ESSAYS ON FOREIGN DIRECT INVESTMENT
AND GLOBALIZATION

By

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ABSTRACT OF THE DISSERTATION

Essays on Foreign Direct Investment and Globalization

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Professor Thomas J. Prusa

This dissertation is composed of three essays investigating the implications of foreign direct investment (FDI) inflows for developing countries and the forces driving such flows.

Lately, many economies have been opening their retail sector to FDI, yet little is known about possible implications of such liberalization. In Chapter 2, using data from Romania, I look at how the presence of global retail chains affects the supplying industries. I show that the subsidiaries of global chains are larger in size, more capital intensive and exhibit higher labor productivity than other retailers. I then apply a difference-in-differences method and find that the expansion of global chains leads to a significant increase in TFP in the supplying industries. These results suggest that the opening of the retail sector to FDI may stimulate productivity growth in upstream manufacturing.

Existing studies have focused on productivity spillovers from FDI postulating a constant marginal effect. In Chapter 3, I use markup as an alternative measure of firm performance, exploring multiple dimensions of the impact of FDI, and examine the possibility that marginal spillovers diminish. Using Romanian data, I find that the

relationship between downstream FDI and upstream markups is in the shape of an inverse-U, i.e. at some critical value of FDI, the marginal effect turns from positive to negative; the intra-industry impact of FDI is weak but, when considering companies with minority foreign ownership, the relationship is also inverse-U shaped. My findings support the idea of diminishing marginal spillovers, which advance current belief on positive vertical spillovers and offers an explanation to the ambiguous evidence on horizontal spillovers.

International vertical integration is an important reason behind the growth in FDI, yet little evidence is available on why it varies across industries. In Chapter 4, I examine the theory of Antras and Helpman and provide an empirical answer to the question. My approach takes advantage of the correspondence between the pattern of international investment and that of trade in intermediates. I show that productivity dispersion and input intensities influences an industry's propensity to import intermediates from developing countries and, hence, the extent of vertical integration.

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Professor Beata S. Javorcik, my former supervisor at the World Bank and co-author, ignited my interests in foreign direct investment and development. She guided me through the composition of the first essay and was especially helpful in offering suggestions that enabled me to bring the second essay to a completion. I am grateful to her for the generous help and for being on my dissertation committee as an external advisor.

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Dedication

To My Parents and My Sister

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Chapter 1

Introduction

1.1 Main Research Questions

In the past decade, foreign direct investment (FDI) has become the distinguishing feature of international economy, with an annual flow exceeding $780 billion and a total stock of $11.9 trillion in 2006 (UN 2007). Despite the rapid growth of FDI, governments around the world, including in developing countries, still place FDI promotion high on their agendas and in many cases. Are such policies justified? On one side, the widely held assumption is that foreign companies more than pay their way and generate positive spillovers to host countries. On the other side, Dani Rodrick, and skeptics alike, claims "one dollar worth of foreign direct investment is worth no more (and no less) than a dollar of any other kind of investment." The evidence, however, has been mixed at best (Görg and Strobl 2001, Görg and Greenaway 2004, and Javorcik 2007). Intrigued by this puzzle, I investigated the implications of FDI inflows for developing countries and the forces driving such flows in this dissertation.

In Chapter 2, jointly with Beata S. Javorcik, I examine how the presence of global retail chains affects firms in the supplying industries. In Chapter 3, I investigate how the expansion of foreign companies affects the markups of their competitors and suppliers in host countries. In Chapter 4, I turn to an explanation of how FDI takes place, international vertical specialization, by examining trade pattern in intermediate goods.

Lately, many economies have opened their retail sector to foreign direct investment. This liberalization has resulted in the emergence and rapid expansion of global retail chains, for instance Wal-Mart, Carrefour, and Metro. Their entry may transform the retail sector and, more importantly, may affect the supplying industries in the host economy through channels like lowering distribution costs, stimulating economies of scale, and increasing competition. Despite the potential profound impact, existing literature has been largely looking at FDI in manufacturing industries and little effort has been devoted to understanding the channels through which the entry of global retailers may affect the economy of a host country. To fill in this gap in literature, in Chapter 2, I investigate global retail chains in Romania and their impact on the productivity of firms in supplying industry.

