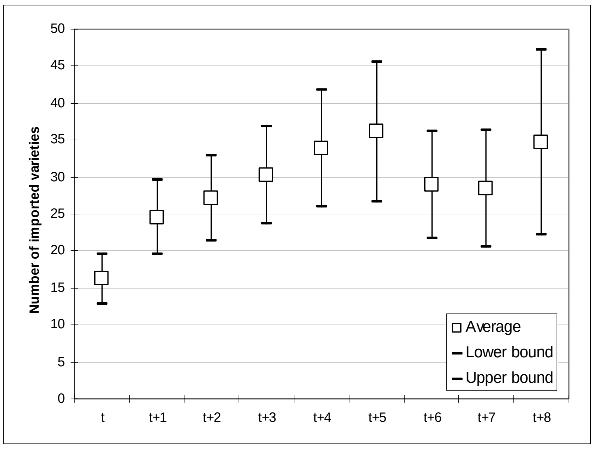
d)



e)



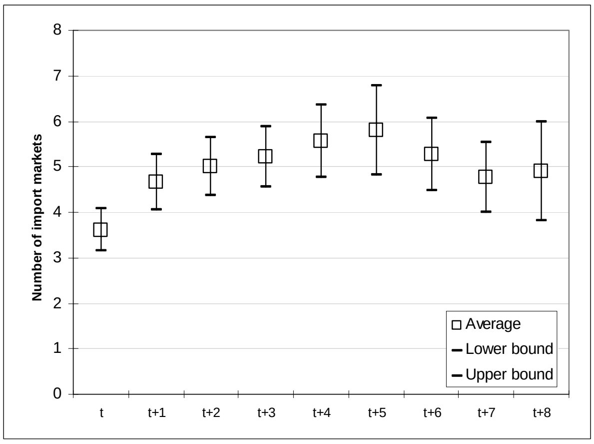
f)



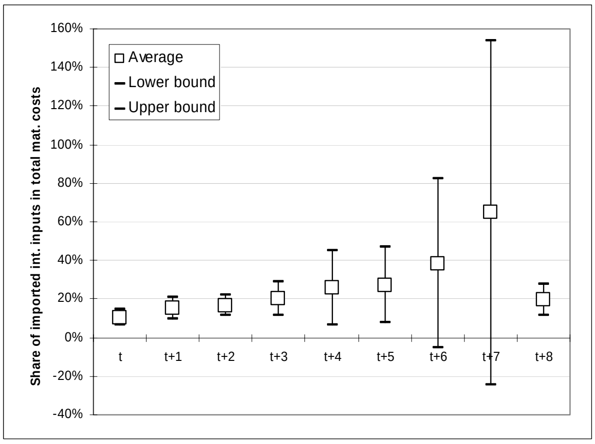
(continues on the next page)

(continued from the previous page)

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: own calculations.

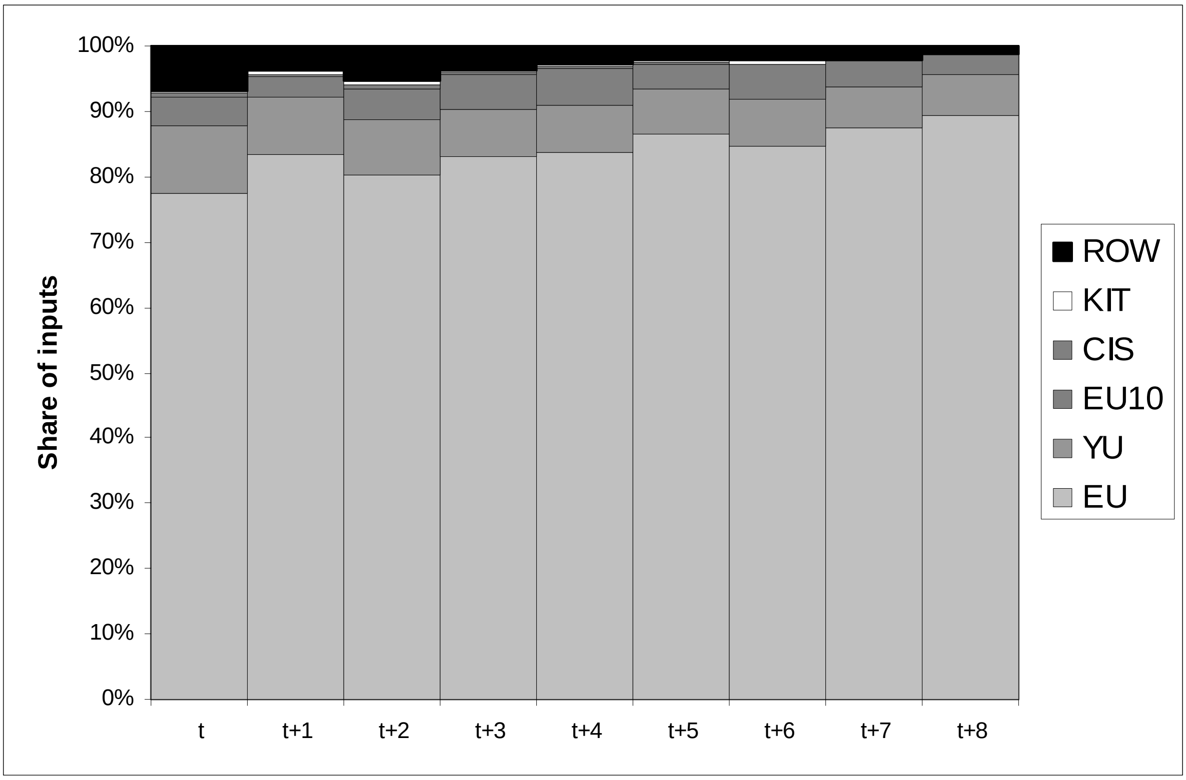
The evolution of employment in new importers closely relates to the movement in total revenue, although the shifts appear more moderate and even (Figure 27d). Unlike total revenue, employment in new importers never reaches the industry average but evens out at around 85% of the industry average.

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 27f trails the number of imported varieties in an average new importer through time. The number of varieties starts at 16 in the first 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 27g 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 27h 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 28 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 28: Geographical composition of intermediate input imports of new importers, 1994-2003.



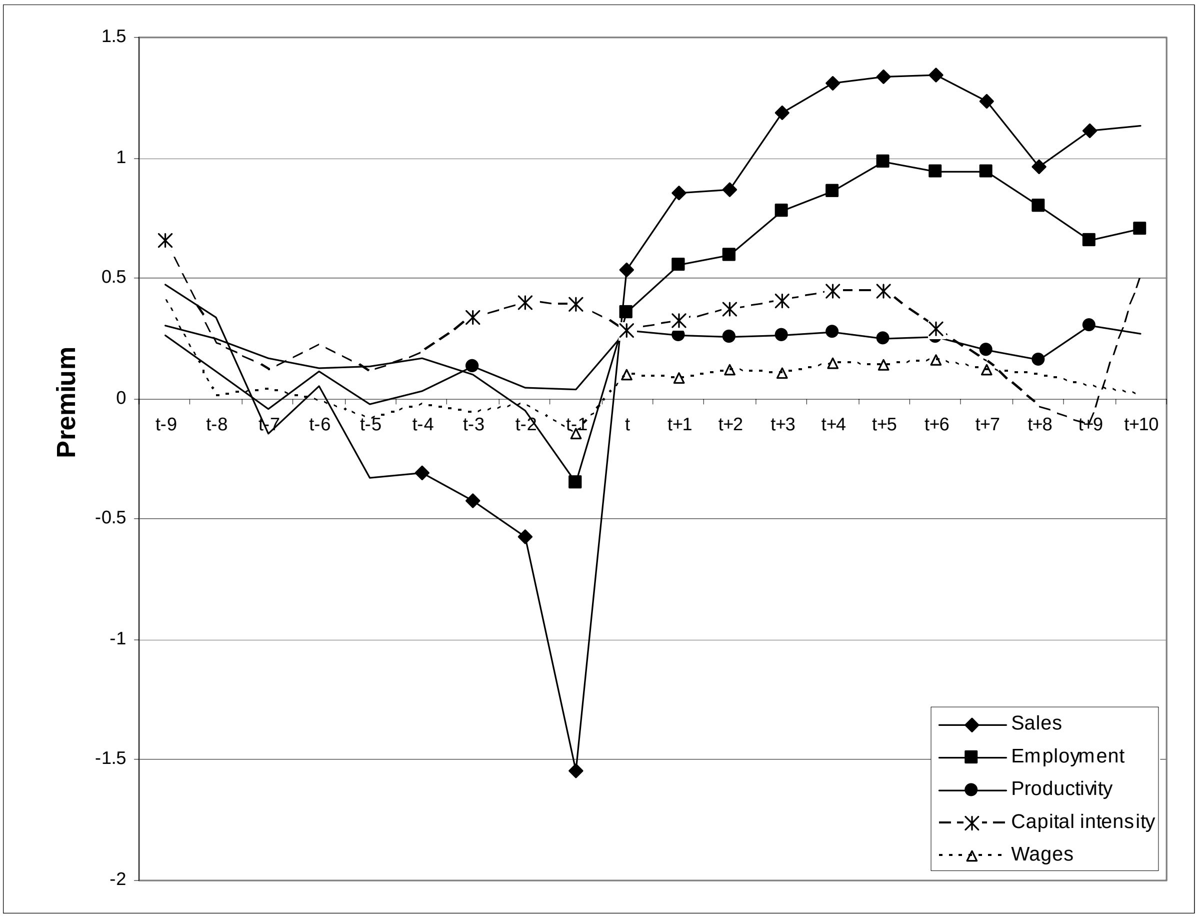
Note: The statistics are based on the restricted sample that excludes the firms with less than 5 employees. New importers are firms that switched from non-importing to permanent foreign sourcing somewhere in the period 1995-2003. Time *t* denotes technical time and is set in the way that *t+k* represents *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: 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 29 presents the results of the regression analysis for five performance measures: total revenues, employment, labour productivity, capital intensity, and average wages. Figures B3-B7 in the Appendix B present the results of the year-by-year analysis for each variable separately.

In most of the performance indicators upcoming new importers do not significantly differ from 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. Here and in later on when the results of propensity score matching are presented, the analysed period for the change in import status is the same as before (1994-2003), but because I have the accounting data available also on the years 2004 and 2005, I can track certain firm characteristics over 1994-2005 period.

Figure 29: 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: own calculations.

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 27a, 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 compare 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. Hall, 1987, p. 602; Klette & Kortum, 2004, p. 989), 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.[88] Table 43 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.

[88] For that reason, age and squared age was also included in propensity score calculation so that firms of similar age were matched in a new importer/non-importer pair.

Table 43: 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: own calculations.

The last column in Table 43 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 first step, the results of the semi-parametric analysis that combine and extend the Olley and Pakes (1996) and Levinsohn and Petrin (2003) approaches will be presented. The aim of this section will be to identify static and dynamic effects of importing through the parameters of the extended production function estimation where I control for selection, simultaneity and endogeneity of import status. In the second 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 dissertation 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.

6.5 Results of the production function estimation

Table 44 and Table 45 present the results from various estimators using the discrete choice import variable and continuous measure of import usage, respectively. For each of the import variables I first estimate the revenue function (columns (1)-(4)) and next the value added function (columns (5)-(8)). After OLS and within estimators I report the results of the Kasahara-Rodrigue estimator using nonlinear (columns (3) and (7)) and grid (columns (4) and (8)) search over the parameters in the second step of estimation procedure.

Table 44: Estimates of production function (discrete import variable), 1994-2003

	Revenue function				Value added function			
Estimators	OLS	Within	Kasahara-Rodrigue		OLS	Within	Kasahara-Rodrigue	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Labour	0.211***	0.241***	0.208***	0.208***	0.746***	0.807***	0.575***	0.560***
	(0.002)	(0.004)	(0.003)	(0.003)	(0.004)	(0.008)	(0.009)	(0.011)
Capital	0.024***	0.038***	0.031***	0.060***	0.205***	0.180***	0.217**	0.110
	(0.001)	(0.002)	(0.010)	(0.013)	(0.003)	(0.004)	(0.100)	(0.071)
Materials	0.757***	0.769***	0.720***	0.550***				
	(0.002)	(0.003)	(0.018)	(0.035)				
Disc.	0.053***	0.008	0.028**	0.440***	0.275***	0.099***	0.783**	0.440
import	(0.004)	(0.005)	(0.012)	(0.028)	(0.009)	(0.011)	(0.366)	(0.381)
γ	–	–			–	–		0.194***
								(0.002)
ρ	–	–			–	–		0.713***
								(0.004)
No. obs.	32,494	32,494	32,494	32,494	31,749	31,749	31,749	21,381

Notes: Standard errors are in parentheses. Columns (3) and (7) use nonlinear search of the parameters that minimize the GMM criterion function, while columns (4) and (8) perform grid search. Standard errors for Kasahara-Rodrigue estimations are obtained by bootstrapping with 100 repetitions.

Source: own calculations.

The most important finding in Table 44 is the large size and frequent significance of the current discrete import variable coefficient across different estimators and model specifications. The OLS point estimates imply that a firm sourcing intermediate inputs only domestically can increase its productivity by 5 or 28 percent if it starts sourcing inputs abroad. To control for the bias due to correlation between an unobserved productivity shock and inputs, not taken care of by OLS estimator, I next perform the within estimator. The latter is namely robust against the simultaneity between time-constant plant-specific shock and input decisions but does not address the simultaneity between inputs and the persistent shocks that vary within firms over time. The within estimator produces somewhat lower but still significant results. Controlling for both selection and correlation between inputs and an unobserved productivity shock by using intermediate inputs as proxies for unobserved productivity shocks, the Kasahara-Rodrigue estimator indicates large productivity effects of the switch form domestic to international input sourcing. Given the wide range of estimates across different specifications, the magnitude of the effect cannot be stated certainly. Nevertheless, the results in Table 44 suggest that imports of intermediate inputs have significant and important static effects on firm productivity.

Another important finding is that even in specification (8) where import variable turns out insignificant, the estimated values of γ are positive and highly significant.[89] This indicates a positive dynamic effect of foreign subcontracting. The value for ρ indicate that serially correlated productivity shocks are highly persistent.

Table 45 presents the results from the estimates using continuous import variable ($m_{total}/m_{domestic}$). The estimated coefficients on capital, labour and materials are mostly significant and similar in value to those in Table 44, suggesting that the use of continuous import variable instead of discrete one does not change the results. As expected, the coefficients on labour input are lower in Kasahara-Rodrigue estimations than in OLS and within estimations since import status is strongly positively correlated with the productivity shock. The opposite holds for the capital coefficients, although the direction of the bias in the capital coefficient is less clear ex-ante since it impacts both through the selection equation and the productivity shock. Estimates on import variable, however turn out to be vastly different across estimators and mainly insignificant in case of Kasahara-Rodrigue estimator. The positive estimate of γ suggest the presence of significant dynamic effect, although smaller in magnitude than in Table 45.

Table 45: Estimates of production function (continuous import variable), 1994-2003

	Revenue function				Value added function			
Estimators	OLS	Within	Kasahara-Rodrigue		OLS	Within	Kasahara-Rodrigue	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Labour	0.210***	0.241***	0.207***	0.207***	0.765***	0.814***	0.574***	0.574***
	(0.002)	(0.004)	(0.005)	(0.006)	(0.004)	(0.008)	(0.009)	(0.009)
Capital	0.024***	0.038***	0.030	0.060*	0.217***	0.182***	0.283***	0.310***
	(0.001)	(0.002)	(0.020)	(0.031)	(0.003)	(0.004)	(0.065)	(0.025)
Materials	0.763***	0.770***	0.738***	0.700***				
	(0.002)	(0.003)	(0.096)	(0.065)				
Cont.	0.032***	0.010**	0.012	-0.200	0.062***	-0.004	1.000**	0.120
import	(0.004)	(0.005)	(0.383)	(0.442)	(0.008)	(0.010)	(0.401)	(0.350)
γ	–	–			–	–		0.017***
								(0.003)
ρ	–	–			–	–		0.638***
								(0.001)
No. obs.	32,494	32,494	32,494	32,494	31,749	31,749	31,749	31,749

Notes: Standard errors are in parentheses. Columns (3) and (7) use nonlinear search of the parameters that minimize the GMM criterion function, while columns (4) and (8) perform grid search.

Source: own calculations.

[89] Standard errors of γ and ρ were obtained by bootstrapping. For each bootstrap repetition of the KR production function estimation, the estimated coefficients were used to run specification in equation $\omega_{it} = \gamma d_{i,t-1} + \rho\omega_{i,t-1} + \xi_t + u_{it}$ which produced an estimate of γ and ρ.

Although there are several studies that explore positive relationship between exporting and productivity (see for example Aw, Chung & Roberts, 2000; Bernard & Jensen, 1999; Bernard, Eaton, Jensen & Kortum, 2003; Clerides, Lach & Tybout, 1998; Burger, Jaklič & Rojec, 2008; and Damijan & Kostevc, 2006) as well as between importing and productivity (see for example, Amiti & Konings, 2007; Kasahara & Rodrigue, 2008; and Halpern, Koren, & Szeidl, 2006), few empirical papers simultaneously examine both imports and exports on the micro level. The notable exceptions are Bernard, Jensen, and Schott (2005) and Kasahara and Lapham (2008) who provide empirical evidence on importers and exporters in the US and Chile, respectively. Ignoring the export variable in the estimation procedure might put bias on some of the estimated coefficients. As Kasahara and Lapham (2008) show, an omission of export variable from the regressors might lead to an upward bias in the coefficient on imported intermediate inputs since better firms are often both importers and exporters.[90] To check whether the dynamic effects of importing are partially influenced by export status, I regress the productivity shock ω_t on lagged productivity shock, ω_{t-1}, lagged import status, d_{t-1}, and as a robustness check also on the lagged export status, ex_{t-1}. If exporting indeed drives the growth of productivity, I would expect it to have positive and significant effect on future realizations of productivity innovations, perhaps larger than that of importing. In order to allow for different business environment across industries and time, I obtain the values of ω by estimating production function separately for each 2-digit NACE industry.

Table 46: OLS regression of TFP on import and export

	(1)	(2)	(3)	(4)
ω_{t-1}	0.736***	0.159***	0.737***	0,159***
	(0.004)	(0.006)	(0.004)	(0.006)
d_{t-1}	0.112***	0.076***	0.119***	0.076***
	(0.006)	(0.011)	(0.007)	(0.011)
ex_{t-1}			-0.012	0.002
			(0.007)	(0.010)
Year dummies	yes	yes	yes	yes
Firm fixed effects	no	yes	no	yes
No. obs	35,361	35,361	35,361	35,361

Notes: Standard errors are in parentheses. Dependent variable is the productivity shock ω_t, which is calculated by $\omega_{it} = y_{it} - \beta_k k_{it} - \beta_l l_{it} - \beta_x x_{it} - \beta_d d_{it}$, where the coefficients are taken from Kasahara-Rodrigue estimator (value added specification with grid search) in an industry-by-industry estimation. ω_{t-1} is lagged productivity shock, d_{t-1} lagged import dummy, and ex_{t-1} is lagged export dummy.

Source: own calculations.

[90] De Loecker (2007) and Van Biesebroeck (2005) obtain productivity estimates from a modified Olley and Pakes (1996) estimation algorithm where they explicitly allow for different market structures for exporting firms. As Kasahara and Rodrigue (2008) does for imports, the introduction of exports as an additional state variable in the Olley and Pakes (1996) estimation algorithm corrects for unobserved productivity shocks that are correlated with export status and filters out differences in market structures between domestic and exporting firms.

Table 46 presents the results for the discrete import and export variables. The inclusion of firm fixed effects significantly lowers coefficients on both lagged productivity shock and lagged import variable, however both remain highly significant. Compared to analogous estimation but on the pooled sample (column (8) of Table 44) column (1) indicates somewhat lower positive effect from importing but still highly significant. It remains so even after including firm fixed effects despite the fact that there is limited within-firm variation in import status due to high persistency of imports. The estimates controlling for export (columns (3) and (4)) are practically unchanged and remain highly significant which proves the robustness of my estimates of dynamic effect of importing. On the other hand, the effect of exporting on productivity realizations is small and insignificant.

The previous section uncovered substantial static (for the case of discrete import variable) and dynamic effects of importing intermediate inputs. Even after controlling for firm-specific effects and exporting status, the fact that a firm imported some of its material inputs had positive effects on future productivity shocks. The remaining shortcoming of such a parametric approach is that one cannot track the size of the effect in time and most importantly, one still cannot control for endogeneity of import decision entirely. The parameters of production function reveal us the average response to importing, yet the true effect of starting to source inputs abroad is somewhat concealed by the observations on the well-established importers and domestically-oriented firms. In order to further explore firm heterogeneity and its association with the import decision, I present the results of propensity score matching. 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 other performance measures.

6.6 Results from propensity score matching

I now turn to the main results as shown in Table 47-Table 50 where I present the average treatment effects[91] and cumulative effects of foreign sourcing of intermediate inputs on firm productivity. Table 47 presents the results for labour productivity where new importers' productivity growth rates[92] 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

[91] In the remainig part of the thesis, I always refer to the average treatment effect *on the treated*.

[92] 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 ($\ln y_{it} - \ln y_{it-1} \approx dy/dt$).

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.

Table 47: Average treatment effect of importing intermediate inputs on the growth of labour productivity (measured by value added per employee), 1994-2005.

Time span	Matching 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.

Source: own calculations.

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. Compared to manufacturing average over the entire period 1994-2005 (2,680 thousand tolars), this amount represents a 20% increase 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.

Table 48: Cumulative effect of importing intermediate inputs on the growth of labour productivity (measured by value added per employee), 1994-2005.

Time span	Matching 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.

Source: own calculations.

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 48 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.

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.[93] Table 49 first presents the effects of importing on annual productivity growth rates, while Table 48 lists the results for the cumulative effects of importing.

As before, new importers grow significantly faster than non-importers only in the first and conditionally the second year (Table 49). 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. (2008) 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.

[93] 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 49: Average treatment effect of importing intermediate inputs on the growth of productivity (measured by total factor productivity), 1994-2005.

Time span	Matching 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.

Source: own calculations.

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 50). 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 47-Table 50 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.

Table 50: Cumulative effect of importing intermediate inputs on the growth of productivity (measured by total factor productivity), 1994-2005.

Time span	Matching 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.

Source: own calculations.

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

	nearest neighbour		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.

Source: own calculations.

Table 51 reports the results for the difference-in-differences regression using value added per employee as a productivity measure. In contrast to Table 47 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 52: 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.

Source: own calculations.

Similarly, Table 52 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.

6.7 Testing the focusing on core competence hypothesis

The key hypothesis in my dissertation 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.

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. 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 and establish innovative organizational practices and process solutions.

Table 53 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.

Table 53: Average treatment effects of importing intermediate inputs on product innovation, 1996-2004.

Time span		Matching 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.

Source: own calculations.

The results reported in Table 53 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 54 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. 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.

Table 54: Average treatment effects of importing intermediate inputs on process innovation, 1996-2004.

Time span		Matching 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.

Source: own calculations.

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.

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. We must not neglect the other side of the relationship: firms need competent and reliable 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, p. 48-49) 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 marketplaces and technological situations, the buyer-supplier joint strategy decreases risks, shortens cycle times, lowers investments, and creates better responsiveness to customer needs.

6.8 Summary of main empirical findings

The main results of the empirical part of the dissertation are summarized in Table 55.

Table 55: Key empirical findings of the dissertation

H1: superior performance of importers	Firms that source intermediate inputs from abroad are larger in terms of revenues and employment, more capital intensive and more productive than firms sourcing only domestically. The superior performance identified is robust since it relates to absolute terms, relative to industry averages, year-by-year and industry-by-industry.
Persistence of import status	There is a strong persistence of import status in time. Among the firms that imported in a given year, 90% of them also imported in next year, while among the firms that did not import in the current year, 71% of them neither imported in the subsequent year. In addition, importers of intermediate inputs have higher chances of survival than non-importers.
H2: intensity of foreign sourcing	Firm productivity, capital intensity and size are increasing with the share of imported inputs in total material costs. All three characteristics are also uniformly increasing in the number of imported varieties of intermediate inputs. Firms that import more than 100 varieties of inputs are on average almost 20% more productive than the average firm in the same industry. Firm performance is positively associated with the number of import markets: firms that buy intermediates from more than 9 countries are on average more than 15% more productive than the average firm.
H3-H6: sorting of organizational modes	Stochastic dominance tests confirm theoretical predictions about the arrangement of firms into production modes according to productivity levels: importers with outward FDI are more productive than offshore outsourcers which are more productive than non-importers.
H7-H8: self-selection into offshoring and captive offshoring	More productive firms choose to purchase intermediate inputs abroad and the most productive offshorers commence with multinational production.
Performance after the initiation of foreign sourcing	In the periods after the beginning of foreign sourcing of inputs, new importers increase revenue, employment, capital intensity, number of imported varieties, number of import markets, share of foreign inputs in total material costs, and productivity. The majority (85%) of inputs are sourced from developed European countries (EU15+EFTA+Switzerland).
H9: productivity growth	Intermediate goods importing yields positive static and dynamic effects on firm productivity. This finding is robust

	to different econometric techniques and specifications. In the first year, offshoring brings about a 20% increase in labour productivity and equal growth of total factor productivity. Despite the short-lived year-on-year growth rates of productivity in excess of non-importers, cumulative gain in productivity of new importers after four years remains significant at around 37% for labour productivity and 35% for total factor productivity. The evidence also shows that it is not exporting status but imports of intermediate inputs that is driving the productivity hike in new importers.
H10: focus on core competence – product innovation	Already in the year of import initiation, 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 as long as four and six years after the switch from domestic to foreign sourcing of intermediate inputs.
H10: focus on core competence – process innovation	In contrast to product innovation, process innovation is more common in prospective importers already prior to import start. Firms considering fragmenting their production processes introduce improvements in management and execution of internal processes before the start of foreign sourcing of inputs. The premium in probability to introduce process innovation drops from 16% to 12% in the year of transformation and stays at around 10% until the end of the fifth year of importing. 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 primarily ignite product innovation.