In assessing externalities from FDI, existing studies have focused on productivity spillovers. However, FDI can affect firm performance in many ways, including technological spillovers, pecuniary spillovers, and competition effects. Markup is a broader measure of profitability than productivity, accounting for overall improvements in firm capabilities due to technological spillovers and the benefits brought by pecuniary externalities. Additionally, markup is a measure of market power and can help to assess the competition effects of FDI. Using markup may better reveal the multiple forces at work and explain the ambiguity in spillover effects. Additionally, a handful of studies which examine relationship between FDI and markups only look at intra-industry impact and are based on data from industrial countries. The conclusions may not be applicable to developing economies. To extend current understanding in this aspect, in Chapter 3, I introduce markup to the study on both intra- and inter-industry impact of FDI using firm-level data from Romania.

1.2 Methodology and Main Findings

One reason why current literature finds negative or neutral spillovers from FDI might be the heterogeneity of the impact. A few prior studies have identified geographical proximity as a factor affecting the spillovers (Görg and Greenaway 2004) and suggested that the impact may be regional specific. In addition, the spillovers may well be sector specific but this possibility has not been considered. Technology in some sectors might simply be harder to adopt than that in others. Even in terms of backward linkage, suppliers from certain sectors may be affected more than others due to factors like closer contact or relationship specific investment.

In Chapter 2, I consider the heterogeneity in both aspects to identify the impact of retail chains expansion. I created a data set with store-level information of the entry time and location of global retail chains in Romania. I then use a difference-in-differences method taking advantage of the differences in the timing of the regional entry of global retail chains and the fact that only some industries within each region should be affected. I find that an expansion of global retail chains leads to a significant increase in the total factor productivity in the supplying industries in the region where the expansion took place. The findings imply that entry of global retail chains may help to improve the productivity of host country supplying industries.

Existing literature has mainly study FDI spillovers in a linear framework and debated about whether marginal spillovers are positive or negative. However, marginal spillovers may diminish due to the “Veblen-Gerschenkron” effect (Findlay 1978). The idea is that if positive spillovers from foreign to indigenous companies do exist, the technological gap between the two will narrow as foreign presence continuously increases.

The scope for indigenous firms to catch-up becomes smaller. As a result, magnitude of marginal spillovers may fall as the levels of FDI rise which may help to explain why studies find conflicting results based on different data sets.

Markup captures both positive spillovers and competition effects of foreign presence. The marginal competition effects of FDI are likely to stay constant or increase as the levels of FDI rise. Interestingly, spillovers and competition effects push markups in opposite directions. The observed impact of FDI on markups reflects the relative strength of the two forces. Consequently, the relationship between FDI and firm markups is likely to be nonlinear. In Chapter 3, I empirically investigate this hypothesis and reach two conclusions. First, the relationship between downstream FDI and upstream markup indeed is in the shape of an inverse-U: at some threshold value, the marginal effect of downstream FDI changes from positive to negative. Second, the intra-industry impact of FDI on markups is weaker; when considering projects with minority foreign ownership, the relationship also displays an inverse-U shape. The results illustrate the relative strength of spillovers versus competition effects and support the hypothesis of diminishing marginal spillovers.