Source: own summary.

7 CONCLUSION

The main objective of the thesis was to study the effects a cross-border dispersion of component production has on the performance and behaviour of heterogeneous firms. International fragmentation of production – the main topic of the dissertation – has been approached in the theoretical and empirical literature mainly through the lens of its impact on job relocation and wages. In contrast, this study abstracted from the aggregate effects of offshoring and focused instead on the questions of productivity growth and core competence building at the firm level. Following the recent literature on international fragmentation, the three key questions I dealt with in my dissertation were, first, whether firm productivity and other performance measures (e.g. size and capital intensity) determine the choice about the organization of production process and in particular the selection of firms into foreign sourcing of intermediate inputs, secondly, does the transformation from domestic to foreign input sourcing have a backward causal impact on firm productivity and, thirdly, is there evidence of such internationalization of production chain facilitating the manufacturers to focus on their core competencies.

7.1 Theoretical analysis

The growing importance of international procurement of intermediate inputs either through arms-length relationships or within the boundaries of multinational firms could not sufficiently be explained by traditional trade theories. The latter treated a firm as an atomistic entity and abstracted from various relationships between constituent parties in the production process. As a consequence, the existing gap between a plethora of organizational types in global production networks and the explanatory power of traditional theories of trade and multinational production spurred methodological convergence that combined traditional trade theory with concepts from industrial organization and the theory of the firm in a common framework. Since the combination of trade with the choice of organizational form represents an important new area of theoretical research, I presented a thorough overview of the evolution of the theory of fragmentation (both the traditional and so called "new new trade theories") and the theory of the firm. The literature review showed that a rich diversity of alternative approaches of the theory of the firm translated into equally abundant theory of outsourcing and offshoring.

In order to theoretically rationalize the relationship between offshoring and productivity growth through stronger focus on core competences, I constructed 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 generated a partial equilibrium model in which heterogeneous monopolistically competitive firms choose between outsourcing and vertically integrating peripheral intermediate inputs, 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. I show that after the changeover form domestic to foreign input sourcing, firms find it optimal to invest more resources to productivity-enhancing activities that boost productivity growth rate in subsequent periods. The model rationalizes the relation between outsourcing/FDI and focusing on the core business, as it shows that firms can increase the level of investment in core competencies and boost productivity growth by fragmenting the production process across borders.

7.2 Empirical analysis

In terms of empirical investigation, this dissertation contributes and enriches small but growing body of empirical research on the relationship between offshoring and firm productivity. Descriptive statistics showed that firms importing intermediate inputs are on average larger in terms of sales and employment, more capital intensive, more productive and are less likely to exit than their non-importing counterparts from the same industry. The theoretical predictions about the arrangement of firms according to their organizational mode was also corroborated by the data: the largest, most capital intensive and productive firms are importers with outward FDI, followed by non-multinational importers of intermediates and lastly the domestic sourcing firms. Productivity turned out to be positively correlated to import intensity (share of imported intermediate inputs in total inputs), import variety (number of distinct imported varieties of intermediate inputs) and geographical dispersion of imported inputs (number of sourcing countries). I employed stochastic dominance tests to confirm the proposition that firms offshoring intermediate inputs are more productive than domestically oriented firms and to validate the selection into offshoring hypothesis which states that more productive firms choose to engage in foreign sourcing of inputs. The examination of the firms that started procuring inputs from abroad revealed that they increase markedly their relative value added per employee, relative total factor productivity, relative sales, relative employment, relative capital intensity, number of imported varieties, number of sourcing countries and import intensity.

In addition, I analyzed the focus on core competence hypothesis that importing intermediate inputs incites productivity growth by enabling firms to invest untied resources towards core business processes. Testing the proposed hypothesis, I apply several alternative approaches and econometric techniques to confirm the presumed positive causal relationship between offshoring and productivity growth. After controlling for simultaneity of variable production factors, endogeneity of import status and self selection bias, production function estimations generated fairly robust evidence that importing inputs correlates positively with productivity and furthermore, that foreign subcontracting has positive dynamic effects on subsequent productivity levels. In order to explore causality further, I used the difference in differences approach on the new importers matched with otherwise similar firms that chose not to source inputs abroad. The results revealed that 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. 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. These findings led me to conclude that offshoring intermediate inputs indeed enables firms to focus on core business functions, igniting process and product innovation that persist over medium term.

7.3 Scientific contribution

The thesis contributes to the formal and empirical research of international fragmentation and productivity effects at the micro level. The extension of the Antras (2005a) and Antras and Helpman (2004) models of offshoring introduces important dynamic aspects of the decision of firms to procure intermediate inputs abroad. The theoretical model represents one of the few attempts to include growth theory into the framework of international trade and production. It is also the first attempt to formalize the focus on core competence hypothesis which states that offshoring not only brings about production cost savings but enables firms to deliver more resources to core business enhancement and thus improves future performance.

The dissertation's contribution to the existing empirical literature lies in using a rich dataset and applying various complementary econometric techniques. In addition, it is one of the very few studies to examine a specific transmission mechanism from cross-border slicing up the value chain to firm productivity growth. The exploitation of a unique dataset is a noteworthy contribution by itself: I link detailed accounting information with the international trade data, information on FDI status and Community Innovation Surveys. The resulting firm-level panel data covers all Slovenian manufacturing firms in the period 1994-2005, a time interval long enough to confidently apply various panel data methods. To my knowledge, this is also the first study to apply propensity score matching to investigate the relationship between international sourcing of inputs and firm productivity/innovation performance.

7.4 Policy implications

With recent proliferation and sophistication of offshoring, globalization entered a new phase that entails new paradigm and new policy measures (Grossman & Rossi-Hansberg, 2006, 2008; Blinder, 2006; and Baldwin, 2006). Rapidly falling transportation costs since the late 19th century caused "the first unbundling" – the end of the necessity of making goods close to the consumer. Firms and sectors were the finest level at which globalization's impact was felt. More recently, advances in communication, falling coordination costs, and further liberalization fostered "the second unbundling" – the end of the need to perform most manufacturing stages in one location. With the second unbundling, globalization forces achieved a far finer resolution – they came directly into factories and offices as international competition now plays itself out at the level of tasks within firms (Baldwin, 2006, p. 7-8). Since globalization will continue to create pressures to reallocate resources across borders, sectors, firms and occupations and since the direction and nature of the changes will be impossible to predict, a successful government responses will include promoting flexibility and adjustment. In the context of the European social model, governments will need to make sure that their safety-net policies for the affected workers do not blur firm's cost of employing workers. In other words, welfare policies should protect workers rather than jobs and should encourage adjustment rather than status quo (Baldwin, 2006, p. 45-46). It is crucial to maintain a political consensus in favour of change in general and globalization in particular. Political support for change is essential since growth requires change. Additionally, like in the case of computerization (Autor, Levy & Murnane, 2003), offshoring is expected to have similar effects on the demand for different skill groups in the developed countries' labour markets: both are associated with reduced labor input of routine manual and routine cognitive tasks and increased labor input of nonroutine cognitive tasks. Blinder (2006) argues that the educational system should thus be preparing workers for lifetime employability rather than lifetime employment. In the future, how children are educated will prove to be far more important than how much.

By outsourcing standardized, peripheral activities, firms can direct scarce resources on their core business activities, further enhancing competitive advantages. Numerous case studies and an increasing number of econometric studies confirm the beneficial effect of international production sharing on firm productivity. In addition, the present study found evidence of the existence of focusing on core capabilities effect as revealed through the increased product and process innovation. The implications of the results for the companies are several. Firms should consider outfarming peripheral processes in which they do not have competitive strengths in a way that does not threaten the production process and long-term strategic position. They should also boost their ambitions and reflect on the possibilities that more distant emerging economies have to offer. The question is not whether to outsource but rather how many functions in the value chain, how and where should they be performed. Deciding what is at the core is crucial. The companies should ask themselves what their source of differentiation is, where do they have world-class cost advantage and proprietary technology processes or profit models. There is also the question of physical proximity: which processes should be nearshored and which offshored? Like any other type of internationalization, international production sharing demands a good awareness of the costs and benefits and capable management and human resources to pull off the project. Where internal resources are inadequate, firms should make use of specialized outsourcing consultancies. This brings about another policy implication aimed at existing and prospective companies: improvements in technologies and globalization tendencies will work together in unbundling tasks previously performed within the firms and this will create vast opportunities for specialized private intermediaries and consultants that could facilitate cross-border vertical fragmentation.

It is no longer a firm's ownership of capabilities that matters for market success but rather its ability to control and make the most of critical capabilities, whether or not they exist on the company's balance sheet (Gottfredson, Puryear & Philips, 2005). Companies no longer compete on the basis of the assets they own but on the quality of bundling their own and external capabilities and solutions into a product, how far they advance organizational redesign and fine-tuning of the value chain, and how innovative their marketing approach is. In this sense, companies ought to regard offshoring in the sense of reorganizing production value chain and reorganizing governance structures as an important core competence on its own.

Innovation has become the key battle ground for the majority of firms and industries. It entails increasing R&D expenditures, growing complexity and greater than ever need for multidisciplinary approach. Firms can no longer afford to be jack of all trades so that R&D cooperation has become crucial. Successful buyer-supplier relationships could serve firms to establish resource platform through which technology, knowledge and ideas could be circulated. Each side would than benefit from other partner's expertise and exploit it in its core business. In addition, a firm could promote horizontal innovative ventures and knowledge spillovers among its suppliers in order to obtain compatible inputs and further gains from R&D cooperation.[94]

In addition, offshoring enables firms to reduce a future competitive threat by emerging subcontractors. Nike and Reebok, for example, no longer perform any manufacturing on their own, but focus instead on maintaining their market position and invest heavily in R&D, advertising and promotion – their core competence. The extent of these investments is so large that it is very hard for any subcontractor to even attempt to move up the value chain and become direct competitor with its own brand. Nevertheless, several examples from the electronics industry remind us that international sourcing might have significant long-term strategic consequences if it turns out helping to create a future competitor. BenQ, Acer, Asustek, and Samsung are all examples of a successful transition from subcontractors to their end-markets using their own brands (Welch, Benito & Petersen, 2007, p. 181, 189). Therefore, before embarking on an offshoring project, firms should identify and protect the key technologies and knowledge from an uncontrolled leakage to outside competitors, as well as prevent excessive emancipation of the supplier.

Obviously, there are more important reasons for international fragmentation of production than sheer cost reductions. Companies are offshoring and outsourcing intermediate goods and services to improve the quality of their products, to sharpen focus on core activities in which they enjoy greater competitive advantages, to exploit the economies of scale and to access certain skills, resources, and markets – in a nutshell, to harvest the benefits of the new international division of labour that is unfolding. Contrary to common belief, international division of tasks offers unprecedented potential benefits for countries on both ends of the process. The host countries gain jobs, skills, technology, access to foreign markets and other benefits while the home countries improve their efficiency in using scarce resources, move

[94] This form of horizontal collaboration in R&D activities is well advanced in Toyota, where for example its break system supplier would be setting up mutual study groups with Toyota's interior system suppliers (Bamford, 1994, p. 27).

into higher value activities[95] and reduce prices of goods and services for the consumers. Lower cost of inputs boosts economic activity, investment, markets for exports, and eventually, job creation.

Given that the results of the empirical analysis showed that offshoring of intermediate inputs leads to productivity improvements and that foreign sourcing is a catalyst for product and process innovation, policymakers should avoid imposing restrictions on production relocation and promote further multilateral and regional trade and investment liberalization. Intensification of production fragmentation requires high quality infrastructure, low trade barriers, predictable business environment, and strong legal protection and fierce intellectual property rights safeguards.[96] These are all important areas on which governments should focus their attention and resources. Although the aggregate effects of international production sharing lies outside the scope of my dissertation, its short-term negative effects on certain aggregate categories, sectors, and professions should not be neglected. On the contrary, to avoid populist manipulations based on anecdotal evidence, both governments and firms should put more weight on lucidly communicating with the general public on the overall benefits of such a globalized production. Reports on jobs relocated should be counterbalanced with the details on the jobs insourced, stories on bankruptcies should be offset by reports on successful startups and internationalization projects, and public concerns about stagnating wages in some sectors should be neutralized by highlighting the benefits of lower prices for the consumers (to the extent that their consumption basket is weighted towards importables). This is why we need to improve official data on offshoring so that policymakers, education and training experts, firms, and workers can make informed decisions sooner rather than later (Brainard & Litan, 2004, p. 6). National governments have an important role to play in facilitating the movement from "sunset" to "sunrise" industries and occupations in that they provide a flexible and stimulating environment for smoother transition ahead. Whether this comes in the form of expensive yet cosier active labour policies or in the form of economical yet more stressful laissez faire approach remains in the domain of the politics.

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

[95] Popular misconception states that a country's wellbeing depends on moving the economy towards high value-added industries. This reasoning is wrong, since this would imply that we could be better off simply by specializing into cigarettes production, petroleum refining, and steel industries, sectors with the highest value-added per employee due to the strong capital intensity of production process (Krugman, 1994). In fact, the key to prosperous society lies in producing goods and services or performing activities in which a country enjoys comparative advantages as productively as possible. There is nothing more to it than letting the forces of comparative advantage and competitive business environment do the job of relocation and productivity growth.

[96] Levchenko (2007) has shown that institutional quality is important determinant of trade flows in an increasingly fragmented global production, while Nunn (2007) provides evidence that a country's contracting environment is indeed a source of comparative advantage.

resist, the future will be uncompromising in punishing their inability to innovate and keep pace.

7.5 The limitations of research

Despite the proposed list of scientific contributions of the dissertation, the study still has some shortcomings and leaves some interesting research questions unanswered. The major theoretical limitation of this study is the fact that the model of firm R&D investment is only partial and does not allow for strategic interactions in investment decision in an oligopolistic industry. However, due to serious analytical burden of such a rich setting with heterogeneous firms competing in a horizontally differentiated market and facing a choice between different organizational modes of production in addition to choosing the optimal level of investment in productivity-enhancing research, formalization of the industry equilibrium – let alone the general equilibrium – would be intractable. Even the numerical simulations of such high-dimensional control problem would be computationally extremely burdensome and would exceed the objectives of the dissertation. However, since the aim of the empirical analysis is to study the effects of international sourcing of intermediate inputs on firm productivity and to test for the presence of focusing on core competence at the firm level, the theoretical explication of industry or general equilibrium seems unnecessary. The deterministic nature of returns on R&D investment can also pose a limitation to the realness of the model. Nevertheless, the introduction of stochastic elements would hardly impinge upon the aim of the theoretical model, which is to provide the theoretical rationale for the increased involvement in productivity-enhancing investment in core competence following the switch from domestic to foreign input sourcing. Stochastic processes have important implications for the characteristics of industry equilibrium, such as entry and exit dynamics, but these issues lie outside the scope of my research.

Most of my limitations in the empirical analysis stems from the characteristics of the data I utilized. First, due to the limited set of information available from the trade data, I was only able to distinguish one segment of cross-border fragmentation, namely the purchase of intermediate inputs abroad and using these inputs in production in the home country. I exclude shipments of intermediate inputs abroad for further processing or final assembly. In a similar vein and given the fact that the major import partners of intermediate inputs in Slovenian manufacturing firms appeared to be developed EU members, one could question the applicability of my theoretical model to the specific case. In defence of the raised concern, I believe that the setting with the low-wage partner country (South) could be translated as the equivalent to more advanced Northern sourcing partner providing superior quality inputs. In other words, instead of interpreting lower Southern wage as the lower marginal cost of producing a standard-quality input, I could take it to represent the quality-adjusted production costs in the technologically advanced partner country. Third, not knowing what function a foreign subsidiary plays in firm's production chain, I was not able to distinguish between vertical and horizontal type of FDI. The theoretical model describes the fragmentation of production value chain and thus accounts for only the vertical type of FDI. Given the fact that according to some surveys of Slovenian outward investors (Damijan, 2004, p. 345) the majority of Slovenian subsidiaries abroad serves as sales representation and forwarding, logistical centres and the like, it would be essential to have information on the type of FDI in order to distinguish between the offshore outsourcing and captive offshoring effects on productivity and innovation.

Due to small sample of manufacturing firms that answered the question in the Community Innovation Surveys about the level of R&D expenditures, I was not able to perform a more direct test of the focusing on core competence hypothesis. Instead of testing for the significant increase of resources channelled to research efforts, I had to examine instead the indirect effects of the hypothesised effect in the form of product and process innovation. However, it is hard to imagine that significant increases in introduction of new products and processes in firms that switched from domestic to foreign input sourcing could be achieved without directing more resources to R&D. Due to data limitation, I also had to completely abstract from measuring more intangible effects of cross-border vertical specialization and focusing on core competencies. Some examples of important business changeovers include better customer relations, improved speed and service, enhanced tactical and strategic advantages, reaping the benefits from the provider's expertise, focus on strategic thinking, and reduction of the overall management burden while retaining control of strategic decision making.

One important limitation that has proven hard to come by stems from the fact that firms operate in a differentiated good market and exhibit notable heterogeneity in productivity and quality, yet we do not observe firm-specific prices but only industry-wide deflators. Klette and Griliches (1996) assert that productivity in differentiated good markets cannot be estimated independently of markups and scale economies when deflated sales are used as a proxy for output. Melitz (2000) and Levinsohn and Melitz (2002) showed further that the true productivity differences will also be understated when prices are endogenous to the firm. Firms with higher markups are likelier, all else equal, to have lower measured productivity (Martin, 2005), so we tend to underestimate the true productivity level for better firms – firms proven to be importers more likely. The problem becomes even more acute when dealing with data on imported intermediate inputs because additional dimensions of country-source, composition and product-quality are expected to be correlated with other firm characteristics.

7.6 Future research

Limitations listed in the previous section provide a starting point for the future research. Having detailed trade data for both firm-level import and export flows, the most exciting avenue for the future examination of internationally involved firms for me represents an investigation of the perplexity between exporting and importing. At the moment, there is empirical evidence on both sides that international operations go hand in hand with higher firm productivity, yet there is, I believe, scarce evidence on the interconnections between importing and exporting. For example, it would be interesting to find out which of the two has stronger causal effect on productivity, which of the two precedes the other in time dimension, and how, if at all, do they feed each other interchangeably. These questions entail constructing a theoretical model combining both importing and exporting, one of the first attempts of which can be found in Kasahara and Lapham (2008).

There are also some contentious methodological issues that remained unresolved in my thesis and deserve attention in the future explorations. If prices of products and inputs are endogenous, something we should accept as a fact rather than a conjecture, future research should aim at providing remedies for omitting firm-specific prices and operating instead with revenues and common deflators. The proposed solutions to date conclude that real productivity is difficult to estimate because one cannot easily decouple firm quality or market power contribution from the measured productivity. However, as Martin (2005, p. 11) notes, economists are generally interested in TFP because at least implicitly they want to assess the relative welfare contributions of different plants. If this is indeed the case, one should not bother with the product quality or firm market power issues in the first place.

One of the ways to explore the data at hand is also to elaborate further on the issue of variety and geographical dispersion of intermediate input sourcing. How do they associate with firm productivity and innovativeness, do they feed back into export performance, and last but not least, do they have an effect on final product variety in multi-product firms.

The relationship between offshoring and innovation also calls for further research attention. Particularly interesting is the question whether business-to-business relationships from intermediate input sourcing can create knowledge linkages that facilitate international cooperation in R&D. Does input sourcing begets knowledge soaking that augments the focus on core competence effect of the sourcing firm?

Qualitative analysis to complement the quantitative analysis would also be in order. Survey of offshoring firms and in-depth case studies could accompany the present results and make up for the missing reflection on managerial, marketing, and strategic issues involved in international fragmentation of production process.

REFERENCES

1. A.T. Kearney (2003). Where to locate: Selecting a country for offshore business processing. *A.T. Kearney Report*. Accessed on October 10 2007 at http://www.carretek.com/main/news/pdf/SelectCountryOBP.pdf

2. Abraham, K. G. & Taylor, S. K. (1996). Firms' use of outside contractors: Theory and evidence. *Journal of Labor Economics*, 14 (3), 394-424.

3. Abramovsky, L., Griffith, R. & Sako, M. (2004). Offshoring of business services and its impact on the UK economy. IFS Briefing Notes BN51, AIM Briefing Note.

4. Acemoglu, D., Aghion, P. & Zilibotti, F. (2003). Vertical integration and distance to frontier. *Journal of the European Economic Association*,1 (2-3), 630-638.

5. Acemoglu, D., Antras, P. & Helpman, E. (2007). Contracts and technology adoption. *American Economic Review*, 97(3), 916-943.

6. Adams, F. G., Gangnes, B. & Shachmurove, Y. (2004). How the dragon captured the world export markets: Outsourcing and foreign investment lead the way. *PIER Working Paper Archive 04-042*, Penn Institute for Economic Research, Department of Economics, University of Pennsylvania.

7. Aghion, P., Bloom, N., Blundell, R., Griffith, R. & Howitt, P. (2005). Competition and innovation: An inverted-U relationship. *The Quarterly Journal of Economics*, 120 (2), 701-728.

8. Aghion, P., Harris, C., Howitt, P. & Vickers, J. (2001). Competition, imitation and growth with step-by-step innovation. *The Review of Economic Studies*, 68 (3), 467-492.

9. Aghion, P. & Howitt, P. (1992). A model of growth through creative destruction. *Econometrica*, 60 (2), 323-351.

10. Aghion, P. & Tirole, J. (1997). Formal and real authority in organizations. *Journal of Political Economy*, 105 (1), 1-29.

11. Alchian, A. A. (1965). Some economics of property rights. *II Politico*, 30 (4), 816-829.

12. Alchian, A. A. & Demsetz, H. (1972). Production, information costs, and economic organization. *American Economic Review*, 62 (5), 777-795.

13. Amiti, M. (2005). Location of vertically linked industries: Agglomeration versus comparative advantage. *European Economic Review*, 49 (4), 809-832.

14. Amiti, M. & Konings, J. (2007). Trade liberalization, intermediate inputs, and productivity: Evidence from Indonesia. *American Economic Review*, 97(5), 1611-1638.

15. Amiti, M. & Wei, S. J. (2004). Demystifying outsourcing. *Finance and Development*, 41 (4), 36-39.

16. Amiti, M. & Wei, S. J. (2005). Fear of service outsourcing: Is it justified? *EconomicPolicy*, 20 (42), 308-347.

17. Amiti, M. & Wei, S. J. (2006). Service offshoring, productivity and employment: Evidence from the US. CEPR Discussion Paper 5475.

18. Anderson, E. & Gatignon, H. (1986). Modes of foreign entry: A transaction cost analysis and propositions. *Journal of International Business Studies*, 17 (3), 1-26.

19. Anderson, J. E. & van Wincoop, E. (2004). Trade costs. *Journal of Economic Literature*, 42 (3), 691-751.

20. Ando, M. & Kimura, F. (2006, May). Fragmentation in Europe and East Asia: Evidence from international trade and FDI data. Mimeo, Faculty of Economics, Hitotsubashi University. Accessed on September 2 2008 at http://www.apeaweb.org/confer/sea06/papers/ando-kimura.pdf

21. Antras, P. (2003). Firms, contracts, and trade structure. *Quarterly Journal of Economics*, 118 (4), 1375-1418.

22. Antras, P. (2005a). Incomplete contracts and the product cycle. *American Economic Review*, 95 (4), 1054-1073.

23. Antras, P. (2005b). Property rights and the international organization of production. *American Economic Review*, 95 (2), 25-32.

24. Antras, P. & Helpman, E. (2004). Global sourcing. *Journal of Political Economy*, 112 (3), 552-580.

25. Aoki, M. (1986). Horizontal vs. vertical information structure of the firm. *American Economic Review*, 76 (5), 971-983.

26. Arellano, M. & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, 58 (2), 277-297.

27. Arellano, M. & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68 (1), 29-51.

28. Arndt, S. W. (1997). Globalization and the open economy. *The North American Journal of Economics and Finance*, 8 (1), 71-79.

29. Arndt, S. W. (1998). Super-specialization and the gains from trade. *Contemporary Economic Policy*, 16 (4), 480-485.

30. Arndt, S. W. (2001). Offshore sourcing and production sharing in preference areas. In S. Arndt & H. Kierzkowski (Ed.), *Fragmentation: New Production Patterns in the World Economy* (Chapter 5, p. 76-87). Oxford: Oxford University Press.

31. Aron, R. & Singh, J. V. (2005). Getting offshoring right. *Harvard Business Review*, 83 (12), 135-143.

32. Arora, A. & Gambardella, A. (2005). The globalization of the software industry: Perspectives and opportunities for developed and developing countries. In A. B. Jaffe, J. Lerner & S. Stern (Ed.), *Innovation Policy and the Economy, Volume 5* (p. 1 - 32). Cambridge, Ma: MIT Press.