In Chapter 4 I turn to one important reason behind the surge in FDI flows into developing countries, international vertical specialization. More companies have found it profitable to break-up the production process into geographically distinct stages and obtain intermediates abroad either through intra-firm trade (FDI) or outsourcing. However, little evidence is available as of why the extent of international vertical specialization varies considerably across industries. Inspired by a recent theory study, we take two steps to examine the question. First, in order to taking advantage of the correspondence between the pattern of international investment and the pattern of trade in intermediates, I formally extend the framework of Antras and Helpman (2004) to two hypotheses linking cross-industry differences in trade pattern with industry characteristics. Secondly, I conduct an empirical analysis on an industry-level panel data of the US manufacturers based on the hypotheses. The results show that a higher degree of productivity dispersion within an industry is associated with a greater share of imports from developing countries in total intermediate purchases. It is consistent with the model prediction and provides another piece of evidence for the importance of firm heterogeneity in determining international trade pattern. The analyses also indicate that various input intensities, including capital intensity, human capital intensity and R&D intensity, also influence an industry's propensity to import intermediates from developing countries. Overall, this chapter extends current understanding of the pattern of trade in intermediates and the underlying firm investment behavior.

Chapter 2

Do the Biggest Aisles Serve a Brighter Future? Global Retail Chains and Their Implications for Romania*

2.1 Introduction

During the past two decades many countries, including some developing economies, have opened their retail sector to foreign direct investment (FDI). This liberalization has resulted in the emergence and rapid expansion of global retail chains. For instance, Wal-Mart, the world's largest retail chain and the largest company, has 2,913 outlets in 13 countries outside the United States, ten of which are in the developing world. French retailer Carrefour, the second largest retailer in the world and the largest in Europe, currently operates 8,688 outlets in 28 foreign countries, including 20 developing countries, while in 1990 it was present in only 2 countries outside France. Despite the phenomenal growth of global retail chains, little is known about their potentially profound impact on the economies of developing host countries.

The entry of global retail chains may transform the retail sector and, more importantly, may affect the supplying industries in the host economy. Global retail chains differ from indigenous retailers not only in terms of scale but also because of their access to advanced technologies, modern management strategies and global sourcing networks. Their entry may change the landscape of the retail sector in the host country through increased concentration and modernization. More importantly, their expansion may have implications for supplying industries in terms of lowering distribution costs, stimulating economies of scale, and increasing competition due to greater ability of foreign retailers to source products from abroad. The competition effect may in turn encourage productivity improvements and innovation among suppliers. Some of these effects have been documented in a recent case study describing the effects of Wal-Mart's entry on detergent producers in Mexico (Javorcik, Keller and Tybout 2006).

Despite the growing importance of global retail chains and the potentially large implications of FDI inflows into the retail sector, little effort has been devoted to understanding the channels through which the entry of global retailers may affect the economy of a host country.[1] This study is a step towards filling this gap in the literature.

To shed light on the implications of opening the retail sector to foreign direct investment, this study uses panel data on retailers and manufacturing firms operating in Romania during the period 1997-2005. The analysis proceeds in two steps. First, we document differences between characteristics of global retail chains and other retailers. We show that Romanian subsidiaries of global retailers are indeed larger in size, more capital intensive and exhibit higher labor productivity than other retailers operating in the country. Second, we use a difference-in-differences method to examine the effects of the entry of global retail chains on the performance of the supplying industries. Our identification strategy relies on the differences in the timing of the entry of global retail chains into

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[1] Most recent work on the impact of foreign direct investment on indigenous firms has analyzed inter-industry effects of foreign entry and some has extended to FDI in service sectors. However, inter-industry impact associated with FDI in retail sector taking place through backward linkages has not been systematically examined in the literature. The existing work on retail sector and supermarket chains in the context of developing countries provides us with broader insight of the development in modern retailing. The existing studies, however, do not distinguish between foreign chains and domestic retailers and hence, do not clarify the potential impact of FDI inflows in the sector. Moreover, they focus only on the implications for

Romanian regions and the fact that only some industries within each region should be affected. We use both OLS and instrumental variable approaches. We find that an expansion of global retail chains leads to a significant increase in the total factor productivity in the supplying industries in the region where the expansion took place. Their presence in a region increases TFP of firms in the supplying industries by 15.2 percent and doubling the number of chains leads to a 10.8 percent increase in TFP. Larger manufacturers seem to be affected more than small enterprises.

Our results suggest that opening of the retail sector to FDI may stimulate productivity growth in upstream manufacturing and provide another piece of evidence in favor of services liberalization.

This study is structured as follows. Section 2.2 reviews the related literature. Section 2.3 discusses the channels through which presence of global chains may affect supplying industries. Section 2.4 describes the data. In section 2.5, we compare the performance of global retail chains to that of other retailers operating in Romania. In section 2.6, we examine the link between the expansion of global retail chains and the performance of the supplying sectors in Romania. Section 2.7 concludes the paper.

2.2 Related Literature

Two strands of the literature are relevant to this study. The first one is research on how inflows of foreign direct investment affect manufacturing industries in a host economy. A large number of studies search for intra-industry effects, postulating that foreign entry may result in knowledge spillovers to local firms as well as in local producers losing part of their market share to foreign entrants. Empirical analyses based on firm-level

agricultural producers. See the next section for more details.

panel data produce mixed results. While Aitken and Harrison (1999) and Djankov and Hoekman (2000) find that an increase in FDI presence negatively affects the total factor productivity of indigenous firms operating in the same industries in Venezuela and Czech Republic, respectively, Aghion et al. (2004) and Haskel et al. (2007) reach the opposite conclusion.[2] More recent studies have argued that while foreign investors have an incentive to prevent knowledge leakage to their competitors, they may encourage transfer of information to their local suppliers. And indeed work by Javorcik (2004) and Blalock and Gertler (2008) show a positive association between FDI and productivity in upstream industries (for a literature review see Görg and Greenaway 2004).

Compared with work on manufacturing industries, studies on the implications of FDI inflows in service sectors are relatively scarce. Eschenbach and Hoekman (2006) document a positive relationship between progress in services liberalization, including openness to FDI, and economic growth in transition countries for the period of 1990-2004. Mattoo et al. (2006) present econometric evidence from a sample of 60 countries over 1990-1999 indicating that openness in the financial and telecommunications sectors influences long-run growth performance. Arnold et al. (2006) analyze firm-level panel data from the Czech Republic and find a significant positive effect of FDI in the services sectors on downstream manufacturing firms' total factor productivity (TFP). Using industry-level panel data, Fernandes (2007) shows progress in service sector liberalization leads to an increase in labor productivity of downstream manufacturing in transition countries. The results of these studies suggest that the quality and availability of services inputs used by manufacturing industries may be positively affected by entry of foreign services providers. There is, however, no work documenting the possible implications of foreign entry into

[2] For a review of the literature, see Görg and Strobl (2001).

services in general (and retail sector in particular) for the performance of manufacturing firms in the supplying industries.

The second literature relevant to this study consists of case studies on the evolution of the retail sector in developing and transition countries. A series of studies describe the rise of modern retail formats, contrast them with traditional retailers and examine the implications of this phenomenon for agricultural producers. Dries, Reardon and Swinnen (2004) draw a detailed picture of the evolution of supermarkets in Central and Eastern European (CEE) countries and discuss their implications for the agricultural sector. Swinnen et al. (2006) document how FDI in the retail sector in some CEE countries facilitates productivity growth of local dairy farmers. Reardon and Berdegue (2002) and Reardon, Timmer, and Berdegue (2003), Minten, Randrianarison and Swinnen (2006), Mattoo and Payton (2007) provide similar analysis on the rise of supermarket in Latin America, Asia and Africa and their effects on the agricultural sector. The majority of these case studies, however, do not distinguish between foreign supermarket chains and domestic ones and thus do not advance our understanding of the effects of FDI. Secondly, their focus is limited to suppliers of agricultural products.[3]

Several recent case studies are devoted to the implications of FDI inflows. Chavez (2002) describes the evolution of foreign retail chains and Mexican domestic retailers around the formation of NAFTA and the increasing competitive pressure caused by the entry of foreign retailers. Javorcik, Keller, and Tybout (2006) document how the entry of Wal-Mart into Mexico has facilitated the modernization of the retail sector and has stimulated fundamental changes in the relationship between retailers and suppliers of