33. Arrow, K. J. (1951). *Social Choice and Individual Values*. New York: Wiley.

34. Arrow, K. J. (1962). The economic implications of learning by doing. *The Review of Economic Studies*, 29 (3), 155-173.

35. Arrow, K. J. (1971). *Essays in the Theory of Risk Bearing*. Chicago: Markham Publishing.

36. Arrow, K. J. (1974). *The Limits of Organizations*. New York: W. W. Norton & Company.

37. Autor, D. H., Levy, F. & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *The Quarterly Journal of Economics*, 118 (4), 1279-1333.

38. Aw, B. Y., Chung, S. & Roberts, M. J. (2000). Productivity and turnover in the export market: Micro-level evidence from the Republic of Korea and Taiwan (China). *World Bank Economic Review*, 14 (1), 65-90.

39. Axtell, R. L. (2001). Zipf distribution of U.S. firm sizes. *Science*, 293 (5536), 1818-1820.

40. Bajari, P. & Tadelis, S. (2001). Incentives versus transaction costs: A theory of procurement contracts. *RAND Journal of Economics*, 32 (3), 387-407.

41. Bajpai, N., Sachs, J., Arora, R. & Khurana, H. (2004, June). Global services sourcing: Issue of cost and quality. Center on Globalization and Sustainable Development Working Paper 16, The Earth Institute, Colombia University.

42. Balassa, B. (1967). *Trade Liberalization among Industrial Countries*. New York: McGraw-Hill.

43. Baldwin, R. (2006, September 20). Globalisation: The great unbundling(s). A report prepared for the Finnish Prime Minister's Office (in context of EU Presidency 2006). Accessed on June 12 2007 at www.unescochair.ns.ac.yu/sr/docs/baldwin2006Globalisation.pdf

44. Baldwin, R. E. & Robert-Nicoud, F. (2008). Trade and growth with heterogeneous firms. *Journal of International Economics*, 74(1), 21-34.

45. Bamford, J. (1994, 8. November). Driving America to tiers. *Financial World*, 163 (23), 24-27.

46. Bank of Slovenia (2007a). *Bank of Slovenia Bulletin*, 16 (2-3). Ljubljana: Bank of Slovenia.

47. Bank of Slovenia (2007b). *Direct Investment 2006*. 11 (2), Ljubljana: Bank of Slovenia.

48. Bardhan, A. & Kroll, C. (2003). The new wave of outsourcing. Fisher Center for Real Estate & Urban Economics Research Report 1103, University of California, Berkeley.

49. Bardi, E. J. & Tracey, M. (1991). Transportation outsourcing: A survey of US practices. *International Journal of Physical Distribution and Logistics Management*, 21 (3), 15-21.

50. Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17 (1), 99-120.

51. Barney, J. B. (1986a). Organizational culture: Can it be a source of sustained competitive advantage? *Academy of Management Review*, 11 (3), 656-665.

52. Barney, J. B. (1986b). Strategic factor markets: Expectations, luck and business strategy. *Management Science*, 32 (10), 1231-1241.

53. Barney, J. B. (1986c). Types of competition and the theory of strategy: Toward an integrative framework. *Academy of Management Review*, 11 (4), 791-800.

54. Barney, J. B. (1988). Returns to bidding firms in mergers and acquisitions: Reconsidering the relatedness hypothesis. *Strategic Management Journal*, 9 (1), 71-78.

55. Barro, R. J. & Sala-i Martin, X. (1997). Technological diffusion, convergence, and growth. *Journal of Economic Growth*, 2 (1), 1-26.

56. Barro, R. J. & Sala-I-Martin, X. (2004). *Economic Growth*. Cambridge, Ma: MIT Press.

57. Bartel, A., Lach, S. & Sicherman, N. (2005). Outsourcing and technological change. NBER Working Paper 11158.

58. Barzel, Y. (1997). *Economic Analysis of Property Rights*. Cambridge: Cambridge University Press.

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

60. Belderbos, R. & Sleuwaegen, L. (2005). Competitive drivers and international plant configuration strategies: A product-level test. *Strategic Management Journal*, 26 (6), 577-593.

61. Benkard, C. L. (2004). A dynamic analysis of the market for wide-bodied commercial aircraft. *Review of Economic Studies*, 71 (3), 581-611.

62. Bennathan, E., Escobar, L. & Panagakos, G. (1989). Deregulation of shipping: What is to be learned from Chile. World Bank Discussion Paper 67, Washington: World Bank.

63. Berle, A. A. & Means, G. C. (1932). *The Modern Corporation and Private Property*. New York: Macmillan.

64. Bernard, A. B., Eaton, J., Jensen, B. & Kortum, S. (2003). Plants and productivity in international trade. *American Economic Review*, 93 (4), 1268-1290.

65. Bernard, A. B. & Jensen, J. B. (1995). Exporters, jobs, and wages in the U.S. manufacturing: 1976-1987. *Brookings Papers on Economic Activity - 1995 Special Issue Microeconomics*, p. 67-119.

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

67. Bernard, A. B. & Jensen, J. B. (2004). Why some firms export. *Review of Economics & Statistics*, 86 (2), 561-569.

68. Bernard, A. B., Jensen, J. B. & Schott, P. K. (2004). How offshore work affects your industry. *Harvard Business Review*, 82 (11), 24-25.

69. Bernard, A. B., Jensen, J. B. & Schott, P. K. (2005). Importers, exporters, and multinationals: A portrait of firms in the U.S. that trade goods. NBER Working Paper 11404.

70. Bernard, A. B., Redding, S. J. & Schott, P. K. (2007). Comparative advantage and heterogeneous firms. *Review of Economic Studies*, 74(1), 31-66.

71. Berry, S. & Pakes, A. (1993). Some applications and limitations of recent advances in empirical industrial organization: Merger analysis. *American Economic Review*, 83 (2), 247-252.

72. Besanko, D. & Doraszelski, U. (2004). Capacity dynamics and endogenous asymmetries in firm size. *RAND Journal of Economics*, 35 (1), 23-49.

73. Besanko, D., Doraszelski, U., Kryukov, Y. & Satterthwaite, M. (2007). Learning-by-doing, organizational forgetting and industry dynamics. CEPR Discussion Paper 6160.

74. Bhagwati, J., Panagariya, A. & Srinivasan, T. N. (2004). The muddles over outsourcing. *Journal of Economic Perspectives*, 18 (4), 93-114.

75. Bhagwati, J. N. (1984). Splintering and disembodiment of services and developing nations. *The World Economy*, 7 (2), 133-143.

76. Bivens, L. J. (2005, 2. August). Truth and consequences of offshoring. Economic Policy Institute Briefing paper 155, Washington, D.C. Accessed on March 30 2008 at http://www.epi.org/briefingpapers/155/bp155.pdf

77. Blalock, G. & Gertler, P. J. (2004). Learning from exporting revisited in a less developed setting. *Journal of Development Economics*, 75 (2), 397-416.

78. Blalock, G. & Veloso, F. (2007). Imports, productivity growth, and supply chain learning. *World Development*, 35 (7), 1134-1151.

79. Blundell, R. & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87 (1), 115-143.

80. Blundell, R. & Bond, S. (2000). GMM estimation with persistent panel data: An application to production functions. *Econometric Reviews*, 19 (3), 321-340.

81. Blundell, R. & Costa Dias, M. (2000). Evaluation methods for non-experimental data. *Fiscal Studies*, 21 (4), 427-468.

82. Boland, L. (1982). *The Foundations of Economic Method*. London: George Allen and Unwin.

83. Bolton, P. & Dewatripont, M. (1994). The firm as a communication network. *The Quarterly Journal of Economics*, 109 (4), 809-839.

84. Bolton, P. & Scharfstein, D. S. (1998). Corporate finance, the theory of the firm, and organizations. *Journal of Economic Perspectives*, 12 (4), 95-114.

85. Booz Allen Hamilton (2003). Business process offshoring: Making the right decision. Booz Allen study, Booz Allen Hamilton, McLean, Virginia.

86. Borga, M. & Zeile, W. J. (2004). International fragmentation of production and the intrafirm trade of U.S. multinational companies. BEA Working Paper 0013, U.S. Bureau of Economic Analysis, Washington.

87. Bowman, C. (2003). Formulating strategy. in D. O. Faulkner & A. Campbell (Ed.), *The Oxford Handbook of Strategy* (p. 404-436). Oxford, New York: Oxford University Press.

88. Bowman, C. & Ambrosini, V. (2000). Value creation versus value capture: Towards a coherent definition of value in strategy. *British Journal of Management*, 11 (1), 1-15.

89. Brainard, L. & Litan, R. E. (2004). *"Offshoring" service jobs: Bane or boon and what to do?* Brookings Institution Policy Brief 132, The Brookings Institution, Washington.

90. Braun, J. (1993). *Essays on Economic Growth and Migration*. PhD thesis, Harvard University, Cambridge, MA.

91. Brooks, G. (2004). Reasons for outsourcing. *New Media Age*, October 2004, 5-6.

92. Buckley, P. J. & Casson, M. (1976). *The Future of Multinational Enterprise*. London: Macmillan.

93. Burger, A., Jaklič, A. & Rojec, M. (2008). Exporting and company performance in Slovenia: Self-selection and/or learning by exporting? *Journal of Economics (Ekonomický Časopis)*, 56 (2), 131-153.

94. Calabrese, G. & Erbetaa, F. (2005). Outsourcing and firm performance: evidence from Italian automotive suppliers. *International Journal of Automotive Technology & Management*, 5 (4), 2.

95. Campa, J. & Goldberg, L. S. (1997). The evolving external orientation of manufacturing industries: Evidence from four countries. NBER Working Paper 5919.

96. Carter, M. J. (1995). Information and the division of labour: Implications for the firm's choice of organisation. *Economic Journal*, 105 (429), 385-397.

97. Cass, D. (1965). Optimum growth in an aggregative model of capital accumulation. *The Review of Economic Studies*, 32 (3), 233-240.

98. Chamberlain, G. (1982). Multivariate regression models for panel data. *Journal of Econometrics*, 18 (1), 5-46.

99. Cheung, S. N. (1983). The contractual nature of the firm. *Journal of Law and Economics*, 26 (1), 1-21.

100. Chinitz, B. (1961). Contrasts in agglomeration: New York and Pittsburgh. *The American Economic Review*, 51 (2), 279-289.

101. Clerides, S. K., Lach, S. & Tybout, J. R. (1998). Is learning by exporting important? Microdynamic evidence from Colombia, Mexico, and Morocco. *The Quarterly Journal of Economics*, 113 (3), 903-947.

102. Coase, R. H. (1937). The nature of the firm. *Economica*, 4 (16), 386-405.

103. Coase, R. H. (1972). Industrial organization: A proposal for research. In V. R. Fuchs (Ed.), *Policy Issues and Research Opportunities in Industrial Organization* (p. 59-73). New York: National Bureau of Economic Research.

104. Conner, K. R. & Prahalad, C. K. (1996). A resource-based theory of the firm: Knowledge versus opportunism. *Organization Science*, 7 (5), 477-501.

105. Conover, W. J. (1999). *Practical Nonparametric Statistics*. (3rd ed.) New York: John Wiley & Sons.

106. Corbett, M. F. (2003, July 7). Putting offshore outsourcing in perspective. *The International Association of Outsourcing Professionals Report.* Accessed on November 7 2007 at http://www.outsourcingprofessional.org/firmbuilder/articles/19/48/844/

107. Costinot, A. (2009). On the Origins of Comparative Advantage. Forthcoming in the Journal of International Economics.

108. Coughlin, C. C. & Segev, E. (2000). Location determinants of new foreign-owned manufacturing plants. *Journal of Regional Science*, 40 (2), 323-351.

109. Cremer, J. (1990). Common knowledge and the co-ordination of economic activities. In M. Aoki, B. Gustafsson & O. E. Williamson (Ed.), *The Firm as a Nexus of Treaties* (p. 53-76). London: Sage Publications.

110. Criscuolo, C. & Leaver, M. (2006). Offshore outsourcing and productivity. Mimeo, OECD. Accessed on January 14 2008 at http://www.oecd.org/dataoecd/55/23/35637436.pdf

111. Curzon Price, V. (2001). Some causes and consequences of fragmentation. In H. Kierzkowski & S. W. Arndt (Ed.), *Fragmentation: New Production Patterns in the World Economy* (p. 88-107). Oxford: Oxford University Press.

112. Cyert, R. M. & March, J. G. (1963). *A Behavioral Theory of the Firm*. Englewood Cliffs: Prentice-Hall.

113. Dachs, B., Ebersberger, B., Kinkel, S. & Waser, B. R. (2006). *European manufacturing survey: Offshoring of production – A European perspective*. Bulletin Number 2. Karlsruhe: Fraunhofer Institute Systems and Innovation Research.

114. Damijan, J. P. (2001). Slovenian investment activity in former Yugoslav markets: Trade-promoting or efficiency-seeking motivation. *Economic and Business Review*, 3 (3/4), 229-247.

115. Damijan, J. P. (2004). Reentering the markets of the former Yugoslavia. In M. Mrak, M. Rojec & C. Silva-Jauregui (Ed.), *Slovenia: From Yugoslavia to the European Union* (Chapter 20, p. 334-349). Washington: World Bank.

116. Damijan, J. P. & Kostevc, Č. (2006). Learning-by-exporting: Continuous productivity improvements or capacity utilization effects? evidence from Slovenian firms. *Review of World Economics*, 142 (3), 599-614.

117. Damijan, J. P., Polanec, S. & Prašnikar, J. (2004). Self-selection, export market heterogeneity and productivity improvements: Firm level evidence from Slovenia. LICOS Discussion Paper 14804, LICOS, K.U. Leuven.

118. Dasgupta, P. & Stiglitz, J. (1980). Industrial structure and the nature of innovative activity. *Economic Journal*, 90 (358), 266-293.

119. Davenport, T. H. (2005). The coming commoditization of processes. *Harvard Business Review*, 83 (6), 101-108.

120. De Loecker, J. (2007). Do exports generate higher productivity? Evidence from Slovenia. *Journal of International Economics*, 73 (1), 69-98.

121. de Roos, N. (2004). A model of collusion timing. *International Journal of Industrial Organization*, 22 (3), 351-387.

122. Deardorff, A. V. (2001a). Fragmentation across cones. In S. W. Arndt & H. Kierzkowski (Ed.), *Fragmentation: New Production Patterns in the World Economy* (p. 35-51). Oxford: Oxford University Press.

123. Deardorff, A. V. (2001b). Fragmentation in simple trade models. *The North American Journal of Economics and Finance*, 12 (2), 121-137.

124. Delgado, M. A., Farinas, J. C. & Ruano, S. (2002). Firm productivity and export markets: A non-parametric approach. *Journal of International Economics*, 57 (2), 397-422.

125. Demsetz, H. (1988). The theory of the firm revisited. *Journal of Law, Economics and Organization*, 4 (1), 141-161.

126. Demsetz, H. (1997). The firm in economic theory: A quiet revolution. *American Economic Review*, 87 (2), 426-429.

127. Denis, C., Mc Morrow, K. & Röger, W. (2006). Globalisation: Trends, issues and macro implications for the EU. EC Economic Papers 254, European Commission, Brussels.

128. Dierickx, I. & Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management Science*, 35 (12), 1504-1511.

129. Director, A. & Levi, E. (1956). Law and the future: Trade regulation. *Northwestern University Law Review*, 51, 281-317.

130. Dixit, A. K. & Grossman, G. M. (1982). Trade and protection with multistage production. *Review of Economic Studies*, 49 (4), 583-594.

131. Dixit, A. K. & Stiglitz, J. E. (1977). Monopolistic competition and optimum product diversity. *The American Economic Review*, 67 (3), 297-308.

132. Djankov, S., Freund, C. & Pham, C. S. (2006). Trading on time. *World Bank Policy Research Working Paper 3909*. Washington: The World Bank. Forthcoming in *The Review of Economics and Statistics*.

133. Domar, E. D. (1946). Capital expansion, rate of growth, and employment. *Econometrica*, 14 (2), 137-147.

134. Doms, M. E. & Dunne, T. (1998). Capital adjustment patterns in manufacturing plants. *Review of Economic Dynamics*, 1 (2), 409-429.

135. Doms, M. E. & Jensen, J. B. (1998a). Comparing wages, skills, and productivity between domestically and foreign-owned manufacturing establishments in the United States. In R. Baldwin, R. L. & J. Richardson (Ed.), *Geography and Ownership as Bases for Economic Accounting* (p. 235-255). Chicago: Chicago University Press.

136. Doms, M. E. & Jensen, J. B. (1998b). Productivity, skill, and wage effects of multinational corporations in the united states. In D. Woodward & D. Nigh (Ed.),

Foreign Ownership and the Consequences of Direct Investment in the United States (p. 49-68). Westport: Greenwood Publishing.

137. Doraszelski, U. & Judd, K. L. (2004). Solving continuous-time Markov-perfect Nash equilibria. *Computing in Economics and Finance 2004 Number 181*, Society for Computational Economics.

138. Doraszelski, U. & Judd, K. L. (2005). Avoiding the curse of dimensionality in dynamic stochastic games. NBER Technical Working Paper 0304.

139. Doraszelski, U. & Markovich, S. (2004). Advertising dynamics and competitive advantage. *Computing in Economics and Finance 2004 Number 61*, Society for Computational Economics.

140. Doraszelski, U. & Satterthwaite, M. (2004). Foundations of Markov-perfect industry dynamics: Existence, purification, and multiplicity. *2004 Meeting Papers Number 189*, Society for Economic Dynamics.

141. Dunne, T., Roberts, M. J. & Samuelson, L. (1988). Patterns of firm entry and exit in U.S. manufacturing industries. *RAND Journal of Economics*, 19 (4), 495-515.

142. Dunne, T., Roberts, M. J. & Samuelson, L. (1989). The growth and failure of U.S. manufacturing plants. *The Quarterly Journal of Economics*, 104 (4), 671-698.

143. Dunning, J. (1977). Trade, location of economic activity, and the multinational enterprise: A search for an eclectic approach. In B. Ohlin, P. O. Hesselborn & P. M. Wijkman (Ed.), *The International Allocation of Economic Activity*. New York: Holmes and Meier.

144. Dunning, J. H. (1981). *International Production and the Multinational Enterprise*. Boston: Allen&Unwin.

145. Dunning, J. H. (1989). *Transnational Corporations and the Growth of Services: Some Conceptual and Theoretical Issues*. United Nations, New York.

146. Dunning, J. H. (2001). The eclectic (OLI) paradigm of international production: Past, present and future. *International Journal of the Economics of Business*, 8 (2), 173-190.

147. Dunning, J. H. & Lundan, S. M. (2008). *Multinational Enterprises and the Global Economy*. Cheltenham, UK: Edward Elgar.

148. Economist (1991, August 31). The ins and outs of outing. *The Economist*, p. 54-56.

149. Economist (2004a, September 11). Outsourcing to India: The latest in remote control. *The Economist*, p. 61-62.

150. Economist (2004b, November 13). A world of work: A survey of outsourcing. *The Economist*, p. 1-16.

151. Economist (2006a, May 18). The growth of growth theory. *The Economist*, p. 80.

152. Economist (2006b, June 3). Survey: If in doubt, farm it out. *The Economist*, p. 6.

153. Economist (2006c September 16). A survey of the world economy. *The Economist*.

154. Economist (2007, January 11). The problem with made in China. *The Economist*, p. 68-70.

155. Egger, H. & Egger, P. (2006). International outsourcing and the productivity of low-skilled labor in the EU. *Economic Inquiry*, 44 (1), 98-108.

156. Egger, P., Pfaffermayr, M., & Wolfmayr-Schnitzer, Y. (2001). The international fragmentation of Austrian manufacturing: The effects of outsourcing on productivity and wages. *The North American Journal of Economics and Finance*, 12 (3), 257-272.

157. Engardio, P., Bernstein, A., & Kripalani, M. (2003, February 3). The new global job shift. *Business Week*, p. 36-48.

158. Ericson, R. & Pakes, A. (1995). Markov-perfect industry dynamics: A framework for empirical work. *Review of Economic Studies*, 62 (1), 53-82.

159. Ethier, W. J. (1982). National and international returns to scale in the modern theory of international trade. *American Economic Review*, 72 (3), 389-405.

160. European Commission (2007). *European Competitiveness Report 2007*. European Commission, Brussels.

161. Fama, E. F. (1980). Agency problems and the theory of the firm. *Journal of Political Economy*, 88 (2), 288-307.

162. Fama, E. F. & Jensen, M. C. (1983). Agency problems and residual claims. *Journal of Law & Economics*, 26 (2), 327-350.

163. Farrell, D. (2004). Beyond offshoring: Assess your company's global potential. *Harvard Business Review*, 82 (12), 82-90.

164. Farrell, D. (2005). Offshoring: Value creation through economic change. *Journal of Management Studies*, 42 (3), 675-683.

165. Feenstra, R. C. (1998). Integration of trade and disintegration of production in the global economy. *Journal of Economic Perspectives*, 12 (4), 31-50.

166. Feenstra, R. C. & Hanson, G. H. (1996). Globalization, outsourcing, and wage inequality. *American Economic Review*, 86 (2), 240-245.

167. Feenstra, R. C. & Hanson, G. H. (1999). The impact of outsourcing and high-technology capital on wages: Estimates for the United States, 1979-1990. *The Quarterly Journal of Economics*, 114 (3), 907-940.

168. Feenstra, R. C. & Hanson, G. H. (2005). Ownership and control in outsourcing to China: Estimating the property-rights theory of the firm. *The Quarterly Journal of Economics*, 120 (2), 729-761.

169. Feenstra, R. C., Markusen, J. R. & Zeile, W. (1992). Accounting for growth with new inputs: Theory and evidence. *American Economic Review*, 82 (2), 415-421.

170. Feenstra, R. C. & Spencer, B. J. (2005). Contractual versus generic outsourcing: The role of proximity. NBER Working Paper 11885.

171. Feinberg, S. E. & Keane, M. (2003). Accounting for the Growth of MNC-Based Trade Using a Structural Model of U.S. MNCs. *American Economic Review*, 96 (5), 1515-1558.

172. Feinberg, S. E. & Keane, M. (2005). Tariff effects on MNC decisions to engage in intra-firm and arms-length trade. Mimeo, Yale University. Forthcoming in *Journal of International Economics*.

173. Fershtman, C. & Pakes, A. (2000). A dynamic oligopoly with collusion and price wars. *RAND Journal of Economics*, 31 (2), 207-236.

174. Findlay, R. (1978). An "Austrian" model of international trade and interest rate equalization. *Journal of Political Economy*, 86 (6), 989-1007.

175. Fischer, I. (1930). *The Theory of Interest*. New York: Macmillan.

176. Foss, N. J. (1993). Theories of the firm: contractual and competence perspectives. *Journal of Evolutionary Economics*, 3 (2), 127-144.

177. Foss, N. J. (1999). The theory of the firm: An introduction to themes and contributions. In N. J. Foss (Ed.), *The Theory of the Firm: Critical Perspectives on Business and Management* (p. xv-lxi). London: Routledge.

178. Frear, C. R., Metcalf, L. E. & Alguire, M. S. (1992). Offshore sourcing: Its nature and scope. *International Journal of Purchasing & Materials Management*, 28 (3), 2-11.

179. *Freedom House*. Accessed on September 1 2008 at http://www.freedomhouse.org/

180. Gardner, E. (1991). Going online with outsiders. *Modern Healthcare*, 21 (28), 35-47.

181. Garten, J. E. (2004, June 21). Offshoring: You ain't seen nothin' yet. *Business Week*, p. 14.

182. Geishecker, I. (2006). Does outsourcing to central and Eastern Europe really threaten manual workers' jobs in Germany? *The World Economy*, 29 (5), 559-583.

183. Gibbons, R. (2005). Four forma(lizable) theories of the firm? *Journal of Economic Behavior & Organization*, 58 (2), 200-245.

184. Girma, S. & Görg, H. (2004). Outsourcing, foreign ownership, and productivity: Evidence from UK establishment-level data. *Review of International Economics*, 12 (5), 817-832.

185. Girma, S., Görg, H. & Strobl, E. (2004). Exports, international investment, and plant performance: Evidence from a non-parametric test. *Economics Letters*, 83 (3), 317-324.

186. Goettler, R. L., Parlour, C. A. & Rajan, U. (2005). Equilibrium in a dynamic limit order market. *Journal of Finance*, 60 (5), 2149-2192.

187. Görg, H. & Hanley, A. (2004). Does outsourcing increase profitability? *Economic and Social Review*, 35 (3), 267-288.

188. Görg, H. & Hanley, A. (2005). International outsourcing and productivity: Evidence from the Irish electronics industry. *The North American Journal of Economics and Finance*, 16 (2), 255-269.

189. Görg, H., Hanley, A. & Strobl, E. (2004). Outsourcing, foreign ownership, exporting and productivity: An empirical investigation with plant level data. GEP Research Paper 04/08, University of Nottingham.

190. Görg, H., Hanley, A. & Strobl, E. (2008). Productivity effects of international outsourcing: Evidence from plant-level data. *Canadian Journal of Economics*, 41 (2), 670-688.