[3] Igan and Suzuki (2007) examine the price impact of modern retailers in Central and Eastern European countries by employing a cross-country regression and find that increases in modern retail stores significantly

soaps, detergents, and surfactants in Mexico. They find that Wal-Mart's entry has driven high-cost suppliers out of business, benefited surviving producers by providing access to a larger market and prompted suppliers to introduce more innovations. In contrast, a case study by Durand (2007) concludes that FDI has played an important role in modernizing the retail sector in Mexico, but has dampened the performance of local retailers and retail wages by introducing higher competitive pressures. These case studies suggest that there may be a strong relationship between the presence of global retail chains and the performance of supplying firms but the direction of such a relationship is still an open question.[4]

2.3 Expansion of Global Retail Chains and Supplying Industries in the Host Country

The entry of global retail chains may affect the performance of firms in the supplying industries of the host economy through several channels. First, it may increase competitive pressures on suppliers. As retail chains become more important, their bargaining power vis a vis suppliers strengthens. Moreover, thanks to their extensive international sourcing networks global retail chains often have the option of importing products rather than purchasing them locally. This stronger position (relative to other retailers operating in the host country) allows global retail chains to require suppliers to lower prices and/or improve products. This in turn forces suppliers to become more efficient. For instance, Mexican-owned detergent producers have reported introducing incremental improvements to their products in order to avoid drastic price cuts demanded by Wal-Mart (Javorcik et al. 2006).

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reduce food inflation.

[4] A related literature reviewed by Basker (2007) examines the effects of Wal-Mart's expansion in the U.S. on

Second, entry of global chains possessing cutting-edge retail technologies and familiar with best international practices may help lower costs faced by suppliers. Rather than sending their products to a large number of small retailers, suppliers may deliver larger shipments to several retail outlets. Thanks to computerized inventory systems used by global retail chains, suppliers may be better informed about changes in demand and may be better able to tailor products to the expectations of consumers. For instance, Wal-Mart provides its suppliers with full and free access to real-time data on how their products are selling. Suppliers can plan production runs earlier and offer better prices (Economist 2001). Tesco tracks every purchase through its Club card and can use this information to help its private-label suppliers to test and adapt innovations (The Boston Consulting Group 2007). Saving on employee time and usage of capital (e.g. truck fleet) when arranging distribution and planning production, suppliers may produce more output with the same amount of labor and achieve higher total factor productivity. Finally, global retail chains could stimulate economies of scale among suppliers by offering producers a larger market (both in the host country as well as abroad).

In sum, by increasing competitive pressures on suppliers, cutting distribution costs and offering easier access to information and a larger market global retail chains may stimulate productivity growth in the supplying industries.

2.4 Data

This study examines the link between the expansion of global retail chains and developments in the supplying industries in the context of Romania. Focusing on Romania has three advantages. The first advantage is the availability of high quality and

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various aspects of economic activity.

comprehensive firm-level data. We have time-varying information on 513,554 companies operating in Romania during the period 1996-2005. The data set contains information on firms of all sizes, including those with one employee. As small or medium-sized enterprises (SMEs) in the supplying industries may be affected to a different degree than large companies, being able to include them in the analysis is an advantage. The second advantage of using Romanian data is the timing of the entry of global retailer chains. They started entering Romania only in the mid-1990s which means that our data cover both the pre- and the post-entry period. The third advantage is that Romania is a large country. With a population of 22 million and an area about 238,000 km^2, it encompasses 42 county-level administrative units and eight broader NUTS regions.[5] Thus, in our econometric analysis, we are able to rely not only on inter-temporal but also on cross-regional variation in the presence of foreign chains.

The main data source for this study is the commercial data base Amadeus published by Bureau van Dijk. It contains information on about 9 million public and private companies in 38 European countries over the 1996-2005 period. Amadeus includes data on location, contact information, industry classification, standard financial statements and detailed shareholder information including the country of origin.

To identify global retail chains, we use information on company name, industry classification and ownership from Amadeus which we cross check against the information on major international retail chains in "World Retail Data and Statistics 2006/2007" and "European Marketing Data and Statistics" published by Euromonitor International, "Economist Intelligence Unit (EIU) Industry Briefing, Romania: Consumer goods and retail background", GAIN report by USDA Foreign Agriculture Service and Dun &

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[5] NUTS stands for the EU nomenclature of territorial units for statistics defined by Eurostat.

Bradstreet Business Report. We identify 9 global retail chains operating in Romania. Their names and characteristics are listed in Table 2.1.

Amadeus data base provides aggregate figures on company operations in Romania. More detailed data on the presence of global retail chains in different Romanian regions were obtained by contacting each retail chain directly. We were successful at collecting information on the opening date of all stores, their location and selling space for 7 of the 9 chains operating in Romania. We did not manage to obtain the data for Kaufland which entered Romania during the last year of the sample and Mega Image which is one of the smaller entrants. For more details, see Table 2.1.

In addition to ownership information, we use information on output, production inputs and profit from balance sheets and income statements. We drop observations with negative values of turnover, materials and tangible fixed assets and unusually large fluctuations in values of variables. In manufacturing industries, we end up with 49,552 companies in the sample. When we incorporate industry-level import and export figures in the analysis we further restrict the sample to 49,390 manufacturing companies. In the retail sector, we restrict our attention to firms with an average employment over 50, which leaves us with roughly the top 1% of all observations for that sector or 932 firms.

We deflate output by the producer price index (PPI) for the three-digit NACE sector, obtained from the *Statistics Year Book of Romania*. We measure labor input as the number of employees, and capital as deflated tangible fixed assets. The capital deflator is a simple average of PPI from five NACE sectors.[6] We define material inputs as material costs deflated by the weighted average of PPI of the supplying sectors with the weights given by

[6] These are: machinery and equipment; office, accounting, and computing machinery; electrical machinery and apparatus; motor vehicles, trailers, and semi-trailers; and other transport equipment.

2000 input-output matrix provided by the Statistical Institute of Romania. Real wage is deflated by the consumer price index from the IMF's *International Financial Statistics* (IFS).

To control for region-specific demand, we calculate the average real wage per worker at the regional level. We use data on wages and employment of all companies operating in Romania during the period of 1997- 2005 listed in Amadeus data base, including all firms active in agriculture, industry, and services sectors. The data are deflated by the same consumer price index. Finally, we also use information on imports and exports obtained from the UN's COMTRADE database and deflate it by the GDP deflator from IFS.

2.5 Global Retail Chains in Romania

2.5.1 Expansion of Global Retail Chains

While the focus of this study is the relationship between the presence of global retail chains and the performance of the supplying industries, we first turn to developments in the Romanian retail sector. Relative to other services, retail and wholesale sector accounts for a large portion of Romania's economic activity. In both 1997-2000 and 2001-2004 periods, it contributed about 10% to total employment and value added of the economy (Fernandes 2007). It was the largest service sector in terms of employment.

Compared to other Central and Eastern European countries, the retail sector in Romania is a late boomer in terms of FDI inflows. The first entry of foreign retail chains into the Czech Republic, Hungary, and Poland took place in the early 1990s and a broader expansion of these chains occurred around the mid-1990s. The first entry of global retail chains into Romania, however, did not take place until 1997 when the German chain Metro opened its first Metro Cash & Carry outlet in Bucharest. It took another two years before other large European retailers entered Romania. Only since year 2000, Romania has seen rapid expansion of foreign retailers, including Carrefour from France, REWE from Germany, and Cora from Belgium (see Table 2.2). In 1999, there were only 5 outlets of 3 global retail chains operating in Romania. From 1999 to 2001, the number of outlets increased fivefold. From 2001 to 2005, the number again tripled and reached a total of 86 outlets. The total selling space of global retail chains increased 10 times from 43,000 square meters in 1999 to 463,000 square meters in 2005 (see Table 2.3).