191. Görzig, B. & Stephan, A. (2002). Outsourcing and firm-level performance. DIW Berlin Discussion Paper 309, German Institute for Economic Research (DIW), Berlin.

192. Gottfredson, M., Puryear, R. & Phillips, S. (2005). Strategic sourcing: From periphery to the core. *Harvard Business Review*, 83 (2), 132-139.

193. Gowrisankaran, G. (1999). A dynamic model of endogenous horizontal mergers. *The RAND Journal of Economics*, 30 (1), 56-83.

194. Gowrisankaran, G. & Town, R. J. (1997). Dynamic equilibrium in the hospital industry. *Journal of Economics & Management Strategy*, 6 (1), 45-74.

195. Graziani, G. (1998). Globalisation of production in the textile and clothing industry: The case of Italian FDI and outward processing in Eastern Europe. In J. Zysman & A. Schwartz (Ed.), *Enlarging Europe: The Industrial Foundations of a New Political Reality* (Research Series No. 99, p. 238-254). Berkeley: University of California International and Area Studies Digital Collection.

196. Graziani, G. (2001). International subcontracting in the textile and clothing industry. In S. Arndt & H. Kierzkowski (Ed.), *Fragmentation: New Production Patterns in the World Economy* (p. 209-230). Oxford: Oxford University Press.

197. Griliches, Z. & Mairesse, J. (1990). R&D and productivity growth: Comparing Japanese and US manufacturing firms. In C. Hulten (Ed.), *Productivity Growth in Japan and United States* (p. 317-348). Chicago: University of Chicago Press.

198. Griliches, Z. & Mairesse, J. (1995). Production functions: The search for identification. NBER Working Paper 5067.

199. Grossman, G. & Helpman, E. (2004). Managerial incentives and the international organization of production. *Journal of International Economics*, 63 (2), 237-262.

200. Grossman, G. & Helpman, E. (2005). Outsourcing in a global economy. *The Review of Economic Studies*, 72 (1), 135-160.

201. Grossman, G. M. & Helpman, E. (1991a). *Innovation and Growth in the Global Economy*. Cambridge, MA: MIT Press.

202. Grossman, G. M. & Helpman, E. (1991b). Quality ladders in the theory of growth. *Review of Economic Studies*, 58 (1), 43-61.

203. Grossman, G. M. & Helpman, E. (2001). *Innovation and Growth in the Global Economy*. Cambridge, MA: MIT Press.

204. Grossman, G. M. & Helpman, E. (2002). Integration versus outsourcing in industry equilibrium. *The Quarterly Journal of Economics*, 117 (1), 85-120.

205. Grossman, G. M. & Helpman, E. (2003). Outsourcing versus FDI in industry equilibrium. *Journal of the European Economic Association*, 1 (2-3), 317-327.

206. Grossman, G. M., Helpman, E. & Szeidl, A. (2006). Optimal integration strategies for the multinational firm. *Journal of International Economics*, Elsevier, 70 (1), 216-238.

207. Grossman, G. M., Helpman, E. & Szeidl, A. (2005). Complementarities between outsourcing and foreign sourcing. *American Economic Review*, 95 (2), 19-24.

208. Grossman, G. M. & Rossi-Hansberg, E. (2006). The rise of offshoring: It's not wine for cloth anymore. In *The New Economic Geography: Effects and Policy Implications*. Jackson Hole: Federal Reserve Bank of Kansas City.

209. Grossman, G. M. & Rossi-Hansberg, E. (2008). Trading tasks: A simple theory of offshoring. *American Economic Review*, 98 (5), 1978–1997.

210. Grossman, S. J. & Hart, O. D. (1986). The costs and benefits of ownership: A theory of vertical and lateral integration. *Journal of Political Economy*, 9 (2), 169-189.

211. Hagel III, J. & Brown, J. S. (2005). Productive friction: How difficult business partnerships can accelerate innovation. *Harvard Business Review*, 83 (2), 82-91.

212. Hall, B. H. (1987). The relationship between firm size and firm growth in the U.S. manufacturing sector. *Journal of Industrial Economics*, 35 (4), 583-606.

213. Halpern, L., Koren, M. & Szeidl, A. (2006). Imports and productivity. *2006 Meeting Paper Number 796*, Society for Economic Dynamics.

214. Halvorsen, R. & Palmquist, R. (1980). The interpretation of dummy variables in semilogarithmic equations. *American Economic Review*, 70 (3), 474-475.

215. Hanson, G. H., Mataloni, R. J. & Slaughter, M. J. (2001). Expansion strategies of U.S. multinational firms. NBER Working Paper 8433.

216. Hanson, G. H., Mataloni, R. J. & Slaughter, M. J. (2005). Vertical production networks in multinational firms. *The Review of Economics and Statistics*, 87 (4), 664-678.

217. Harris, R. G. (2001). A comminication-based model of global production fragmentation. In S. Arndt & H. Kierzkowski (Ed.), *Fragmentation: New Production Patterns in the World Economy* (p. 52-75). Oxford: Oxford University Press.

218. Harrison, A. E. & McMillan, M. S. (2006). Outsourcing jobs? Multinationals and US employment. NBER Working Paper 12372.

219. Harrod, R. F. (1939). An essay in dynamic theory. *The Economic Journal*, 49 (193), 14-33.

220. Hart, O. (1989). An economist's perspective on the theory of the firm. *Columbia Law Review*, 89 (7), 1757-1774.

221. Hart, O. (1995). *Firms, Contracts, and Financial Structure*. Oxford: Oxford University Press.

222. Hart, O. & Moore, J. (1990). Property rights and the nature of the firm. *Journal of Political Economy*, 98 (6), 1119-1158.

223. Hausman, W. H., Lee, H. L. & Subramanian, U. (2005). Global logistics indicators, supply chain metrics, and bilateral trade patterns. *World Bank Policy Research Working Paper Series 3773*, The World Bank, Washington.

224. Havik, K. & Mc Morrow, K. (2006). Global trade integration and outsourcing: How well is the EU coping with the new challenges? EC Economic Papers 259, European Commission, Brussels.

225. Head, K. & Ries, J. (2002). Offshore production and skill upgrading by Japanese manufacturing firms. *Journal of International Economics*, 58 (1), 81-105.

226. Head, K., Ries, J. & Spencer, B. J. (2004). Vertical networks and US auto parts exports: Is Japan different? *Journal of Economics & Management Strategy*, 13 (1), 37-67.

227. Heckman, J. J., Ichimura, H. & Todd, P. E. (1997). Matching as an econometric evaluation estimator: Evidence from evaluating a job training programme. *Review of Economic Studies*, 64 (4), 605-54.

228. Heckman, J. J., Ichimura, H. & Todd, P. E. (1998). Matching as an econometric evaluation estimator. *Review of Economic Studies*, 65 (2), 261-294.

229. Helper, S. (1991). Strategy and irreversibility in supplier relations: The case of the US automobile industry. *Business History Review*, 65 (4), 781-824.

230. Helpman, E. (2006). Trade, FDI, and the organization of firms. *Journal of Economic Literature*, 44 (3), 589-630.

231. Helpman, E. & Krugman, P. (1985). *Market Structure and Foreign Trade*. Cambridge, MA: MIT Press.

232. Helpman, E., Melitz, M. J. & Yeaple, S. R. (2004). Export versus FDI with heterogeneous firms. *American Economic Review*, 94 (1), 300-316.

233. Holmes, T. J. (1999). Localization of industry and vertical disintegration. *The Review of Economics and Statistics*, 81 (2), 314-325.

234. Holmström, B. (1979). Moral hazard and observability. *The Bell Journal of Economics*, 10 (1), 74-91.

235. Holmström, B. (1982). Moral hazard in teams. *Bell Journal of Economics*, 13 (2), 324-340.

236. Holmstrom, B. & Milgrom, P. (1994). The firm as an incentive system. *American Economic Review*, 84 (4), 972-991.

237. Holmström, B. & Roberts, J. (1998). The boundaries of the firm revisited. *Journal of Economic Perspectives*, 12 (4), 73-94.

238. Hopenhayn, H. A. (1992). Entry, exit, and firm dynamics in long run equilibrium. *Econometrica*, 60 (5), 1127-1150.

239. Horn, H., Lang, H. & Lundgren, S. (1995). Managerial effort incentives, X-inefficiency and international trade. *European Economic Review*, 39 (1), 117-138.

240. Hoskisson, R., Eden, L., Lau, C. & Wright, M. (2000). Strategy in emerging economies. *Academy of Management Journal*, 43 (3), 249-267.

241. Hubbard, T. N. (2001). Contractual form and market thickness in trucking. *RAND Journal of Economics*, 32 (2), 369-386.

242. Hummels, D. (1999). Toward a geography of trade costs. GTAP Working Paper 17, Center for Global Trade Analysis, Purdue University.

243. Hummels, D. (2007). Transportation costs and international trade in the second era of globalization. *Journal of Economic Perspectives*, 21 (3), 131-154.

244. Hummels, D., Ishii, J. & Yi, K.-M. (2001). The nature and growth of vertical specialization in world trade. *Journal of International Economics*, 54 (1), 75-96.

245. Hummels, D., Lugovskyy, V. & Skiba, A. (2009). The trade reducing effects of market power in international shipping. Forthcoming in *Journal of Development Economics*.

246. Hummels, D., Rapoport, D. & Yi, K.-M. (1998). Vertical specialization and the changing nature of world trade. *FRBNY Economic Policy Review*, (June), 79-99.

247. Intel (2006a). *Intel 2006 annual report*. Intel Corporation, Santa Clara, California. Accessed on August 2007 at http://.les.shareholder.com/downloads/INTC/486090993x0x191213/E57F79FE-B694-4116-BCF0-2C8005F154BC/2006IntelAnnualReport.pdf.

248. Intel (2006b). *Intel 2006 corporate responsibility report*. Intel Corporation, Santa Clara, California. Accessed on August 2007 at http://download.intel.com/intel/cr/archive/pdf/06CR_Report.pdf.

249. Jean, S. (2002). International trade and firms' heterogeneity under monopolistic competition. *Open Economies Review*, 13 (3), 291-311.

250. Jenkins, M., Liu, P., Matzkin, R. L. & McFadden, D. L. (2004, December 31). The browser war - econometric analysis of Markov perfect equilibrium in markets with network effects. Mimeo, University of California, Berkeley. Accessed on May 22 2008 at http://elsa.berkeley.edu/wp/mcfadden0204/browser120104.pdf

251. Jensen, J. B. & Kletzer, L. G. (2005). Tradable services: Understanding the scope and impact of services outsourcing. IIE Working Paper Series WP05-9, Institute for International Economics.

252. Jensen, M. C. & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency cost, and capital structure. *Journal of Financial Economics*, 3 (4), 305-360.

253. Jensen, M. C. & Meckling, W. (1992). Specific and General Knowledge, and Organizational Structure. In L. Werin & H. Wijkander (Ed.), *Contract Economics* (p. 251-291). Oxford: Blackwell Publishers.

254. Jeswiet, J. & Hauschild, M. (2005). EcoDesign and future environmental impacts. *Materials & Design*, 26 (7), 629-634.

255. Jones, C. I. (1999). Growth: With or without scale effects? *American Economic Review*, 89 (2), 139-144.

256. Jones, R. W. (1971). A three-factor model in theory, trade, and history. In J. N. Bhagwati, R. W. Jones, R. Mundell & J. Vanek (Ed.), *Trade, Balance of Payments and Growth: Essays in Honor of Charles Kindleberger* (p. 3-21). Amsterdam: Elsevier.

257. Jones, R. W. (2000). *Globalization and the Theory of Input Trade*. Cambridge, MA: MIT Press.

258. Jones, R. W. & Kierzkowski, H. (1990). The role of services in production and international trade: A theoretical framework. In R. W. Jones & A. Krueger (Ed.), *The Political Economy of International Trade* (p. 31-48). Oxford: Basil Blackwell.

259. Jones, R. W. & Kierzkowski, H. (2001). A Framework for Fragmentation. In S. W. Arndt &H. Kierzkowski (Ed.), *Fragmentation: New Production Patterns in the World Economy* (Chapter 2, p. 17-34). Oxford: Oxford University Press.

260. Jones, R.W., Kierzkowski, H. & Lurong, C. (2005). What does evidence tell us about fragmentation and outsourcing? *International Review of Economics & Finance*, 14 (3), 305-316.

261. Jovanovic, B. (1982). Selection and the evolution of industry. *Econometrica*, 50 (3), 649-670.

262. Judd, K. & Schmedders, K. (2002). Optimal rules for patent races. Discussion Papers 1343, Northwestern University, Center for Mathematical Studies in Economics and Management Science. Forthcoming in *International Journal of Industrial Organization*.

263. Judd, K. L. (1998). *Numerical Methods in Economics*. Cambridge, MA: MIT Press.

264. Kaminski, B. (2001). How accession to the European Union has affected external trade and foreign direct investment in Central European Economies. Policy Research Working Paper Series 2578, The World Bank, Washington.

265. Kapur, D. & Ramamurti, R. (2001). India's emerging competitive advantage in services. *Academy of Management Executives*, 15 (2), 20-33.

266. Kasahara, H. & Lapham, B. (2008). Productivity and the decision to import and export: Theory and evidence. CESifo Working Paper 2240, CESifo.

267. Kasahara, H. & Rodrigue, J. (2008). Does the use of imported intermediates increase productivity? Plant-level evidence. *Journal of Development Economics*, 87 (1), 106-118.

268. Keller, W. & Yeaple, S. R. (2005). Multinational enterprises international trade, and productivity growth : Firm-level evidence from the united states. Discussion Paper Series 1: Economic Studies 2005-07, Deutsche Bundesbank, Research Centre. Forthcoming in *The Review of Economics and Statistics*.

269. Kierzkowski, H. (2001). Joining the global economy: Experience and prospects of the transition economies. In S. Arndt & H. Kierzkowski (Ed.), *Fragmentation: New Production Patterns in the World Economy* (p. 231-253). Oxford: Oxford University Press.

270. Kimura, F. (2005). The globalisation of production networks: A view from Asia. Mimeo, Faculty of Economics, Keio University.

271. Kimura, F. & Fujii, T. (2003). Globalizing activities and the rate of survival: Panel data analysis on Japanese firms. *Journal of the Japanese and International Economies*, 17 (4), 538-560.

272. Kirkegaard, J. F. (2004). Outsourcing - stains on the white collar? IIE paper series, Institute for International Economics. Accessed on February 25 2007 at

www.iie.com/publications/papers/kirkegaard0204.pdf

273. Kirkegaard, J. F. (2005). Outsourcing and offshoring: Pushing the European model over the hill, rather than off the cliff! IIE Working Paper Series WP05-1, Institute for International Economics.

274. Kirkegaard, J. F. (2007). Offshoring, outsourcing, and production relocation: Labor-market effects in the OECD countries and developing Asia. Peterson Institute Working Paper Series WP07-02, Peterson Institute for International Economics.

275. Klein, B., Crawford, R. G. & Alchian, A. A. (1978). Vertical integration, appropriable rents, and the competitive contracting process. *Journal of Law & Economics*, 21 (2), 297-326.

276. Kleinert, J. (2003). Growing trade in intermediate goods: Outsourcing, global sourcing, or increasing importance of MNE networks? *Review of International Economics*, 11 (3), 464-482.

277. Klette, T. J. (1999). Market power, scale economies and productivity: Estimates from a panel of establishment data. *Journal of Industrial Economics*, 47 (4), 451-476.

278. Klette, T. J. & Griliches, Z. (1996). The inconsistency of common scale estimators when output prices are unobserved and endogenous. *Journal of Applied Econometrics*, 11 (4), 343-361.

279. Klette, T. J. & Griliches, Z. (2000). Empirical patterns of firm growth and R&D investment: A quality ladder model interpretation. *Economic Journal*, 110 (463), 363-387.

280. Klette, T. J. & Kortum, S. (2004). Innovating firms and aggregate innovation. *Journal of Political Economy*, 112 (5), 986-1018.

281. Kletzer, L. G. (2004). Trade-related job loss and wage insurance: A synthetic review. *Review of International Economics*, 12 (5), 724-748.

282. Knight, F. H. (1921). *Risk, Uncertainty, and Profit*. Boston: Hart, Schaffner & Marx.

283. Knight, F. H. (1944). Diminishing returns from investment. *The Journal of Political Economy*, 52 (1), 26-47.

284. Kogut, B. & Kulatilaka, N. (1994a). Operating flexibility, global manufacturing, and the option value of a multinational network. *Management Science*, 40 (1), 123-139.

285. Kogut, B. & Kulatilaka, N. (1994b). Options thinking and platform investments: Investing in opportunity. *California Management Review*, 36 (2), 52-71.

286. Kohler, W. (2004). Aspects of international fragmentation. *Review of International Economics*, 12 (5), 793-816.

287. Koopmans, T. C. (1965). *On the Concept of Optimal Economic Growth*. Amsterdam: North Holland.

288. Kor, Y. Y. & Mahoney, J. T. (2004). Edith Penrose's (1959) contributions to the resource-based view of strategic management. *Journal of Management Studies*, 1, 183-191.

289. Krugman, P. R. (1979). Increasing returns, monopolistic competition, and international trade. *Journal of International Economics*, 9 (4), 469-479.

290. Krugman, P. R. (1993). What do undergrads need to know about trade? *American Economic Review*, 83 (2), 23-26.

291. Krugman, P. R. (1994). Competitiveness: A dangerous obsession. *Foreign Affairs*, 73 (2), 28-44.

292. Krugman, P. R. (1995). Growing world trade: Causes and consequences. *Brookings Papers on Economic Activity*, 26 (1), 327-377.

293. Kulatilaka, N. & Trigeorgis, L. (1994). The general flexibility to switch: Real options revisited. *International Journal of Finance*, 6 (2), 778-798.

294. Kurz, C. J. (2006). Outstanding outsourcers: A firm- and plant-level analysis of production sharing. Finance and Economics Discussion Series 2006-04, Federal Reserve Board, Washington, D.C.

295. Langohr, P. (2003). Competitive convergence and divergence: Capability and position dynamics. Computing in Economics and Finance 2003 229, Society for Computational Economics.

296. Leamer, E. E. (1996). The effects of trade in services, technology transfer and delocalisation on local and global income inequality. *Asia-Pacific Economic Review*, 2 (1), 44-60.

297. Lechner, M. (2001). Identification and estimation of causal effects of multiple treatments under the conditional independence assumption. In M. Lechner & F. Pfeiffer (Ed.), *Econometric Evaluation of Active Labour Market Policies* (p. 43-58). Heidelberg: Physica.

298. Levchenko, A. A. (2007). Institutional quality and international trade. *Review of Economic Studies*, 74 (3), 791-819.

299. Levin, J. & Tadelis, S. (2005). Employment versus contracting in procurement: Theory and evidence from U.S. cities. Mimeo, Haas School of Business, UC Berkeley, Berkeley. Accessed on July 5 2008 at http://www.cramton.umd.edu/workshop/papers/levin-tadelis-procurement.pdf

300. Levinsohn, J. & Melitz, M. (2002). Productivity in a differentiated products market equilibrium. Mimeo, Harvard University. Accessed on October 2 2006 at http://sccie.ucsc.edu/conference/2001/productivity.pdf

301. Levinsohn, J. & Petrin, A. (2003). Estimating production functions using inputs to control for unobservables. *Review of Economic Studies*, 70 (2), 317-341.

302. Lewin, A. Y. & Peeters, C. (2006). The top-line allure of offshoring. Harvard *Business Review*, 84 (3), 22-24.

303. Li & Fung (2007). Li & Fung acquires global sourcing operations of Tommy Hilfiger. Press release, Li & Fung Limited, Hamilton, Bermuda. Accessed on January 26 2008 at: http://www.lifung.com/eng/newsroom/press/p070211.pdf.

304. Limao, N. & Venables, A. J. (2001). Infrastructure, geographical disadvantage, transport costs, and trade. *World Bank Economic Review*, 15 (3), 451-479.

305. Linder, J. C. (2005). Outsourcing integration. *Harvard Business Review*, 83 (6), 19.

306. Liu, B. J. & Tung, A.-C. (2004, May 10). Export outsourcing and foreign direct investment: Evidence from Taiwanese exporting firms. DEGIT Conference Paper c010-047, DEGIT - Dynamics, Economic Growth, and International Trade. Accessed on June 11 2007 at http://www.degit.ifw-kiel.de/papers/degit_10/C010_047.pdf

307. Liu, H. & Mcgoldrick, P. J. (1996). International retail sourcing: Trend, nature, and process. *Journal of International Marketing*, 4 (4), 9-33.

308. Loasby, B. J. (1994). Organisational capabilities and interfirm relations. *Metroeconomica*, 45 (3), 248-265.

309. Lucas, R. J. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22 (1), 3-42.

310. MacGarvie, M. (2006). Do firms learn from international trade? *The Review of Economics and Statistics*, 88 (1), 46-60.

311. Majcen, B. & Kaminski, B. (2004). Trade policy in the transition process. In M. Mrak, M. Rojec & C. Silva-Jauregui (Ed.), *Slovenia: From Yugoslavia to the European Union* (p. 132-149). Washington: The World Bank.

312. Majcen, B. & Lapornik, M. (1989). Efektivna zaščita panog gospodarstva SR Slovenije v letu 1986 [Effective protection of individual sectors of the economy of SR of Slovenia in 1986]. Mimeo, Institute for Economic Research, Ljubljana.

313. Malmgren, H. B. (1961). Information, expectations and the theory of the firm. *The Quarterly Journal of Economics*, 75 (3), 399-421.

314. Malthus, T. R. (1798). *An Essay on the Principle of Population*. London: W. Pickering.

315. Mankiw, G. N. & Swagel, P. (2006). The politics and economics of offshore outsourcing. *Journal of Monetary Economics*, 53 (5), 1027-1056.

316. Mann, C. L. (2003). Globalization of IT services and white collar jobs: The next wave of productivity growth. International Economics Policy Brief PB03-11, Institute of International Economics, Washington.

317. Mann, C. L. (2005, January 15). This is Bangalore calling: Hang up or speed dial? Working paper of the Federal Reserve Bank of Cleveland. Accessed on June 2 2008 at http://www.iie.com/publications/papers/mann0105.pdf

318. Marin, D. (2006). A new international division of labor in Europe: Outsourcing and offshoring to Eastern Europe. *Journal of the European Economic Association*, 4 (2-3), 612-622.

319. Marin, D. (2008). The new corporation in Europe. Bruegel Policy Brief 07, Bruegel, Brussels.

320. Marin, D. & Verdier, T. (2008). Power inside the firm and the market: a general equilibrium approach. *Journal of the European Economic Association*, 6 (4), 752-788.

321. Marin, D. & Verdier, T. (2003). Globalization and the empowerment of talent. Discussion Papers in Economics 268, University of Munich, Department of Economics.

322. Marin, D. & Verdier, T. (2005). Corporate hierarchies and international trade: Theory and evidence. Mimeo, University of Munich. Accessed on May 23 2007 at http://www.economia.unimi.it/fileadmin/uploads/firb/pdf/Marin_Verdier.pdf

323. Marino, K. E. (1996). Developing consensus on firm competencies and capabilities. *Academy of Management Executive*, 10 (3), 40-51.

324. Markusen, J. (2005). Modelling the offshoring of white-collar services: From comparative advantage to the new theories of trade and FDI. NBER Working Paper 11827.

325. Marschak, J. & Andrews, W. (1944). Random simultaneous equations and the theory of production. *Econometrica*, 12 (3/4), 143-205.

326. Marschak, J. & Radner, R. (1972). *Economic Theory of Teams*. New Haven: Yale University Press.

327. Martin, R. (2005). Computing the true spread. CEP Discussion Paper 0692, Centre for Economic Performance, LSE, London.

328. *Mast Industries*. (2008). Accessed on March 26 2007 at http://www.mast.com/.

329. Mattoo, A. & Wunsch, S. (2004). Pre-empting protectionism in services - the WTO and outsourcing. World Bank Policy Research Working Paper 3237, The World Bank, Washington.

330. Mayer, T. & Zignago, S. (2005). Market access in global and regional trade. CEPII Working Paper 2005-02, CEPII Research Center, Paris.

331. McCarthy, J. C. (2004, May 14). Near-term growth of offshoring accelerating. Forrester report, Forrester Research, Cambridge, MA. Accessed on May 19 2006 at http://www.forrester.com/Research/Document/Excerpt/0,7211,34426,00.html

332. McGovern, G. & Quelch, J. (2005). Outsourcing marketing. *Harvard Business Review*, 83 (3), 22-26.

333. McKinsey Global Institute (2003a). New horizons: Multinational company investment in developing economies. Technical report, McKinsey Global Institute, San Francisco.

334. McKinsey Global Institute (2003b). Offshoring: Is it a win-win game? Technical report, McKinsey Global Institute, San Francisco.

335. McKinsey Global Institute (2004). Can Germany win from offshoring? Technical report, McKinsey Global Institute, San Francisco.

336. McKinsey Global Institute (2005). How offshoring of services could benefit France. Technical report, McKinsey Global Institute, San Francisco.

337. McLaren, J. (1999). Supplier relations and the market context: A theory of handshakes. *Journal of International Economics*, 48 (1), 121-138.

338. McLaren, J. (2000). "Globalization" and vertical structure. *American Economic Review*, 90 (5), 1239-1254.

339. McNulty, P. J. (1984). On the nature and theory of economic organization: The role of the firm reconsidered. *History of Political Economy*, 16 (2), 233-253.