Following the trend observed in other transition economies, foreign chains have become dominant players in the Romanian retail sector in which there are few significant domestic players. In 1999, they employed around 1,400 workers, invested 44 million dollars in capital stock and generated 3.2% of total retail sales. In 2005, they had a total workforce of more than 18,900, a total capital stock of 844 million dollars and generated 3.27 billion dollars in sales, accounting for about 22.2% in total retail sales. (See Table 2.2)

The expansion of global retail chains in Romania was not uniform across regions. The area around the capital city Bucharest, especially its outskirts, was the initial focus of their entry. The Western region, close to Hungary, also attracted a lot of entry in the initial period (see Table 2.4).[7] In 2005, the regional distribution of outlets was still uneven. There were 16 and 19 outlets in Bucharest and West, respectively, but only 4 outlets in Northeast and 3 in Southwest (see Figure 2.1).

The expansion strategy depended on the history and the nature of each chain's

[7] The regional classification is based on the community nomenclature of territorial units for statistics (NUTS) defined by Eurostat.

activities. Cash & carry market has a longer history in Romania, starting with Metro's entry in 1997, and it sells to private traders/stores as well as households. Such chains have expanded into large and medium-sized cities. The hypermarket format was first introduced into Romania in 2001 by Carrefour and is the largest of all formats targeting households. Hypermarkets, therefore, concentrate in cities with population more than 300,000.[8]

2.5.2 Performance Premium of Global Retail Chains

To shed more light on the importance of global retail chains in the Romanian retail sector, we explore the extent to which they differ from other retailers with respect to a number of performance indicators. We do so by estimating a simple model on the data for the 1997-2005 periods:

$$y_{it} = \alpha_0 + \alpha_1 \cdot global\_chain_{it} + \alpha_2 \cdot \ln age_{it} + \alpha_3 \cdot \ln L_{it-1} + \alpha_r + \alpha_t + \varepsilon_{it} \qquad \textbf{(2.1)}$$

where y_{it} is the outcome variable for retailer *i* operating at time *t* capturing the retailer's performance. The performance indicators include employment, capital stock, capital-labor ratio, total sales, market share, sales per worker, real wage per worker, value added per worker (value added is defined as the difference between sales and material costs), return to assets (computed as the ratio of profits to total assets), and return to sales (calculated as the ratio between profits and total sales).[9] Except for market share, return to assets and return to sales, all variables enter in a logarithmic form. We define $global\_chain_{it}$ as a dummy taking on the value of one if the retailer *i* is one of the 9 identified global retail chains and zero otherwise. The estimate of α_1 is, therefore, the premium associated with

[8] Hypermarkets are defined as retail outlets selling groceries and non-food merchandise with a retail sales area of over 2,500 square meters. They are frequently located in out-of-town sites or as the anchor store in a shopping center.

[9] Note that we use company-level data, as outlet-level information is not available for the variables of

global retail chains. We control for the logarithm of age_{it}, defined as the number of years since establishment to capture the learning-by-doing effects. To control for size differences between different retailers we include one period lag of employment (also in logarithmic form). To control for regional differences in economic conditions, we include region fixed effects α_r. We also include year fixed effects, α_t, to take into account macroeconomic shocks, such as the 1998-1999 Russian financial crisis. As it does not seem meaningful to compare global retail chains to one-person kiosks or family-run street vendors, we limit the sample to retailers and wholesale traders with an average employment over 50, which leaves us with the top 1 percent of all the observation or 932 firms (see Table 2.5 for summary statistics).