340. Melitz, M. (2000, December 15). Estimating firm-level productivity in differentiated product industries. Mimeo, Harvard University. Accessed on May 20 2006 at http://www.princeton.edu/~mmelitz/papers/PRODEST.PDF

341. Melitz, M. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, 71 (6), 1695-1725.

342. Melitz, M. J. & Ottaviano, G. I. P. (2008). Market size, trade, and productivity. *Review of Economic Studies*, 75 (1), 295-316.

343. Meyer, K. E. (2004). Perspectives on multinational enterprises in emerging economies. *Journal of International Business Studies*, 35 (4), 259-276.

344. Meyer, K. E. & Peng, M. W. (2005). Probing theoretically into Central and Eastern Europe: transactions, resources, and institutions. *Journal of International Business Studies*, 36 (6), 600-621.

345. Millman, G. J. (2003). Going beyond commodity outsourcing. *Financial Executive*, 19 (6), 55-58.

346. Mirrlees, J. A. (1976). The optimal structure of incentives and authority within an organization. *Bell Journal of Economics*, 7 (1), 105-131.

347. Mitra, D. & Ranjan, P. (2005). Y2K and offshoring: The role of external economies and firm heterogeneity. NBER Working Paper 11718.

348. Molnar, M., Pain, N. & Taglioni, D. (2007). The internationalisation of production, international outsourcing and employment in the OECD. OECD Economics Department Working Paper 561, OECD.

349. Montagna, C. (2001). Efficiency gaps, love of variety and international trade. *Economica*, 68 (269), 27-44.

350. Muendler, M. A. (2004). Trade, technology, and productivity: A study of Brazilian manufacturers, 1986-1998. CESifo Working Paper Series 1148, CESifo, Munich.

351. Murtha, T. P. (2004). The metanational firm in context: Competition in knowledge-driven industries. In M. A. Hitt & J. Cheng (Ed.), *Theories of the Multinational Enterprise Diversity, Complexity and Relevance* (p. 101-136). Amsterdam: Elsevier.

352. Naghavi, A. & Ottaviano, G. (2006a). Outsourcing, complementary innovations and growth. CEPR Working Paper DP5925, CEPR.

353. Naghavi, A. & Ottaviano, G. (2006b). Outsourcing, contracts and innovation networks. CEPR Working Paper DP5681, CEPR.

354. Naghavi, A. & Ottaviano, G. (2007, April 14). The organizational theory of growth and industry dynamics with heterogeneous firms. Mimeo, University of Modena. Accessed on March 22 2008 at http://www.intertic.org/Conference/Naghavi.pdf

355. Navaretti, G. B. & Venables, A. J. (2004). *Multinational Firms in the World Economy*. Princeton: Princeton University Press.

356. Nelson, R. R. & Winter, S. G. (1973). Toward an evolutionary view of economic capabilities. *American Economic Review*, 63 (2), 440-449.

357. Nordas, H. K. (2007). International production sharing: A case for a coherent policy framework. WTO discussion paper 11, World Trade Organization, Geneva.

358. Nordas, H. K., Pinali, E. & Grosso, M. G. (2006). Logistics and time as a trade barrier. OECD Trade Policy Working Papers 35, OECD Trade Directorate.

359. Nunn, N. (2007). Relationship-specificity, incomplete contracts, and the pattern of trade. Journal of Economics, 122 (2), 569-600.

360. Olley, G. S. & Pakes, A. (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica*, 64 (6), 1263-1297.

361. Olsen, K. B. (2006). Productivity impacts of offshoring and outsourcing: A review. STI Working Paper 2006/1, OECD.

362. Orberg Jensen, P. D., Kirkegaard, J. F. & Sondergaard Laugesen, N. (2006). Offshoring in Europe: Evidence of a two-way street from Denmark. IIE Working Paper WP06-03, Institute for International Economics, Washington.

363. Outsourcing Institute (2005). *8th annual outsourcing index: Money matters*. Special Report 4, Outsourcing Institute.

364. Pakes, A. (2000). A framework for applied dynamic analysis in I.O. NBER Working Paper 8024.

365. Pakes, A. & Ericson, R. (1998). Empirical implications of alternative models of firm dynamics. *Journal of Economic Theory*, 79 (1), 1-45.

366. Pakes, A. & McGuire, P. (1994). Computing Markov-perfect Nash equilibria: Numerical implications of a dynamic differentiated product model. *RAND Journal of Economics*, 25 (4), 555-589.

367. Pakes, A. & McGuire, P. (2001). Stochastic algorithms, symmetric Markov perfect equilibrium, and the 'curse' of dimensionality. *Econometrica*, 69 (5), 1261-1281.

368. Panagariya, A. (2004). Why the recent Samuelson article in not about offshore outsourcing. Mimeo, Columbia University, New York. Accessed on March 23 2006 at http://www.columbia.edu/~ap2231/Policy%20Papers/Samuelson%20JEP%20(Summer%202004)_Not%20on%20Outsourcing.htm

369. Paul, C. J. M. & Siegel, D. S. (2001). The impacts of technology, trade and outsourcing on employment and labor composition. *Scandinavian Journal of Economics*, 103 (2), 241-264.

370. Paul, D. L. & Wooster, R. B. (2008). Strategic investments by US firms in transition economies. *Journal of International Business Studies*, 39 (2), 249-266.

371. Pavcnik, N. (2002). Trade liberalization, exit, and productivity improvement: Evidence from Chilean plants. *Review of Economic Studies*, 69 (1), 245-276.

372. Penrose, E. (1955). Limits to the growth and size of firms. *The American Economic Review*, 45 (2), 531-543.

373. Penrose, E. (1959). *The Theory of the Growth of the Firm*. New York: Oxford University Press.

374. Peretto, P. & Smulders, S. (2002). Technological distance, growth and scale effects. *Economic Journal*, 112 (481), 603-624.

375. Peretto, P. F. (1999). Cost reduction, entry, and the interdependence of market structure and economic growth. *Journal of Monetary Economics*, 43 (1), 173-195.

376. Pitelis, C. (2002). On the garden of Edith. In C. Pitelis (Ed.), *The Growth of the Firm: The Legacy of Edith Penrose*. New York: Oxford University Press.

377. Polanec, S. (2004). On the evolution of size and productivity in transition: Evidence from Slovenian manufacturing firms. LICOS Discussion Papers 15404, LICOS - Centre for Institutions and Economic Performance, K.U. Leuven.

378. Prahalad, C. K. & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*, 68 (3), 79-91.

379. Puga, D. & Trefler, D. (2002). Knowledge creation and control in organizations. NBER Working Paper 9121.

380. Quinn, J. B. & Hilmer, F. G. (1995). Strategic outsourcing. *The McKinsey Quarterly*, (1), 48-70.

381. Raa, T. T. & Wolff, E. N. (2001). Outsourcing of services and the productivity recovery in U.S. manufacturing in the 1980s and 1990s. *Journal of Productivity Analysis*, 16 (2), 149-165.

382. Radner, R. (1996). Bounded rationality, indeterminacy, and the theory of the firm. *Economic Journal*, 106 (438), 1360-1373.

383. Ramsey, F. P. (1928). A mathematical theory of saving. *The Economic Journal*, 38 (152), 543-559.

384. Rebelo, S. (1991). Long-run policy analysis and long-run growth. *Journal of Political Economy*, 99 (3), 500-521.

385. Reve, T. (1990). The firm as a nexus of internal and external contracts. In M. Aoki, B. Gustafsson & O. Williamson (Ed.), *The Firm as a Nexus of Treaties* (p. 133-161). London: Sage.

386. Ricardo, D. (1817). *On the Principles of Political Economy and Taxation*. Cambridge: Cambridge University Press.

387. Richardson, G. B. (1972). The organisation of industry. *Economic Journal*, 82 (327), 883-896.

388. Rigobon, R. & Stoker, T. M. (2004). Censored regressors and expansion bias. Sloan School of Management Working paper 4451-03, Massachusetts Institute of Technology (MIT).

389. Rodrigue, J.-P., Comtois, C. & Slack, B. (2006). *The Geography of Transport Systems*. New York: Routledge.

390. Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94 (5), 1002-1037.

391. Romer, P. M. (1987). Growth based on increasing returns due to specialization. *American Economic Review*, 77 (2), 56-62.

392. Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy*, 98 (5), S71-102.

393. Rosenbaum, P. R. & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70 (1), 41-55.

394. Rosenbaum, P. R. & Rubin, D. B. (1984). Reducing bias in observational studies using subclassification on the propensity score. *Journal of the American Statistical Association*, 79 (387), 516-524.

395. Rosenbaum, P. R. & Rubin, D. B. (1985). Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *The American Statistician*, 39 (1), 33-38.

396. Ross, S. A. (1973). The economic theory of agency: The principal's problem. *American Economic Review*, 63 (2), 134-139.

397. Rugman, A. (1980). Internalization as a general theory of foreign direct investment: A re-appraisal of the literature. *Review of World Economics (Weltwirtschaftliches Archiv)*, 116 (2), 365-379.

398. Salanie, B. (1997). *The Economics of Contracts*. Cambridge, MA: MIT Press.

399. Samuelson, P. A. (2004). Where Ricardo and Mill rebut and confirm arguments of mainstream economists supporting globalization. *Journal of Economic Perspectives*, 18 (3), 135-146.

400. Sayek, S. & Sener, F. (2006). Outsourcing and wage inequality in a dynamic product cycle model. *Review of Development Economics*, 10 (1), 1-19.

401. Schultze, C. L. (2004, June 22). Offshoring, import competition, and the jobless recovery. *Policy Brief 136, The Brookings Institution*. Accessed on July 28 2007 at http://www.brookings.edu/~/media/Files/rc/papers/2004/0622business_schultze/20040622.pdf

402. Schumpeter, J. A. (1934). *The Theory of Economic Development*. Cambridge, MA: Harvard University Press.

403. Sheshinski, E. (1967). Optimal accumulation with learning by doing. In K. Shell (Ed.), *Essays on the Theory of Optimal Economic Growth* (p. 31-52). Cambridge: MIT Press.

404. Shoemaker, P. J. H. (1992). How to link strategic vision to core capabilities. *Sloan Management Review*, 34 (1), 67-81.

405. Siegel, D. & Griliches, Z. (1992). Purchases services, outsourcing, computers, and productivity in manufacturing. In Z. Griliches (Ed.), *Output Measurement in the Service Sector* (p. 429-458). Chicago: University of Chicago Press.

406. Simon, H. A. (1951). A formal theory of the employment relationship. *Econometrica*, 19 (3), 293-305.

407. Sjöholm, F. (2003). Which Indonesian firms export? The importance of foreign networks. *Papers in Regional Science*, 82 (3), 333-350.

408. Slaughter, M. J. (2004, October). Insourcing jobs: Making the global economy work for America. *Organization for International Investment*. Accessed on April 7 2006 at http://www.ofii.org/insourcing/insourcing_study.pdf

409. Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*. New York: Random House.

410. Smith, D. (2006). Offshoring: Political myths and economic reality. *The World Economy*, 29 (3), 249-256.

411. Smith, J. A. & Todd, P. E. (2001). Reconciling conflicting evidence on the performance of propensity-score matching methods. *The American Economic Review*, 91 (2), 112-118.

412. Smulders, S. & van de Klundert, T. (1995). Imperfect competition, concentration and growth with firm-specific R&D. *European Economic Review*, 39 (1), 139-160.

413. Smulders, S. & Van de Klundert, T. (2004). Monopolistic competition and economic growth. In S. Brakman & B. J. Heijdra (Ed.), *The Monopolistic Competition Revolution in Retrospect* (p. 307-331). Cambridge: Cambridge University Press.

414. Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70 (1), 65-94.

415. Song, M. (2006). A dynamic analysis of cooperative research in the semiconductor industry. Society for Economic Dynamics 2006 Meeting Papers 468, Society for Economic Dynamics.

416. Spencer, B. J. (2005). International outsourcing and incomplete contracts. *Canadian Journal of Economics*, 38 (4), 1107-1135.

417. Stehrer, R. (2006). Outsourcing activities in the World economy. In P. Barrar & R. Gervas (Ed.), *Global Outsourcing Strategies* (p. 141-151). Hampshire, UK: Gower Publications.

418. Stevens, W. (2007). The risks and opportunities from globalisation. Treasury Working Paper Series 07/05, New Zealand Treasury.

419. Sutton, J. (1991). *Sunk Costs and Market Structure*. Cambridge: MIT Press.

420. Sutton, J. (1997). Gibrat's legacy. *Journal of Economic Literature*, 35 (1), 40-59.

421. Svetličič, M. & Jaklič, A. (2001). Neposredne investicije v državah nekdanje Jugoslavije. In J. Prašnikar (Ed.), *Izzivi in Priložnosti Na Trgih Nekdanje Jugoslavije*. Proceedings from the 3rd Slovenian Business Conference. Ljubljana: Časnik Finance.

422. Swan, T. W. (1956). Economic growth and capital accumulation. *Economic Record*, 32, 334-361.

423. Swenson, D. L. (2000). Firm outsourcing decisions: Evidence from U.S. foreign trade zones. *Economic Inquiry*, 38 (2), 175-189.

424. Swenson, D. L. (2005a). Overseas assembly and country sourcing choices. *Journal of International Economics*, 66 (1), 107-130.

425. Swenson, D. L. (2005b). Outsourcing price decisions: Evidence from U.S. 9802 imports. NBER Working Paper 11184.

426. Tadelis, S. (2002). Complexity, flexibility, and the make-or-buy decision. *American Economic Review*, 92 (2), 433-437.

427. Teece, D. J. (1982). Towards an economic theory of the multiproduct firm. J*ournal of Economic Behavior & Organization*, 3 (1), 39-63.

428. Teece, D. J., Pisano, G. & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18 (7), 509-533.

429. Tempest, R. (1996, September 22). Barbie and the World economy. *Los Angeles Times*, p. A1 in A12.

430. Thompson, P. (2001). The microeconomics of an R&D-based model of endogenous growth. *Journal of Economic Growth*, 6 (4), 263-283.

431. Thompson, P. & Waldo, D. (1994). Growth and trustified capitalism. *Journal of Monetary Economics*, 34 (3), 445-462.

432. Tisdale, S. (1994). Shoe and tell. *New Republic*, 211 (11), 10-11.

433. Tommy Hilfiger (2007). *Li & Fung acquires global sourcing operations of Tommy Hilfiger*. Accessed on August 26 2008 at www.tommy.com/opencms/opencms/corporate/press/Corporate_Releases/li_fung_sourcing.html

434. Udovič, B. (2009). *Ekonomska varnost in ekonomska diplomacija: primer tujih neposrednih investicij Nove ljubljanske banke na trgih Zahodnega Balkana.* Unpublished doctoral dissertation, Ljubljana: Faculty of Economics.

435. UNCTAD (2001). *World Investment Report: Promoting Linkages*. United Nations Conference on Trade and Development, New York.

436. UNCTAD (2004). *World Investment Report: The Shift Towards Services*. United Nations Conference on Trade and Development, New York.

437. UNCTAD (2006). *World Investment Report: FDI from Developing and Transition Economies: Implications for Development*. United Nations Conference on Trade and Development, New York.

438. UNCTAD (2007). *World Investment Report 2007: Transnational Corporations, Extractive Industries and Development*. United Nations Conference on Trade and Development, New York.

439. UNCTAD (2008). *About GSP*. Accessed on September 4 2008 at http://www.unctad.org/Templates/.

440. UNIDO (2002). *Industrial Development Report 2002/2003*. United Nations Industrial Development Organization, Vienna.

441. Van Ark, B., Banister, J. & Guillemineau, C. (2006). Competitive advantage of "low-wage" countries often exaggerated. Executive Action Report A-0212-06-EA, The Conference Board, New York.

442. Van Biesebroeck, J. (2005). Exporting raises productivity in Sub-Saharan African manufacturing firms. *Journal of International Economics*, 67 (2), 373-391.

443. Van Biesebroeck, J. (2008). The sensitivity of productivity estimates: Revisiting three important debates. *Journal of Business & Economic Statistics*, 26 (3), 311-328.

444. Vernon, R. (1966). International investment and international trade in the product cycle. *Quarterly Journal of Economics*, 80 (2), 190-207.

445. Wagner, J. (2006). Exports, foreign direct investment, and productivity: Evidence from German firm level data. *Applied Economics Letters*, 13 (6), 347-349.

446. Walden, E. & Wetherbe, J. (2005). Give a little, get a little. *Harvard Business Review*, 83 (9), 30-32.

447. Walsh, S. T. & Linton, J. D. (2001). The competence pyramid: A framework for identifying and analyzing firm and industry competence. *Technology Analysis and Strategic Management*, 13 (2), 165-177.

448. Weintraub, G., Benkard, C. L. & Van Roy, B. (2008). Markov perfect industry dynamics with many firms. *Econometrica*, 76 (6), 1375 – 1411.

449. Welch, L. S., Benito, G. R. & Petersen, B. (2007). *Foreign Operation Methods: Theory, Analysis, Strategy*. Cheltenham: Edward Elgar Publishing.

450. Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5 (2), 171-180.

451. Wernerfelt, B. (1997). On the nature and scope of the firm: An adjustment-cost theory. *Journal of Business*, 70 (4), 489-514.

452. Willcocks, L. P. & Lacity, M. C. (Ed.) (2006). *Global Sourcing of Business and IT Services*. Basingstoke, New York: Palgrave Macmillan.

453. Williamson, O. E. (1964). *Economics of Discretionary Behavior: Managerial Objectives in a Theory of the Firm*. Englewood Cliffs: Prentice-Hall.

454. Williamson, O. E. (1971). The vertical integration of production: Market failure considerations. *The American Economic Review*, 61 (2), 112-123.

455. Williamson, O. E. (1975). *Markets and Hierarchies, Analysis and Antitrust Implications: A Study in the Economics of Internal Organization*. New York: The Free Press.

456. Williamson, O. E. (1979). Transaction-cost economics: The governance of contractual relations. *Journal of Law and Economics*, 22 (2), 233-261.

457. Williamson, O. E. (1985). *The Economic Institutions of Capitalism*. New York: Free Press.

458. Williamson, O. E. (1996). *The Mechanisms of Governance*. Oxford: Oxford University Press.

459. WTO (2005a). *Overview of Developments in the International Trading Environment. Annual Report by the Director-General.* World Trade Organization, Geneva.

460. WTO (2005b). *World Trade Report 2005*. World Trade Organization, Geneva.

461. WTO (2007). *Trade Policy Review: European Communities*. World Trade Organization, Geneva.

462. WTO (2008a). *Regional trade agreements: Facts and figures*. Accessed on September 1 2008 at http://www.wto.org

463. WTO (2008b). *World Trade Report 2008*. World Trade Organization, Geneva.

464. Yeaple, S. R. (2003). The complex integration strategies of multinationals and cross country dependencies in the structure of foreign direct investment. *Journal of International Economics*, 60 (2), 293-314.

465. Yeats, A. J. (1989). Shifting patterns of comparative advantage: Manufactured exports in developing countries. Policy Research Working Paper 165, World Bank, Washington.

466. Yeats, A. J. (2001). Just how big is global production sharing? In S. W. Arndt & H. Kierzkowski (Ed.), *Fragmentation: New Production Patterns in the World Economy* (Chapter 7, p. 108-143). Oxford: Oxford University Press.

467. Yi, K.-M. (2003). Can vertical specialization explain the growth of World trade? *Journal of Political Economy*, 111 (1), 52-102.

468. Young, A. A. (1928). Increasing returns and economic progress. *The Economic Journal*, 38 (152), 527-542.

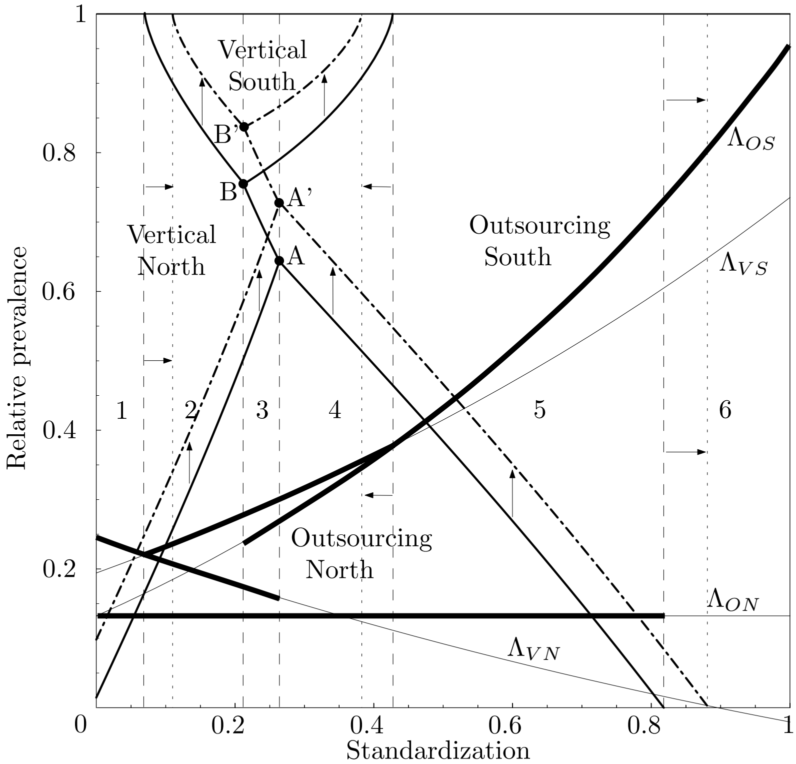
469. Žabkar, V. & Brenčič, M. M. (2004). Values, trust, and commitment in business-to-business relationships: A comparison of two former Yugoslav markets. *International Marketing Review*, 21 (2), 202-215.

Sources of data

1. Agency of the Republic of Slovenia for Public Legal Records and Related Services: Business Register of Slovenia (2005), firms' financial statements (1994-2003).
2. Bank of Slovenia: FDI flows (1994-2003)
3. Statistical Office of the Republic of Slovenia: export and import data (1994-2003), producer price indices at the 2-digit level of NACE classification (1994-2005), Community Innovation Survey data (1996-2002).

Appendix A:

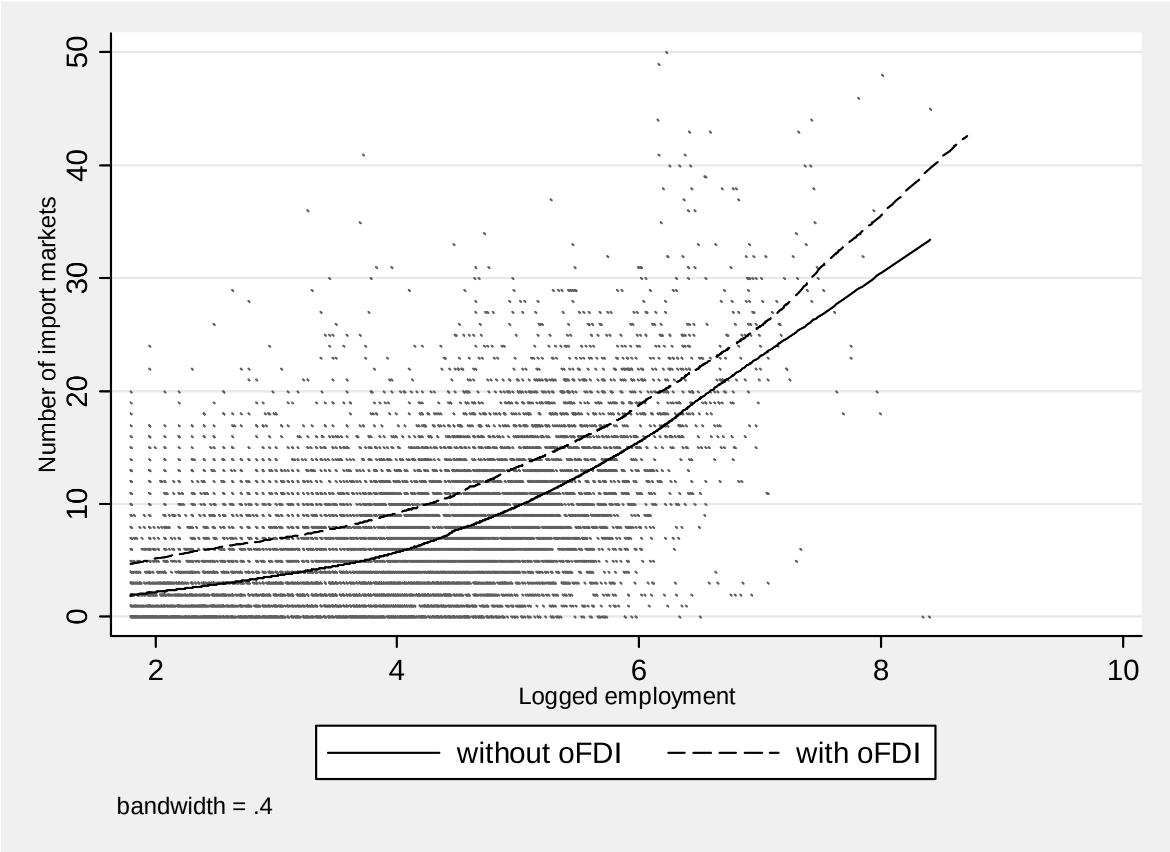
Figure below depicts the values of $\Lambda_t\left(\Omega_{t-1}, z_t\right)$ at the different standardization phases for each of the production mode together with the prevalence of each mode. Dashed vertical lines divide the area into six regions in accordance with the possible sequences of production modes. Bolded lines denote the values of the parameters Λ_t that are valid in each section. The dash-dotted lines depict the borders of production modes in the dynamic setting whereas the compact lines are from the static model described in the Chapter 4.1.



By first looking at the static-setting divisions, it can be seen that a shift upwards to the next feasible production mode always corresponds to the higher Λ_t. However, this does not automatically imply the validity of the rule in the dynamic context. When a firm has to choose not only the optimal production mode but also the optimal level of R&D investment, the break-even productivity levels that separate production modes change as well. The level of productivity that made a firm indifferent between two production modes in the static model, now brings lower instantaneous profits in the advanced production mode because of higher optimal level of investment and hence higher variable costs. Since the function of optimal R&D investment is analytically indeterminate, we cannot derive the dynamic counterparts of production mode borders. We can, though, claim that the switching points between the modes are at higher productivity levels at any standardization phase. In other words, a firm must be even more productive to be able to profit from the change in production mode because of higher investment expenditures in the subsequent location-ownership type. It turns out the sheer notion of margins shifting higher in the productivity dimension is enough to prove the proposition that the advancement to the subsequent production mode corresponds to the shift in Λ_t. In the prevalence-standardization diagram, the above discussed border repositioning unveils itself in an upward shift of lines delimiting the production modes. Arrows denote the changes from the static to the dynamic equilibrium. It is easily seen that the enlargement of section 1 does not bring about any changes to the order of parameter Λ_t values and the same is true for the narrowing of section 4. Next, even if the horizontal positions of intersections A′ and B′ change, this does not threaten the order of the parameters in sections 2 and 3. The only possible but highly unlikely cases for parameter values reversal would be if A′ (or even B′) shifted further to the right from the $\Lambda_{ON} - \Lambda_{VN}$ intersection, or if B′ (or even A′) shifted further to the left from the $\Lambda_{OS} - \Lambda_{VN}$ intersection.

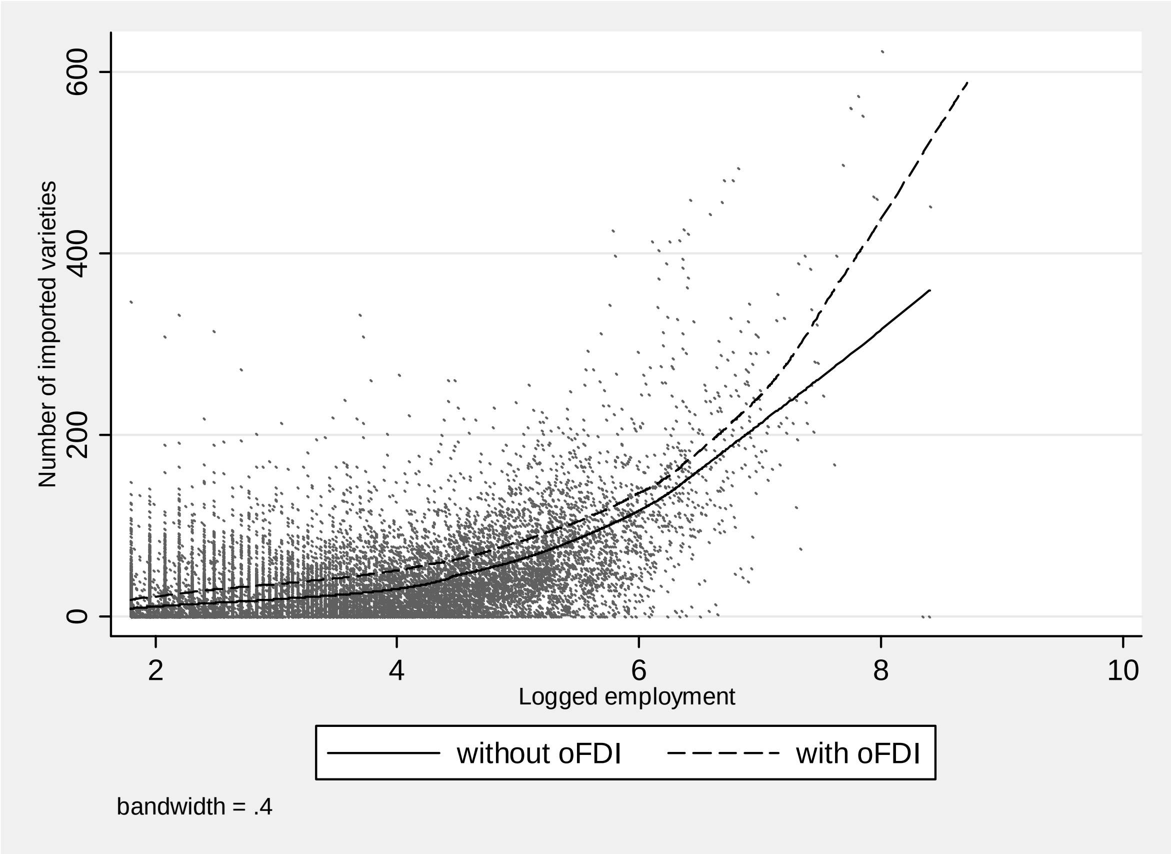
Appendix B:

Figure B1: The relationship between firm size and the number of import markets



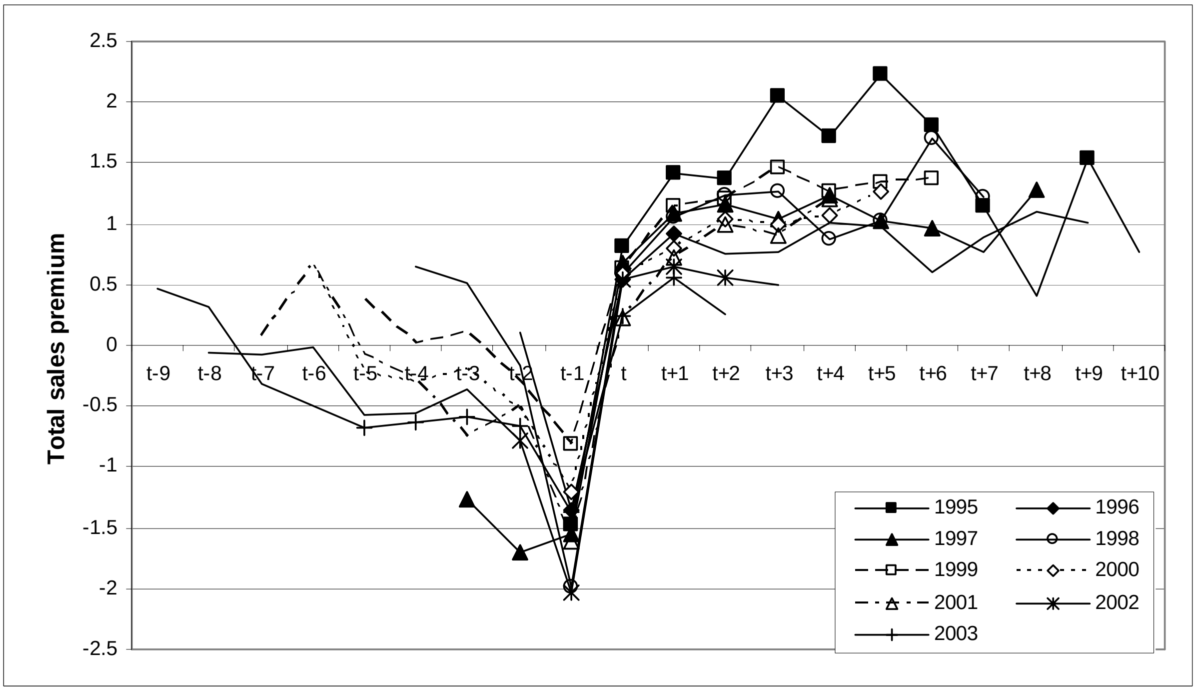
Source: own calculations.

Figure B2: The relationship between firm size and the number of imported varieties



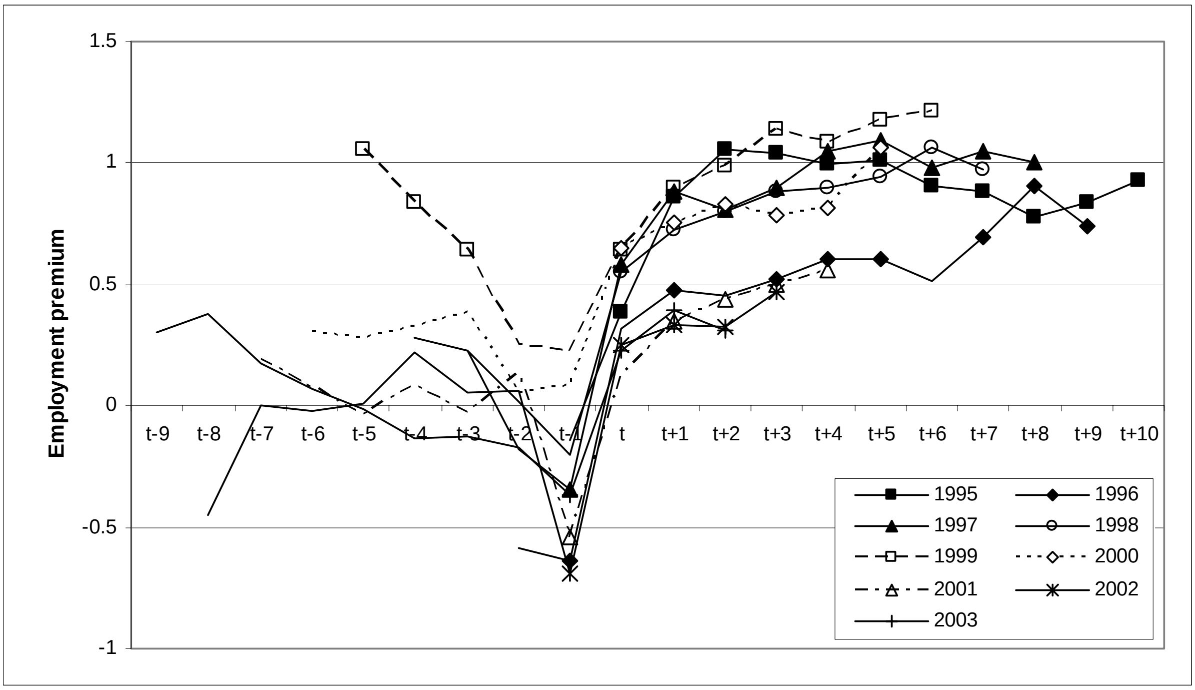
Source: own calculations.

Figure B3: The premium of new importers relative to non-importers in terms of total revenue



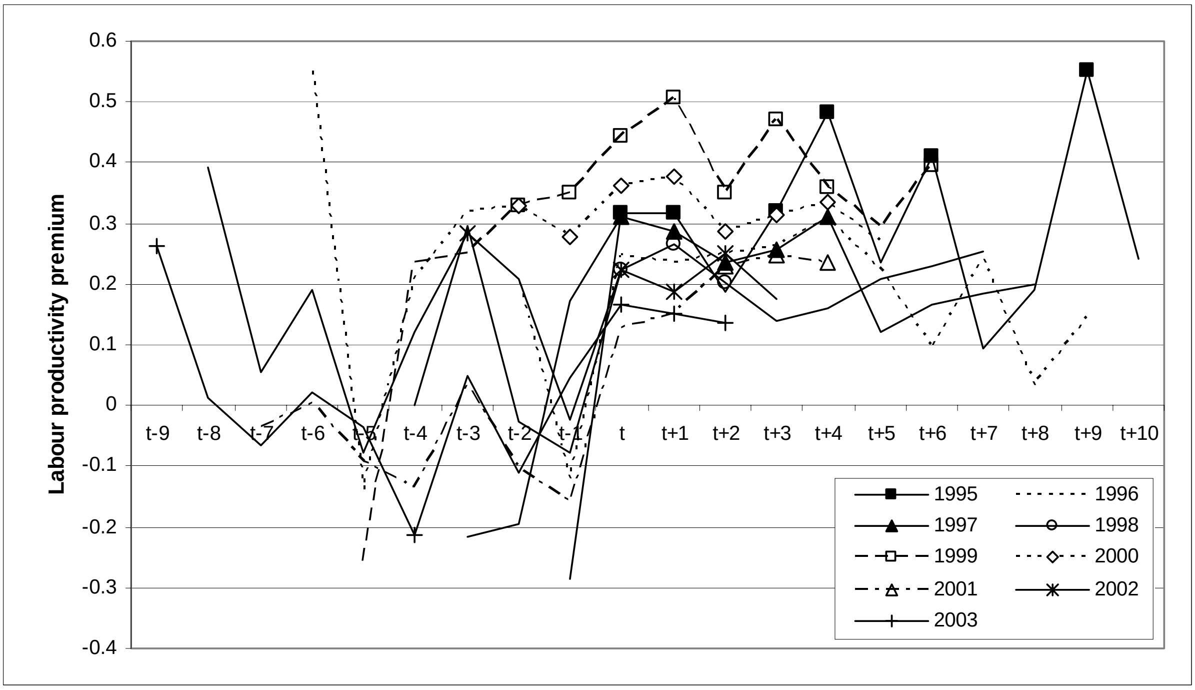
Source: own calculations.

Figure B4: The premium of new importers relative to non-importers in terms of employment



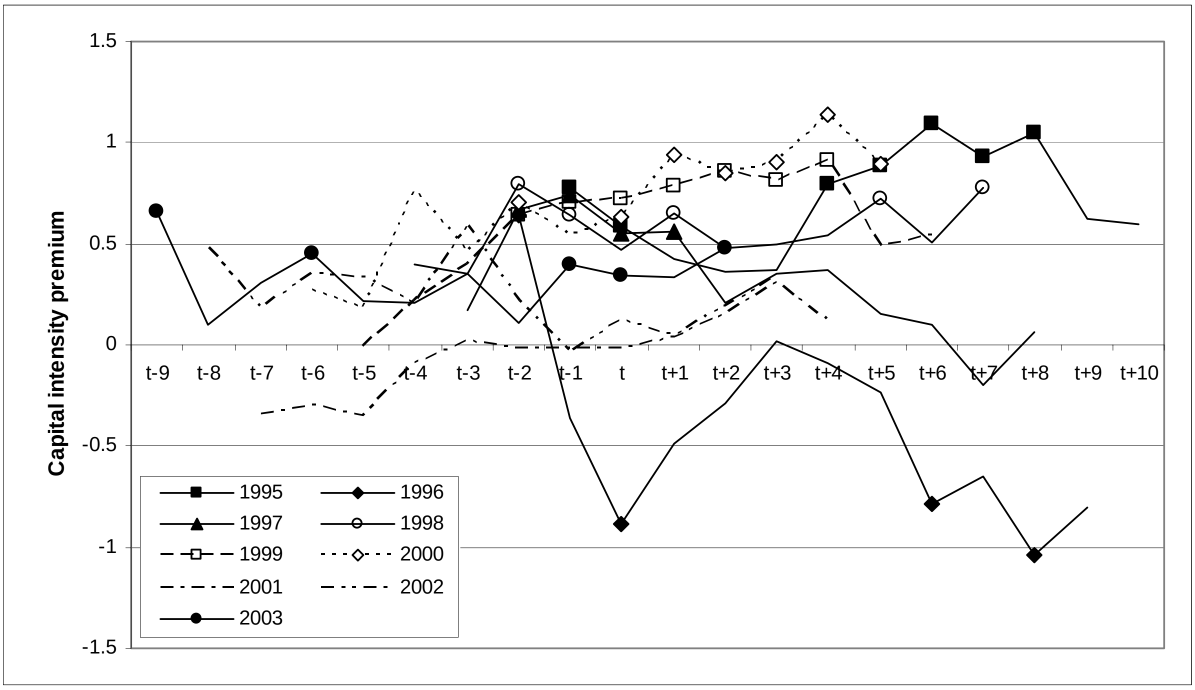
Source: own calculations.

Figure B5: The premium of new importers relative to non-importers in terms of labour productivity



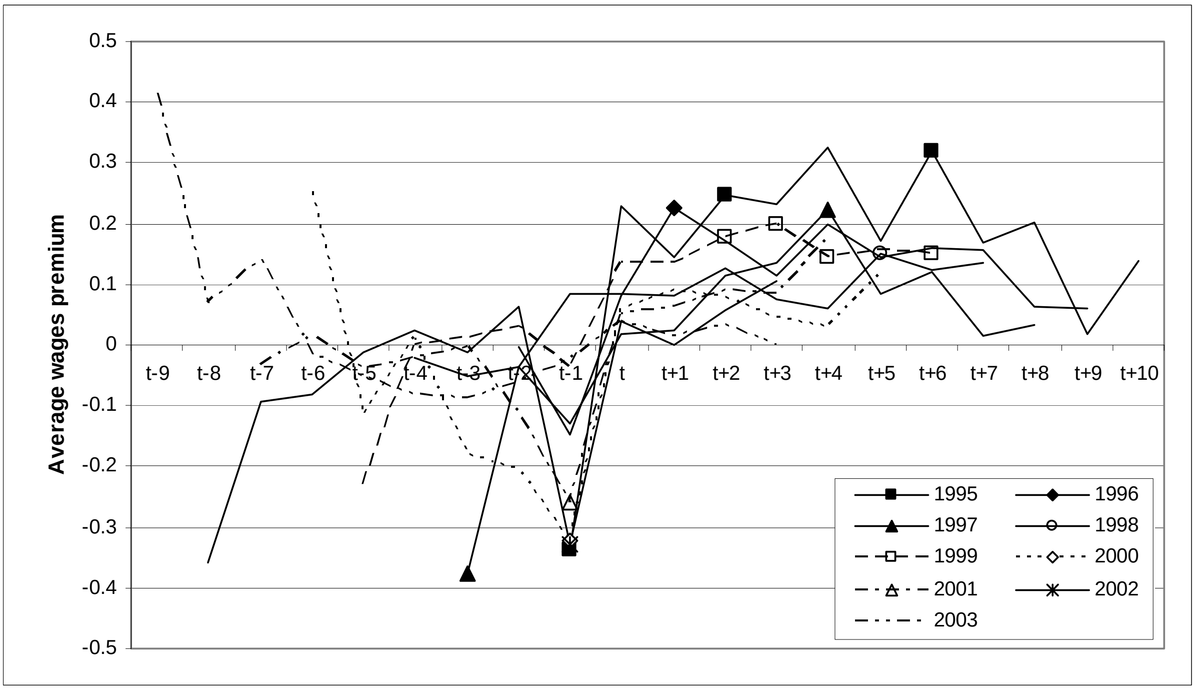
Source: own calculations.

Figure B6: The premium of new importers relative to non-importers in terms of capital intensity



Source: own calculations.

Figure B7: The premium of new importers relative to non-importers in terms of average wages



Source: own calculations.

EKONOMSKA FAKULTETA
UNIVERZA V LJUBLJANI

ANŽE BURGER

DINAMIČNI UČINKI MEDNARODNE FRAGMENTACIJE PROIZVODNEGA PROCESA: EMPIRIČNA ANALIZA PODJETIJ SLOVENSKE PREDELOVALNE INDUSTRIJE

POVZETEK DOKTORSKE DISERTACIJE

LJUBLJANA, 2008

KAZALO

1 Uvod

Priča smo vedno bolj globaliziranemu in kompleksnemu ekonomskemu dogajanju v svetu. V zadnjih šestdesetih letih se ni povečal zgolj obseg mednarodnega poslovanja, temveč tudi diapazon njegove pojavnosti. Napredek v transportu, informacijski tehnologiji in internet je podjetjem odprl vrata na globalne trge proizvodnih faktorjev ter trge končnih proizvodov in storitev. Klasični izvoz in horizontalni tip tujih neposrednih investicij (TNI) je v najrazvitejših gospodarstvih že dolgo časa v senci mednarodne fragmentacije proizvodnje blaga in storitev. Za dolgoročni uspeh podjetja dandanes namreč ni več dovolj le aktivno trženje svojih izdelkov tudi v tujini. Ključnega pomena postaja reorganizacija in globalno umeščanje proizvodnega procesa v smislu iskanja najnaprednejših in najcenejših inputov na mednarodnih trgih, izvajanje dela proizvodnih funkcij in storitev v državah s cenejšimi proizvodnimi dejavniki – bodisi skozi vertikalno integrirane podružnice bodisi z neodvisnimi pogodbenimi dobavitelji in podizvajalci – ter vzvodov kot so 24-urno poslovanje, mobiliziranje tujega lokalnega znanja in talenta ter zunanje izvajanje cele vrste poslovnih procesov.

Raziskovanje na področju internacionalizacije proizvodne verige in produktivnosti podjetij so usmerjala in oblikovala številna empirična dejstva in vprašanja iz poslovnega okolja. Zaradi povečanja fragmentacije proizvodnega procesa je svet v zadnjih nekaj desetletjih doživel razmah trgovine z vmesnimi proizvodi tako takšne znotraj multinacionalnih podjetij kot tudi tiste med neodvisnimi podjetji. V zadnjih dvajsetih letih je v porastu zlasti slednji tip trgovine z inputi, narašča pa tudi mednarodni pretok storitev. Obenem narašča raznoterost oblik organiziranja mednarodnega poslovanja, od pojava kompleksnejših oblik tujih neposrednih investicij do cele vrste pogodbenih odnosov med neodvisnimi strankami. Mikro podatki na ravni podjetij nadalje razkrivajo veliko heterogenost podjetij celo znotraj ozko definiranih panog in heterogenost strukture mednarodnih trgovinskih tokov in tujih neposrednih investicij med različnimi panogami. Vsaka izmed oblik organiziranosti vertikalne verige ima specifične lastnosti in izbira strukture je tako firmsko kot tudi sektorsko specifična. Poleg pravkar omenjene reorganizacije proizvodne verige so investicije v znanje v razmerah globalne konkurence eden izmed najpomembnejših vzvodov utrjevanja in izboljševanja položaja na trgu.

Temeljna teza disertacije predpostavlja, da podjetja zunanje izvajanje del lahko izkoristijo ne samo kot učinkovit način zniževanja stroškov poslovanja, pač pa tudi kot strateški vzvod za osredotočenje na osrednjo dejavnost podjetja. S sprostitvijo proizvodnih faktorjev iz delegiranih neključnih poslovnih aktivnosti lahko podjetja preusmeritvijo vire v raziskave in razvoj novih produktov in proizvodnih procesov, nadgradnjo obstoječih proizvodov in storitev, izboljševanje odnosov s strankami in prehod z operativnega na strateški management. Teza moje doktorske disertacije je, da se omenjeni prehod na izboljševanje ključnih kompetenc podjetja odrazi v rasti produktivnosti in izboljšanju drugih kazalnikov poslovne uspešnosti.

Namen disertacije je ugotoviti, ali offshoring (bodisi outsourcing v tujini ali vertikalna neposredna investicija v tujini) povečuje produktivnost podjetij, ki ga izvajajo. V tesni povezavi z osrednjim namenom disertacije želim ugotoviti tudi, ali poleg stroškovno učinkovitejše proizvodnje na rast produktivnosti vplivajo tudi drugi transmisijski mehanizmi, zlasti osredotočenje na temeljno dejavnost podjetja. Cilji teoretičnega dela doktorske disertacije so proučiti vpliv heterogenosti podjetij v panogi na porazdelitev različnih tipov organiziranja proizvodne verige in teoretsko osmisliti in razložiti fenomen osredotočenja na temeljno dejavnost podjetja in njegov vpliv na rast produktivnosti podjetja. osredotočenje na ključne kompetence podjetja je v teoretičnem modelu zasnovano kot racionalna odločitev podjetja, ki se v nekem trenutku odloči za mednarodno zunanje izvajanje določenih inputov ali proizvodnih procesov. Glavni prispevek teoretičnega modela je analiza preskoka iz domače na mednarodno vertikalno fragmentirano proizvodno verigo z vidika vpliva na višino investicij v izboljšanje ključnih kompetenc podjetja ter posledično na gibanje ravni produktivnosti novo internacionaliziranega podjetja. V središču pozornosti empiričnega dela disertacije so podjetja v slovenski predelovalni industriji, na podlagi katerih skušam ugotoviti povezavo med produktivnostjo in drugimi značilnostmi podjetij ter organizacijskimi oblikami podjetij znotraj iste panoge, preveriti, ali gre pri odločitvi za mednarodno proizvodnjo inputov za samoselekcijo boljših podjetij v tovrstno obliko internacionalizacije ter oceniti vpliv začetka offshoringa na gibanje produktivnosti pred, ob in v letih po začetku intenzivnejšega zunanjega izvajanja del v tujini. Ključni cilj empiričnega dela pa je ugotoviti, ali kot posledica zunanjega izvajanja proizvodnih procesov prihaja do sprememb v strateški usmerjenosti v smeri osredotočenja na ključno dejavnost podjetja.

V nadaljevanju povzetka bom na kratko predstavil teorije mednarodne fragmentacije proizvodnje od tradicionalnih do najnovejših modelov s heterogenimi podjetji in raznoterimi oblikami organiziranosti proizvodnega procesa. Sledil bo pregled dosedanjih empiričnih študij ter predstavitev teoretičnega modela mednarodne fragmentacije proizvodnje ter učinkov na investicije v temeljno dejavnost in rast produktivnosti. V naslednjem poglavju bo predstavljena empirična metodologija ter opisani podatki in lastnosti vzorca. Sledila bo predstavitev rezultatov, v zadnjem delu pa bodo podani sklepi raziskave.

2 Razvoj na področju mednarodne fragmentacije proizvodnje

Le malo konceptov s področja mednarodne ekonomije je v zadnjem obdobju doživelo večjo pozornost medijev kot »outsourcing«, »offshoring« in podobni termini. V izogib nejasnostim glede pomena izrazov, povezanih s fragmentacijo proizvodnje, zato najprej podam najbolj razširjene definicije pojmov, ki jih uporabljam v disertaciji. V ta namen uporabljam UNCTAD-ovo terminologijo, ki pojavnost različnih oblik mednarodne proizvodnje oklesti na štiri osnovne načine glede na naslednji dve dimenziji: lokacija proizvodnje segmenta proizvodne verige in lastniško ureditev razmerij med različnima deloma verige dodane vrednosti. Zunanje izvajanje preko neodvisnega dobavitelja (**outsourcing)** je tako generični pojem za nabavljanje vmesnih dobrin ali storitev, ki so bile pred tem (pro)izvedene v podjetju. Zunanje izvajanje v tujini (**offshoring)** pomeni pridobivanje materialnih ali storitvenih inputov iz tujine. Ker podjetje določen proizvodni segment lahko proizvede doma ali v tujini ter znotraj enotne lastniške strukture ali preko neodvisnega dobavitelja, poznamo štiri oblike organiziranosti proizvodnega procesa: i) domača integrirana proizvodnja, ii) domače zunanje izvajanje del (domestic outsourcing), iii) proizvodnja v podružnici multinacionalnega podjetja v tujini oz. vertikalni tip tuje neposredne investicije (captive offshoring) ter iv) proizvodnja v neodvisnem podjetju v tujini (offshore outsourcing). Zaradi jezikovne jedrnatosti v nadaljevanju povzetka uporabljam angleške izraze. Domači outsourcing, outsourcing v tujini in vertikalni tip TNI skupaj sestavljajo proces, poimenovan **fragmentacija** proizvodnje (Jones in Kierzkowski (2001).

Mednarodna fragmentacija proizvodnje je že dolgo poznani pojav, ki pa se je skozi čas intenzificiral in postajal vse bolj kompleksen. Obstaja več razlogov za razmah mednarodne delitve dela zlasti po drugi svetovni vojni. Prvi razlog je zmanjšanje carinskih in necariskih ovir v mednarodni trgovini blaga in storitev. V letu 1947, ko je GATT začel delovati, so povprečne carine na industrijske izdelke znašale kar 40%, po uveljavitvi vseh sprejetih določil iz Urugvajske runde pa bo povprečna carinska MFN stopnja padla pod 4% (WTO, 2005, str. 7). Nižje carine in necarinske ovire omogočajo večkratno prehajanje polizdelkov in končnih izdelkov iz države v državo, kar pojasnjuje velik del nadproporcionalnega povečanja mednarodne trgovine v zadnjih šestih desetletjih Yi (2003). Drugi razlog je obstoj velikih razlik v stroških dela med državami v razvoju in razvitimi državami, ki omogoča, da se delovno intenzivni procesi izvajajo v državah z nizkimi plačami. Ocenjuje se, da je bilo od leta 1995 svetovnemu obsegu delovne sile dodanih kar 700 milijonov dodatnih delavcev, do leta 2030 pa se pričakuje dodatno povečanje v obsegu 1,5 milijarde zaposlenih (Stevens 2007, str. 10). Tretjič, stroški prevoza tovora so se znižali zaradi hitrejših prevoznih sredstev, boljše tehnologije, manjših časovnih izgub pri pretovarjanju, boljše infrastrukture, manjših administrativnih ovir in deregulacije transportnih storitev. Četrti razlog za povečano mednarodno fragmentacijo proizvodnje je najti v aktivnih trgovinskih in investicijskih politikah določenih držav v razvoju in izboljšanju njihovega institucionalnega okvirja. Tu gre predvsem za spodbujanje tujih investicij v obliki prostotrgovinskih območij, davčnih spodbud in zaščite intelektualne lastnine in drugih lastninskih pravic. Povečana konkurenca s strani uspešnih multinacionalnih podjetij z razvejanimi verigami dodane vrednosti so nadaljnji razlog za odločitev mnogih podjetij, da del proizvodnega procesa izvajajo v tujini.

Analiza trendov trgovine z vmesnimi proizvodi in tokov neposrednih tujih investicij na ravni globalnega gospodarstva, Evropske unije in Slovenije je pokazala, da mednarodna trgovina z vmesnimi proizvodi predstavlja velik del povečanja celotne vrednosti mednarodne trgovine in da so ravno deli in komponente tisti segment trgovine igrali največjo vlogo v tem procesu. Vrednost uvoza vmesnih dobrin je v Sloveniji vseskozi naraščala, vendar se struktura uvoza te kategorije proizvodov od leta 1995 do 2006 ni bistveno spremenila v korist sestavnih delov in komponent. Tudi podatki o tokovih neposrednih tujih naložb v svetu kažejo, da se je internacionalizacija poslovanja povečevala, čeprav je iz obstoječih podatkov nemogoče razbrati, kolikšen del tega povečanja gre pripisati vertikalni čezmejni reorganizaciji proizvodnje.

3 Pregled teorije mednarodne fragmentacije proizvodnje

Vse večji pomen mednarodne trgovine z vmesnimi proizvodi in storitvami bodisi skozi outsourcing bodisi skozi vertikalne povezave tradicionalne teorije mednarodne menjave in fragmentacije proizvodnje (npr. Jones & Kierzkowski, 1990, 2001; Arndt, 2001; Deardorff, 2001a, 2001b; in Kohler, 2004) niso mogle več zadovoljivo pojasnjevati, ne da bi vključevale koncepta vertikalne fragmentacije in teorije pogodbenih odnosov med kupci in dobavitelji. To je bil motiv, da so raziskovalci teorijo mednarodne menjave obogatili s koncepti organizacije in strukture trga ter teorije pogodb. S tem so pojasnili različne organizacijske oblike podjetja v mednarodnem okolju in postavili temeljni kamen za teoretične in empirične raziskave. Za razumevanje vprašanja o načinu organiziranja vertikalne procesne verige in njenemu dosegu z vidika internacionalnosti je bilo potrebno podrobneje obravnavati specifične značilnosti vertikalnih in pogodbenih odnosov znotraj podjetja in med nepovezanimi strankami. Teorija je na tem mestu črpala dolgoletne izkušnje teorije pogodb in teorije podjetja. Investicije, specifične za vsak tip odnosa (relationship-specific investment), nepopolne pogodbe (incomplete contracts), pogajanje Nashevega tipa (Nash bargaining), iskanje in paritev (search and matching), transakcijski stroški in sistem spodbud so osnovni principi, ki razlagajo odločitve o izbiri organizacijske oblike.

Neodvisno od države, panoge in obdobja proučevanja, raziskave kažejo, da je le majhen delež podjetij vpetih v mednarodno okolje in da so v povprečju le-ta precej bolj produktivna, večja in kapitalsko intenzivna od domačih konkurentov. Pod vtisom teh ugotovitev Melitz (2003) razvije teoretski model monopolistične konkurence s heterogenimi podjetji, ki je bil kmalu apliciran na modele mednarodne vertikalne integracije proizvodnje, kar je ustvarilo realistične modele s sočasno pojavnostjo različnih organizacijskih oblik, relativno prevlado posameznih oblik v skladu z empiričnimi dejstvi in strukturami trga v takšni odvisnosti od eksogenih dejavnikov, kot jih dejansko opazimo v realnosti (npr. Antras, 2005a ter Antras & Helpman, 2004). Pregled teorije podjetja in teorije fragmentacije proizvodnje je razkrila širok nabor alternativnih pogledov na obstoj in delovanje podjetij, ki se je odrazila tudi na pestrosti alternativnih pristopov modeliranja organizacijskih oblik mednarodne fragmentacije.

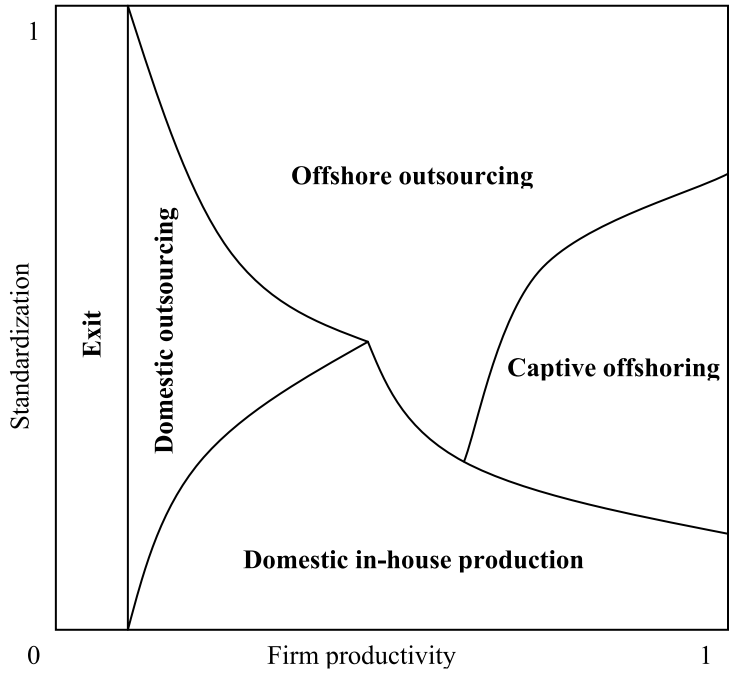
4 Teoretični model

Teoretični model mednarodne fragmentacije proizvodnje in rasti produktivnosti skozi učinek osredotočenja na temeljno dejavnost podjetja je preprosta nadgradnja modelov Antrasa

(2005a) ter Antras in Helpman (2004) modelov, ki doda mehanizem, preko katerega uvoz vmesnih proizvodov omogoča večjo specializacijo v uporabi resursov. To osredotočenje v naslednjih obdobjih vodi v višjo rast produktivnosti. Svet sestavljata dve državi: Sever z visokimi plačami in Jug z nizko ceno dela. Poleg popolno konkurenčne industrije obstaja še monopolistično konkurenčna industrija z horizontalno diferenciranimi potrošnimi dobrinami. Delo je edini proizvodni faktor. Proizvodnja ene enote poljubne različice zahteva dve vrsti inputov: visokotehnološki in nizkotehnološki input (komponenta ali proces). Visokotehnološki input je lahko proizveden le na Severu, medtem ko je nizkotehnološki input lahko proizveden v katerikoli izmed držav. Kot v modelu Melitza (2003) se podjetja razlikujejo v produktivnosti, katere začetna višina jim je dodeljena pred vstopom v panogo. Podjetja v prvem koraku zaznajo svojo produktivnost in se odločijo o vstopu ali prenehanju delovanja. V primeru vstopa v panogo podjetje izbira lokacijo proizvodnje nizkotehnološkega inputa in način organiziranosti proizvodnje (vertikalna integracija ali pogodbeni odnos). Na razpolago ima torej štiri alternativne organizacijske oblike: vertikalno integrirana proizvodnja doma, zunanje izvajanje preko domačega neodvisnega dobavitelja (domači outsourcing), proizvodnja inputa preko podružnice v tujini (vertikalna TNI) in zunanje izvajanje preko tujega neodvisnega dobavitelja (offshore outsourcing). Zunanje izvajanje (outsourcing) je obremenjeno z nepopolnimi pogodbami, medtem ko vertikalna integracija zahteva višje stroške upravljanja. Poleg tega podjetja tehtajo med nižjimi mejnimi proizvodnimi stroški nizkotehnološkega inputa v tujini in nižjimi fiksnimi organizacijskimi stroški v domači državi.

Slika 1 prikazuje predvidevanja modela glede izbire optimalne organiziranosti proizvodnega procesa glede na raven produktivnosti podjetja in zrelost panoge, v kateri deluje (zrelost panoge narašča z pomembnostjo nizkokvalitetnega inputa v celotnem proizvodu). Teoretske napovedi o pojavnosti alternativnih organizacijskih oblik se sklada z opazljivimi dejstvi v poslovnem svetu. Ko je izdelek še v zgodnjih razvojnih fazah, kot na primer v biotehnologiji in visokotehnološki elektroniki, proizvajalci obdržijo vse proizvodne faze znotraj podjetja. Po začetni fazi, ko proizvod postane že nekoliko bolj standardiziran, ga najbolj produktivna podjetja delno že proizvajajo v podružnicah v tujini (npr. farmacevtska industrija). Največja raznoterost organizacijskih oblik se pojavi nekoliko kasneje v življenjskem ciklu proizvoda, ko so visokotehnološki inputi oz. storitve še vedno pomembne. Primeri te faze vključujejo avtomobilsko industrijo, mikroprocesorje in kemično industrijo. Ko proizvodnja postane še bolj proizvodno intenzivna, vertikalna integracija v domači državi postane nerentabilna, saj višji stroški proizvodnje postanejo večje breme od stroškov nepopolnih pogodb. V tej fazi je trenutno uporabniška elektronika: sestavljanje in proizvodnja manj ključnih komponent sta največkrat predana neodvisnim proizvajalcem doma ali v tujini, lahko pa ju izvajajo v podružnicah v državah z nizkimi stroški dela. Za zadnjo stopnjo v proizvodnem ciklu proizvoda je značilno delovno intenzivna proizvodnja, tako da so smiselne le neintegrirane organizacijske oblike, bodisi outsourcing doma ali v tujini. Če opazujemo tekstilno in obutveno industrijo, opazimo, da je mednarodni outsourcing delovno intenzivnih inputov in storitev v resnici najpogostejša oblika organiziranosti proizvodnega procesa.

Slika 1: Optimalna organiziranost proizvodnje vmesnih proizvodov glede na produktivnost podjetja in zrelost panoge.

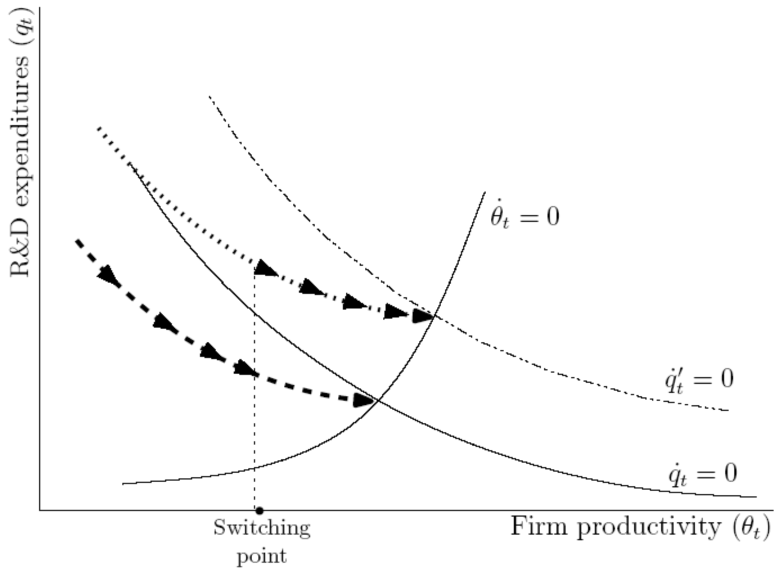


Vir: lastni izračuni.

Poleg organizacijske oblike lahko podjetje izbere najbolj optimalno višino investicij v izboljšanje ključnih kompetenc oziroma produktivnosti. Stabilnost in obstoj ravnotežja panoge je opravičena na podlagi dinamičnega modela panožnega ravnovesja Ericsona in Pakesa (1996), medtem ko Weintraub, Benkard, and Roy (2008) omogočajo uveljavitev nekaterih ključnih predpostavk za poenostavitev dinamičnega problema podjetja. Rezultat dinamične optimizacije v parcialnem ravnotežju pokažejo, da preskok podjetja iz domače v mednarodno dobavo vmesnega inputa povzroči povečanje izdatkov za investicije v izboljšanje produktivnosti. Zaradi cenejše proizvodnje v tujini in višje donosnosti investicij v ključne kompetence v prihodnosti lahko podjetje usmeri dodatna sredstva v aktivnosti, ki mu izboljšajo vsesplošno učinkovitost poslovanja (Slika 2). Višje investicije v naslednjih časovnih obdobjih povečajo rast in nivo produktivnosti v podjetju.

Teoretični model prikazuje, da je internacionalizacija proizvodnega procesa postopen proces, kot ga predstavljajo tudi evolucijski teorije mednarodnega poslovanja. Podjetja potrebujejo dovolj časa, da pridobijo organizacijsko znanje in povečajo produktivnost na raven, ko je napredovanje na tuje trge že ekonomsko upravičeno.

Slika 2: Optimalna višina investicij v raziskave in razvoj ob prehodu iz domače na tujo proizvodnjo vmesnega proizvoda



Opomba: Točka preloma (switching point) označuje raven produktivnosti, pri kateri je preskok od domače na tujo proizvodnjo vmesnega proizvoda ravno rentabilno. Puščice označujejo optimalno višino investicij in gibanje produktivnosti podjetja.

Nadalje model napoveduje povečanje investicij za inovacije oziroma preusmeritev sredstev v izboljšanje ključnih kompetenc. Istočasno pride do povečanja rasti produktivnosti, saj višji izdatki za investicije privedejo do višjih stopenj rasti. Višina investicij in s tem stopnje rasti produktivnosti kasneje začnejo usihati, kar je konsistentno z empiričnimi študijami o učinkih tujih neposrednih investicij na rast produktivnosti. Obenem razloži tudi pojav samoizbire v mednarodno fragmentacijo proizvodnje, kjer ključno vlogo igra nivo produktivnosti. Model osmišlja tudi pojav tako imenovanih rojenih globaliziranih podjetij (born globals), saj izhodiščno najbolj produktivna podjetja v panogi v zgodnjih obdobjih svojega obstoja internacionalizirajo del proizvodnih procesov.

5 Predhodne empirične študije

Mednarodna fragmentacija proizvodnje je zlasti zaradi nedavnega porasta zunanjega izvajanja storitev doživela veliko pozornosti tako v medijih kot tudi v akademskih razpravah. Kljub visoki popularnosti pa je raziskanost povezave med offshoringom in produktivnostjo ostala dokaj slabo raziskana. Študije na ravni sektorskih podatkov dokazujejo pozitivne učinke mednarodne delitve dela na agregatno produktivnost. Egger in drugi (2001) za Avstrijo ugotavljata, da kar 0.2 odstotne točke od 0.9% povečanja avstrijske skupne faktorske produktivnosti lahko pripišemo mednarodni fragmentaciji proizvodnje. Egger in Egger (2006) dokažeta pozitivni dolgoročni učinek offshoringa na produktivnost nizkokvalificiranega dela v 12 EU članicah, medtem ko Amiti in Wei (2006) za ZDA ugotovita, da offshoring storitev prispeva okrog 10% k celotni rasti produktivnosti dela, offshoring materialnih inputov pa 5%.

V skupini empiričnih študij na ravni podjetij Görg, Hanley in Strobl (2008) identificirata pozitivne učinke offshoring storitev na produktivnost podjetij v Irski elektronski industriji, ne pa tudi učinke offshoringa materialnih vmesnih proizvodov. Görg in Hanley (2005) pokažeta prisotnost pozitivne statistične povezanosti med offshoringom in skupno faktorsko produktivnostjo, Görg, Hanley in Strobl (2004) pa najdejo pozitivno povezavo med offshoringom materialnih inputov in produktivnostjo tako v domačih podjetjih kot tudi v irskih podružnicah tujih multinacionalk. Criscuolo and Leaver (2005) proučita vpliv offshoring storitev in ugotovita, da 10 odstotno povečanje intenzivnosti offshoringa privede do 0.37% povečanja skupne faktorske produktivnosti v vzorcu britanskih podjetij. Van Biesebroeck (2005) dokaže pozitivno povezanost med uvozom inputov in rastjo produktivnosti v Zimbabveju, Muendler (2004) pa na podatkih brazilskih predelovalnih podjetij ne najde značilnega vpliva uvoza vmesnih proizvodov. Amiti and Konings (2007) za Indonezijo v obdobju zniževanja carin na uvoz inputov in končnih dobrin ugotovita, da imajo liberalizacija trgovine z vmesnimi proizvodi znatno močnejši pozitivni vpliv in da uvozni status in intenzivnost uvoza pozitivno vplivata na povečanje produktivnosti v podjetjih. Halpern in drugi (2006) ter Kasahara in Rodrigue (2008) s pomočjo izboljšane polparametrične metode ocenjevanja proizvodne funkcije najdejo značilne pozitivne učinke uvoza vmesnih proizvodov na produktivnost madžarskih in čilskih podjetij.

Pregled empiričnih študij je pokazal, da obstajajo močni dokazi o pozitivnih vplivih offshoringa na produktivnost tako na agregatni kot tudi na podjetniški ravni, nobena izmed raziskav pa ne obravnava kavzalnosti med obema. Hkrati le ena izmed študij (Halpern et al., 2006) natančneje specificira transmisijski mehanizem vpliva offshoringa na povečanje produktivnosti. V tem pogledu pričujoča disertacija pomembno prispeva k empirični literaturi, saj obravnava podrobneje vprašanje vzročnosti in je prva, ki empirično preveri hipotezo o pozitivnih učinkih osredotočenja na temeljne kompetence podjetja.

6 Metodologija in lastnosti podatkov

Teoretični model disertacije formalizira dva vira pozitivne povezave med produktivnostjo podjetja in organiziranostjo proizvodne verige preko meja domače države. Najprej govorimo o tako imenovanem procesu samoselekcije, kjer se nadpovprečno produktivna podjetja samoiniciativno odločijo za uvoz inputov iz tujine. Po drugi strani pa model osmisli tudi povratno kavzalno povezavo med produktivnostjo in offshoringom inputov, saj pokaže, da optimalno delovanje podjetij vodi v povečanje investicij v izboljšanje ključnih kompetenc po začetku uvažanja vmesnih proizvodov. V empirični analizi je omenjeni pozitivni korelaciji težko razločiti ena od druge, zato uporabljam različne metodološke pristope, ki v različnih merah popravijo endogenost odločitve za uvoz inputov.

Empirični del je strukturiran tako, da kompleksnost uporabljenih ekonometričnih narašča od najbolj preprostih do metodološko najbolj korektnih. Struktura vsebuje tudi svojevrsten didaktični moment, saj z vsako nadaljnjo metodo opozorim na katero od nerešenih metodoloških problemov, opozorim na pomanjkljivosti uporabljene tehnike in upravičim uporabo naslednjega, bolj primernega metodološkega pristopa. Začenjam s osnovno deskriptivno analizo, kjer primerjam neuvoznike z različnimi tipi uvoznikov vmesnih proizvodov. Nato vse vrednosti izrazim v odklonih glede na povprečje dejavnosti podjetja, s čimer se znebim strukturnih razlik med panogami. Primerjavo povprečnih vrednosti izbranih spremenljivk nadgradim s testoma stohastične dominance (Kolmogorov-Smirnov and Mann-Whitney testa), ki z uporabo vseh razpoložljivih in ne le prvih momentov porazdelitve obravnavanih skupin podjetij analizirata značilne razlike v porazdelitvah produktivnosti. Ti testi v nasprotju s t-testom tudi ne zahtevajo dodatnih predpostavk o dejanski distribuciji populacijskih podatkov in so torej neparametrični. Z njimi preverim hipoteze o razvrstitvi skupin podjetij po naraščajoči produktivnosti in hipotezi o samoselekciji v offshoring in mednarodno vertikalno fragmentacijo proizvodnje.

V naslednjem koraku iz celotne populacije uvoznikov omejim zgolj na nove uvoznike in spremljam njihovo poslovanje v času pred, ob in po začetku uvažanja inputov. Deskriptivne rezultate pospremim z izračunom uvozne premije, kjer z regresijsko analizo po vzoru Bernard in Jensena (1999) izračunam odstotno premijo uvoznikov pred neuvozniki, pri čemer kontroliram za pomembnimi spremenljivkami, ki so sicer korelirane z statusom uvoza (velikost, izvozni status in lastništvo podjetja).

Prva izmed dveh osrednjih metodologij je ocenjevanje proizvodnih funkcij, kjer sledim pomembnim prispevkom polparametričnih modelov Olley in Pakesa (1996) in Levinsohn in Petrina (2003). Za izhodiščni ekonometrični model uporabim rešitev, ki jo predlagata Kasahara in Rodrigue (2008) in ki poleg standardnih metodoloških problemov poskušata omiliti tudi problem endogenosti odločitve za začetek uvoza vmesnih proizvodov. Prvi problem, ki ga omenjena nadgradnja modelov Olley in Pakesa (1996) in Levinsohn in Petrina (2003) odpravlja, je pristranost vzorca zaradi izstopa podjetij. Ker je verjetnost izstopa iz panoge odvisna od značilnosti podjetja (velikosti, kapitalne intenzivnosti in uvoznega statusa), to dejstvo vnaša pristranost ocen parametrov. Naslednji problem se nanaša na simultanost variabilnih proizvodnih faktorjev, kot je delo. Ker je del produktivnosti, ki je ekonometrik ne zazna, poznan podjetniku, slednji lahko že v tekočem obdobju prilagodi zaposlenost variabilnih dejavnikov. To povzroči pozitivno korelacijo med variabilnimi proizvodnimi faktorji in napako in ustvari pristranske ocene parametrov proizvodne funkcije. Zadnji problem ocenjevanja pa je endogenost odločitve podjetja o uvozu, saj se zanj v povprečju odločajo le bolj produktivna in na splošno boljša podjetja. Zaradi tega dejstva, Kasahara in Rodrigue (2008) razširita funkciji izstopa iz panoge in povpraševanja po materialnih inputih z dodatno spremenljivko stanja, to je uvozni status. Omenjeni polparametrični model ocenjevanja proizvodne funkcije v analizi primerjam z enostavnejšimi cenilkami, kot sta metoda najmanjših kvadratov in metoda naključnih učinkov. Z dodatnimi regresijskimi analizami naknadno ugotavljam, ali ima poleg statičnega, enkratnega učinka, uvoz tudi dinamični učinek v smislu pozitivnega vpliva na prihodnje gibanje produktivnostnih šokov podjetja.

Druga ekonometrična tehnika, ki jo uporabim tudi za testiranje hipoteze o osredotočenju na ključne kompetence podjetja, je paritev na podlagi ocenjene verjetnosti začetka uvažanja (propensity score matching) (glej na primer Heckman et al., 1997, 1998). Ta metoda temelji na izbiri kontrolnega podjetja ali skupine podjetij, ki so v večih dimenzijah karseda podobni izbranemu novemu uvozniku. Primerjava značilnosti med novim izvoznikom in kontrolnimi enotami nam omogoča oceniti, kako bi se produktivnost in inovacijska uspešnost gibali v primeru, ko podjetje ne bi začelo uvažati. Na ta način lahko dobimo korektnejšo oceno dejanskega kavzalnega učinka uvoza inputov v smeri produktivnosti in inovativnosti podjetja. Kombinacija različnih matching tehnik z pristopom razlike v razlikah (difference in differences; Blundell & Costa Dias, 2000) še dodatno okrepi kvaliteto ocene učinkov začetka uvažanja inputov.

Podatki, ki jih uporabljam v empiričnem delu disertacije so podatki na ravni podjetij in zajemajo časovno obdobje 1994-2005. Obravnavam le podjetja iz slovenske predelovalne industrije (SKD panoge med 15 in 37), ki zaposlujejo pet ali več oseb. Razlog za slednjo omejitev je nižja zanesljivost poročanih podatkih za majhna podjetja. Podatkovna baza je sestavljena iz več različnih podatkovnih baz, ki sem jih združil po ključu identifikacijskih številk in letu. Statistični urad RS mi je dal na voljo natančne informacije iz računovodskih izkazov, ki jih podjetja obvezno poročajo vsako leto in ki med drugim vsebujejo podatke o vrednosti sredstev, številu zaposlenih in prodaji. Iz istega vira prihaja baza podatkov o zunanji trgovini, v kateri so zabeležene vse zunanjetrgovinske pošiljke po podjetjih in letih. Ti podatki med drugim vsebujejo vrednost pošiljke, tarifo, namen uporabe in državo izvora. Omenjeni bazi Statističnega urada sta bili združeni s petimi zaporednimi Poročili o inovacijskih dejavnostih v predelovalni dejavnosti in izbranih storitvenih dejavnostih (1996, 1998, 2000, 2002 in 2004). Poleg naštetih podatkov sem uporabil še podatke Banke Slovenije o neposrednih tujih naložbah z informacijami o obstoju izhodnih in vhodnih tujih neposrednih investicijah. Vsi vrednostni podatki so izraženi v slovenskih tolarjih in so deflacionirani z indeksom cen potrošnih dobrin (podatki, ki se nanašajo na kapital) in indeksom cen proizvajalcev na 2-mestnem nivoju SKD za podatke, ki se nanašajo na prodajo in dodano vrednost.

7 Rezultati empirične analize

Kot je razvidno iz Tabele 1, baza podatkov v empiričnem delu vsebuje 4197 podjetij in 22041 opazovanj v obdobju 1994-2003, za katero obstajajo podatki o zunanji trgovini in TNI. Največja podjetja po zaposlenosti, prodaji in višini opredmetenih osnovnih sredstev so stalni uvozniki, katerim sledijo občasni uvozniki in na zadnjem mestu podjetja z izključno domačo dobavo materialnih inputov. Enak vrstni red velja tudi za višino dodane vrednosti na zaposlenega. V Tabeli 1 lahko tudi razberemo, da so podjetja, ki preživijo na trgu do konca proučevanega obdobja v povprečju prav tako boljša v vseh proučevanih dimenzijah in nadaljnja analiza dinamike uvoznikov in neuvoznikov je pokazala, da imajo prvi nižjo verjetnost izstopa iz panoge kot drugi, kar potrjuje smiselnost vključitve statusa uvoza kot dodatno spremenljivko v funkciji izstopa v Kasahara-Rodrigue postopku.

Tabela 1: Opisna statistika, 1994-2003

	Prodaja	VA/L	L	Kapital	Mtotdelež	Minpdelež	Op. enote / N podjetij
Vsa podjetja	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
Stalni uvozniki	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
Neuvozniki	82,690.4	1,528.9	20.9	30,725.9			1,368
	(5,949.8)	(25.74)	(1.05)	(4,805.3)			480
Nestalni uvozniki	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
Preživeli	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
Propadli	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

Opombe: Standardne napake so v oklepajih. Izračuni temeljijo na okrnjenem vzorcu podjetij z vsaj petimi zaposlenimi. *Stalni uvozniki* so podjetja z pozitivnim uvozom vsako leto. *Neuvozniki* so podjetja, ki v nobenem letu niso uvažala. *Nestalni uvozniki* so podjetja z vsaj enim letom uvoza in vsaj enim letom brez uvoza. *Preživeli* so podjetja, ki do leta 2005 niso ugasnila, medtem ko so *Propadli* podjetja, ki so prenehala delovati v poljubnem letu do 2005. *Prodaja*, dodana vrednost na zaposlenega (*VA/L*), in *kapital* so izraženi v 1000 Slovenskih tolarjih. *L* je število zaposlenih. Skupni uvozni delež (*Mtotdelež*) in uvozni delež vmesnih dobrin (*Minpdelež*) so deleži uvoza vseh oz. vmesnih proizvodov v skupnih materialnih stroških. *Op. enote* je število opazovanj, *N podjetij* pa število podjetij v obdobju 1994-2003.

Primerjava značilnosti podjetij z izključno domačimi viri vmesnih proizvodov in uvoznikov brez in z neposredno tujo investicijo v tujini potrdi teoretične napovedi glede vrstnega reda skupin podjetij po uspešnosti poslovanja (Tabela 2). Glede na povprečje 3-mestnih panog najproduktivnejša, največja in najbolj kapitalno intenzivna so podjetja, ki uvažajo inpute in imajo v tujini tudi vsaj eno investicijo, sledijo jim uvozniki brez izhodnih neposrednih tujih investicij, najslabša po omenjenih kazalcih pa so na domači trg omejena podjetja. Produktivnost, merjena z dodano vrednostjo na zaposlenega, je v prvi skupini podjetij za 15-30% višja od povprečja panoge, v drugi skupini od 1-7%, domača podjetja pa so na ravni 75-84% povprečne vrednosti produktivnosti. Enake ugotovitve držijo tudi po posameznih dvomestnih dejavnostih ločeno. V vseh razen eni panogi so uvozniki za 1-15% bolj produktivni od povprečnega podjetja v pripadajoči 3-mestni industriji, v 15 od 22 obravnavanih dejavnostih pa se je njihova prednost pred povprečjem panoge v obravnavanem obdobju povečala.

Tabela 2: Povprečna relativna prodaja, produktivnost dela, zaposlenost in kapitalska intenzivnost po načinu dobave vmesnih dobrin, 1994-2003.

	Domača nabava inputov					Uvoz inputov brez tujih investicij					Uvoz inputov s tujo investicijo				
	rprodaja	rval	rl	rkl	N	rprodaja	rval	rl	rkl	N	rprodaja	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

Opombe: Izračuni temeljijo na okrnjenem vzorcu podjetij z vsaj petimi zaposlenimi. Obravnavane spremenljivke so izražene relativno glede na povprečje 2-mestne dejavnosti: *rprodaja* – relativna prodaja; *rval* – relativna dodana vrednost na zaposlenega; *rl* – relativno število zaposlenih; *rkl* – relativna kapitalska intenzivnost; *N* – število podjetij.

Vir: lastni izračuni.

Analiza povezave med kvalitativnimi vidiki uvoza vmesnih dobrin in uspešnostjo poslovanja je podala nekaj zanimivih ugotovitev. Prvič, z večanjem deleža uvoženih inputov v celotnih materialnih stroških se povečuje produktivnost podjetij. Največjo premijo dosegajo podjetja, ki uvažajo tri četrtine vrednosti materiala. Drugič, produktivnost narašča tudi z večanjem števila različic uvoženih vmesnih dobrin. Podjetja, ki uvažajo več kot 100 dobrin so v povprečju za 20% bolj produktivna od povprečja njihove 3-mestne panoge. Tretjič, produktivnost je v monotoni pozitivni povezavi tudi z številom držav, iz katerih prihajajo vmesne dobrine. Podjetja z 10 ali več državami uvoznicami so v povprečju za 15% bolj produktivna od povprečja njihove dejavnosti. Število uvoženih različic in geografska razpršenost uvoza narašča tudi z velikostjo podjetja, saj multinacionalni uvozniki v povprečju uvozijo 20-50 različic več kot njihovi uvozni konkurenti brez investicij, njihovo število uvoznih partneric pa je v povprečju višje za 4 države. Stopnja vstopa v status uvoznika na ravni 4.2-6.7% na leto je precej nižja od stopnje vstopa v izvoz (4-17%; Damijan et al., 2004), medtem ko je stopnja izstopa iz uvoznega statusa na ravni 4% primerljiva s stopnjo za izvoz.

Testiranje hipotez o razvrstitvi skupin podjetij po načinu proizvodnje vmesnih dobrin glede na produktivnost (Hipoteze I-IV) je bilo izvedeno s Kolmogorov-Smirnov in Mann-Whitney testi stohastične dominance. Vse štiri hipoteze so se na podatkih slovenskih predelovalnih podjetij potrdile z veliko gotovostjo: najproduktivnejša so podjetja, ki del svojih materialnih inputov uvozijo in imajo hkrati tudi vsaj eno podružnico v tujini, sledijo jim uvozniki brez tujih neposrednih investicij, na zadnjem mestu pa so na domači trg omejena podjetja (Tabela 3).

Tabela 3: Kolmogorov-Smirnov test stohastične dominance za hipoteze I-III, 1994-2003.

	Skupina	D	P-vrednost	Popravljen
H I: domača podjetja < uvozniki vmesnih dobrin	Neuvozniki	0.2044	0.000	
	Uvozniki	-0.0022	0.964	
	Skupni K-S:	0.2044	0.000	0.000

	Skupina	D	P-vrednost	Popravljen
H II: domača podjetja < uvozniki brez TNI v tujino	Neuvozniki	0.1875	0.000	
	Uvozniki brez tujih investicij	-0.0020	0.970	
	Skupni K-S:	0.1875	0.000	0.000

	Skupina	D	P-vrednost	Popravljen
H III: uvozniki brez TNI v tujino < uvozniki s TNI v tujino	Uvozniki brez tujih investicij	0.1635	0.000	
	Uvozniki s tujimi investicijami	-0.0029	0.973	
	Skupni K-S:	0.1635	0.000	0.000

Opomba: Izračuni temeljijo na okrnjenem vzorcu podjetij z vsaj petimi zaposlenimi.

Vir: lastni izračuni.

Z uporabo istih testov sta bili testirani in potrjeni tudi hipotezi o samoselekciji podjetij v mednarodno fragmentacijo proizvodnje in samoizboru podjetij iz uvoznika vmesnih proizvodov brez TNI v multinacionalnega uvoznika. Podjetja, ki preidejo na bolj zahtevno mednarodno obliko poslovanja, so bolj produktivna od ostalih podjetij že v letu pred spremembo. Nadaljnja analiza se je iz vseh uvoznikov inputov osredotočila na tiste, ki so v obravnavanem obdobju prešla iz domače na mednarodno nabavo vmesnih dobrin. Namen tega dela empirične analize je raziskati, kakšne spremembe se dogajajo v novih uvoznikih v obdobju pred, v in po letu začetka uvažanja vmesnih proizvodov. Ta podjetja so namreč od vseh ostalih kategorij podjetij (stalni uvozniki, stalni neuvozniki) najbolj povečala raven produktivnosti v obravnavanem obdobju. Glede na povprečje vseh podjetij v pripadajoči dejavnosti se je v 12 letih produktivnost novih uvoznikov povečala za okrog 15 odstotnih točk v primeru dodane vrednosti na zaposlenega in za okrog 2 odstotni točki v primeru skupne faktorske produktivnosti. Razlika izvira iz povečanja relativne kapitalske intenzivnosti po začetku uvažanja, ki je dodana vrednost na zaposlenega ne upošteva, skupna faktorska produktivnost pa. Največje izboljšanje glede povprečja dejavnosti sta po začetku uvažanja doživeli vrednost prodaje in število zaposlenih. Število različic uvoženih vmesnih proizvodov se je od prvega do osmega leta po začetku uvoza povečalo iz 16 na 35, kar je še vedno pod povprečjem vseh uvoznikov (48 različic). V prvih šestih letih od začetka uvažanja novi uvozniki dodajo novo državo dobaviteljico v povprečju vsake dve leti, kar priča o zahtevnosti odprtja novega dobavnega trga. Uvozna intenziteta se poveča iz 10% na povprečje vseh uvoznikov (20%) v obdobju 9 let od začetka uvažanja. Izračun premij novih uvoznikov nad neuvozniki z regresijsko analizo po vzoru Bernard in Jensena (1999) potrdi zgornje ugotovitve in razkrije povečanje prednosti po začetku uvažanja v vseh obravnavanih kategorijah (produktivnost, velikost, prodaja in povprečne plače na zaposlenega) razen v kapitalni intenzivnosti, kjer je premija značilno pozitivna že pred začetkom uvažanja in se po spremembi ne poveča dodatno.

Rezultati ocenjevanja proizvodne funkcije dokazujejo pozitiven učinek uvažanja inputov na produktivnost podjetja, saj je indikator uvoza pozitiven in statistično značilen v večini ekonometričnih specifikacijah (Tabela 4). Testiranje serijske korelacije produktivnostnih šokov in odvisnosti le-teh od predhodnega statusa uvoza razkrije, da ima uvoz inputov tudi pozitivni dinamični učinek na prihodnji razvoj produktivnosti. Kasahara-Rodrigue cenilka v specifikaciji z zvezno spremenljivko uvoza (rezultati katere so v pričujočem slovenskem povzetku izpuščeni) izkazujejo manj značilne rezultate glede učinka uvoza na produktivnost, vendar dodatna analiza produktivnostih šokov kljub temu potrjuje pozitiven dinamični učinek uvažanja na prihodnje gibanje produktivnosti. Vključitev preteklega statusa izvoza nima vpliva na višino produktivnosti in ne spreminja vpliva uvoza.

Tabela 4: Rezultati ocen proizvodne funkcije (diskretna uvozna spremenljivka), 1994-2003

	Prihodkovna funkcija				Funkcija z dodano vrednostjo			
Cenilke:	OLS	Within	Kasahara-Rodrigue		OLS	Within	Kasahara-Rodrigue	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Delo	0.211***	0.241***	0.208***	0.208***	0.746***	0.807***	0.575***	0.560***
	(0.002)	(0.004)	(0.003)	(0.003)	(0.004)	(0.008)	(0.009)	(0.011)
Kapital	0.024***	0.038***	0.031***	0.060***	0.205***	0.180***	0.217**	0.110
	(0.001)	(0.002)	(0.010)	(0.013)	(0.003)	(0.004)	(0.100)	(0.071)
Material	0.757***	0.769***	0.720***	0.550***				
	(0.002)	(0.003)	(0.018)	(0.035)				
Diskretni	0.053***	0.008	0.028**	0.440***	0.275***	0.099***	0.783**	0.440
uvoz	(0.004)	(0.005)	(0.012)	(0.028)	(0.009)	(0.011)	(0.366)	(0.381)
γ	–	–			–	–		0.194***
								(0.002)
ρ	–	–			–	–		0.713***
								(0.004)
Št. opaz.	32,494	32,494	32,494	32,494	31,749	31,749	31,749	21,381

Opombe: Standardne napake so v oklepajih. Izračuni temeljijo na okrnjenem vzorcu podjetij z vsaj petimi zaposlenimi. Stolpca (3) in (7) uporabljata nelinearno metodo iskanja parametrov, ki minimizirajo GMM kriterijsko funkcijo, medtem ko stolpca (4) in (8) uporabljata iskanje po mreži. Standardne napake za Kasahara-Rodrigue cenilko so pridobljene z bootstrappingom s 100 ponovitvami.

Vir: lastni izračuni.

Ocena učinkov uvažanja vmesnih proizvodov z uporabo metode paritve (matchinga) na podlagi ocenjene verjetnosti začetka uvažanja je bila izvedena tako za dodano vrednost na zaposlenega kot tudi za metodološko bolj korektno skupno faktorsko produktivnost. Slednja je bila pridobljena iz ocen proizvodnih funkcij po metodi Kasahara-Rodrigue za vsako 2-mestno panogo posebej. Statistično značilno večjo rast produktivnosti od primerljivih neuvoznikov so novi uvozniki dosegali le v prvem letu uvažanja in pogojno v naslednjem, medtem ko v vseh nadaljnjih obdobjih njihova rast produktivnosti ni značilno presegala rasti kontrolnih podjetij (Tabela 5). V prvem letu so novi izvozniki zaradi uvoza inputov povečali produktivnost kar za 20 odstotnih točk hitreje kot primerljivi neuvozniki, medtem ko ocene učinkov začetka izvažanja na isti populaciji Slovenskih podjetij znaša 8 oz. 14 odstotnih točk

(De Loecker (2007) in Damijan et al., 2004). V naslednjem letu se učinek zniža na 4-10 odstotnih točk, vendar je statistična značilnost le v okviru 10% tveganja. Ocene povprečnega učinka začetka uvažanja na dodano vrednost na zaposlenega izkazujejo enak vzorec (značilnost v prvem in drugem letu uvažanja) in vrednostno podoben vpliv: v prvem letu se dodana vrednost na zaposlenega poveča za 550 tisoč SIT bolj kot v kontrolnih podjetjih, kar predstavlja okrog 20% povprečne vrednosti dodane vrednosti na zaposlenega v obravnavanem obdobju.

Tabela 5: Povprečni učinki začetka uvažanja vmesnih proizvodov na rast skupne faktorske produktivnosti, 1994-2005.

Čas	Metoda	ATT	SE[a]	Pr	N
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

Opombe: DID_t označuje $\Delta y_{it}^{Newimporter} - \Delta y_{it}^{Control}$, pri čemer je *y* skupna faktorska produktivnost. [a] bootstrap standardne napake (100 ponovitev). Za "nearest neighbour matching" so bile izračunane standardne napake z metodo »sub-sampling« (100 ponovitev). *, **, *** označujejo stopnjo značilnosti na 10%, 5% and 1%.

Vir: lastni izračuni.

Kljub kratkotrajnim učinkom začetka uvažanja na rast produktivnosti, kar predvideva tudi teoretični model, so učinki na kumulativno rast oziroma na povečanje nivoja produktivnosti dolgotrajna in značilna (Tabela 6). V četrtem letu po začetku uvažanja novi uvozniki v povprečju pridobijo dodatnih 35 odstotnih točk rasti skupne faktorske produktivnosti nad rastjo v kontrolnih podjetjih. Na primeru dodane vrednosti na zaposlenega je ocena kumulativnega učinka podobna: okrog milijon SIT, kar predstavlja približno 37% povečanje produktivnosti. Komplementarna regresija z razliko v razlikah potrdi značilnost in kratkotrajnost učinka začetka uvažanja inputov na rast produktivnosti, tudi ko kontroliramo vpliv pretekle produktivnosti, kapitalske intenzivnosti in tekočega statusa izhodnih in vhodnih investicij. Izkaže se, da izhodne TNI nimajo vpliva na velikost učinka začetka uvažanja, medtem ko podjetja v tuji lasti rastejo nekoliko hitreje od podjetij v domači lasti.

Tabela 6: Kumulativni učinek začetka uvažanja vmesnih proizvodov na rast skupne faktorske produktivnosti, 1994-2005.

Čas	Metoda	ATT	SE[a]	Pr	N
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 označuje $\left(y_{i,s=t} - y_{i,s=-1}\right)^{Newimporter} - \left(y_{i,s=t} - y_{i,s=-1}\right)^{Control}$, pri čemer je y skupna faktorska produktivnost. [a] bootstrap standardne napake (100 ponovitev). Za "nearest neighbour matching" so bile izračunane standardne napake z metodo »sub-sampling« (100 ponovitev). *, **, *** označujejo stopnjo značilnosti na 10%, 5% in 1%.

Vir: lastni izračuni.

Osrednjo hipotezo disertacije, ki pravi, da zunanje izvajanje del bodisi preko podružnic v tujini ali preko neodvisnega pogodbenega dobavitelja inputov omogoča podjetjem večje osredotočenje na temeljne kompetence, sem testiral na podlagi podatkov o proizvodni in procesni inovativnosti podjetij. Iz Tabele 7 je razvidno, da dve leti pred začetkom uvažanja bodoči novi uvozniki vpeljejo nov proizvod na trg z enako verjetnostjo kot kontrolni neuvozniki. Že v prvem letu uvoza pa se stopnja inoviranja proizvodov poveča za 7-11%. Stopnja inoviranja se še poveča glede na neizvoznike v nadaljnjih letih po začetku uvažanja in ostane značilna v vsem obdobju. Za razliko od učinka na rast produktivnosti je vpliv na povečanje inovativnosti precej bolj dolgoročen.

Tabela 7: Povprečni učinki začetka uvažanja vmesnih proizvodov na proizvodno inovativnost, 1996-2004.

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

Opombe: D_t označuje $y_{it}^{Newimporter} - y_{it}^{Control}$, pri čemer je y slamnata spremenljivka za proizvodno inovacijo. [a] bootstrap standardne napake (100 ponovitev). Za "nearest neighbour matching" so bile izračunane standardne napake z metodo »sub-sampling« (100 ponovitev). *, **, *** označujejo stopnjo značilnosti na 10%, 5% in 1%.

Vir: lastni izračuni.

Tabela 8: Povprečni učinki začetka uvažanja vmesnih proizvodov na procesno inovativnost, 1996-2004.

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

Opombe: D_t označuje $y_{it}^{Newimporter} - y_{it}^{Control}$, pri čemer je y slamnata spremenljivka za procesno inovacijo. [a] bootstrap standardne napake (100 ponovitev). Za "nearest neighbour matching" so bile izračunane standardne napake z metodo »sub-sampling« (100 ponovitev). *, **, *** označujejo stopnjo značilnosti na 10%, 5% in 1%.

Vir: lastni izračuni.

Tabela 8 prikazuje rezultate metode matchinga za procesne inovacije. Za razliko od proizvodnih inovacij bodoči novi uvozniki že v obdobju pred začetkom uvažanja inovirajo v večjem obsegu kot podobni neuvozniki. Vzrok temu je lahko v tem, da podjetja, ki razmišljajo o fragmentaciji proizvodnega procesa preko meja Slovenije že pred tem uvajajo izboljšave v upravljanju in organizaciji notranjih proizvodnih procesov, kar na koncu vodi do mednarodne nabave vmesnih proizvodov.

Tudi tu se pojavnost inoviranja z leti poveča, učinek po šestih letih od začetka uvažanja pa je vrednostno enak kot v primeru proizvodnega inoviranja. Rezultati obeh vrst inovacij torej potrjujejo pozitiven učinek začetka uvažanja na intenzivnost inoviranja, kar je lahko vzeti kot posreden dokaz hipoteze o osredotočenju na ključne kompetence.

8 Zaključek

Osrednji namen disertacije je analiza učinkov mednarodne fragmentacije proizvodnje na produktivnost in strateško usmerjenost heterogenih podjetij v predelovalni dejavnosti. Mednarodna fragmentacija je bila v teoretični in empirični literaturi v večini proučevana z vidika učinkov na selitev dela in višino plač. V nasprotju s tem, se je pričujoča študija oddaljila od proučevanja agregatnih učinkov offshoringa in se osredotočila na vprašanja rasti produktivnosti in izgrajevanja ključnih kompetenc na ravni podjetja. V duhu najnovejših teorij mednarodne trgovine in proizvodnje so bila osrednja tri vprašanja moje disertacije naslednja: prvič, ali produktivnost in druge značilnosti podjetja oblikujejo odločitev o organiziranosti proizvodnih procesov ter ali se podjetja samoizberejo v mednarodno proizvodnjo in nabavo vmesnih proizvodov; drugič, ali ima transformacija od domačega v mednarodno dobavo vmesnih proizvodov povratne kavzalne učinke na rast produktivnosti; in tretjič, ali lahko potrdimo tezo, da mednarodna fragmentacija proizvodnje omogoča podjetjem boljše osredotočenje na ključne kompetence. Rezultati empirične analize so na vsa tri vprašanja odgovorila pritrdilno.