We present the estimated premium associated with being a global retail chain for ten performance indicators in Table 2.6. We find that global retail chains differ significantly from other retailers in Romania. The estimated premium for the eight indicators is positive and statistically significant at the 5% level or better. As for the scale, foreign chains are much larger in terms of employment, capital stock and sales. They are more capital intensive (as measured by capital-labor ratio). This is consistent with anecdotes that global retail chains tend to be leaders in adopting advanced retail technologies, from large sales rooms and warehouses to computerized inventory tracking systems. In terms of sales per worker, real wage per worker, and value added per worker, global retail chains exhibit a premium in terms of all three variables. They have higher sales per worker, higher labor productivity and tend to pay higher wages. Moreover, we find that global retail chains enjoy larger market shares. However, we do not find any differences in terms of profitability measured by return on assets and return on sales.

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interest.

To summarize, although their entry into Romania lagged behind their expansion in other more advanced transition countries in CEE, global retail chains expanded rapidly in Romania since 2000. Their expansion was uneven across regions with Bucharest area receiving the first and the most entries. Overall, global retail chains have played an increasingly important role in the sector and accounted for over one fifth of the total retail sales in 2005. Our simple econometric analysis finds that global retail chains differ significantly from other retailers in the country. They are larger in scale and more capital intensive. They enjoy higher labor productivity and larger market share. Their rapid expansion and larger size suggest that they may have greater bargaining power vis a vis suppliers while at the same time offering them access to a larger market and lower costs. In short, the presence of global retail chains has brought significant changes to the landscape of the retail sector in Romania. In the next section, we explore the implications of their presence on the performance of the supplying industries, which is the main objective of this study.

2.6 Impact on the Total Factor Productivity in the Supplying Industries

2.6.1 Identifying Assumptions

In our analysis of the relationship between the presence of global retail chains and the performance of the supplying industries, we take advantage of regional variation in foreign chains' expansion. We rely on the Nomenclature of Territorial Units for Statistics (NUTS) and divide Romania into eight NUTS regions with an average territory of 29,800 square kilometers.[10] We focus on the changes in suppliers' performance following the

[10] The 8 regions are Bucharest-Ilfov, North East, South East, North West, South West, South, West and Center.

entry of foreign chains into their region. Our presumption is that the impact of global chains' entry tends to be limited to the regional level.

We base our assumption on the following facts. First, while Romania is the third largest country in CEE with a territory of 238,000 km^2, its rail and road networks are among the least extensive in transition countries hindering development of national distribution systems. Romania's rail network, which is the main means of internal transport for passengers and freight, covers 14,217 km of which only 35% is electrified. Its rolling stock is in urgent need of replacement. According to information from the World Development Indicators, the railway density in Romania in 2004 is about 4.7 km per 100 km^2 of land area and falls behind that in Hungary (8.9 km per 100 km^2), Poland (6.4 km per 100 km^2) and Croatia (4.9 km per 100 km^2). The road infrastructure of Romania also lags behind that of western Balkan states such as Croatia, or Serbia and Montenegro. Up until 2002 Romania's public roads covered only 73,260 km, which amounted to about 30.7 km per 100 km^2 of land area. Less than one-quarter of roads were designated as modern and only 113 km were motorways. In the following years, the coverage of public road network increased to 78,000 km yet most of them still need almost constant repair (EIU country profile, 2003, 2006). In terms of total road density, there was about 86 km road per 100 km^2 land area in Romania, which was much less than 178 km per 100 km^2 in Hungary and 138 km per 100 km^2 in Poland (the World Development Indicators).

Second, the distribution system in Romania is underdeveloped as very few professional distributors are in operation. Foreign retails find it difficult to find distributors with the required skills and capital base (EIU 2004, 2006). Third, one of the global retailers confirmed that the company does not use a centralized procurement system in Romania and that each outlet independently sources goods for sale. This suggests that individual stores are more likely to source locally than nationally.

The underdevelopment of the transportation infrastructure and the distribution sector would limit retailers' ability to source products across regions. The potential spillover from global retail chains to the supplying sectors would, therefore, be constrained by regional boundaries. As we recognize that regional characteristics may affect the entry decision of global retail chains, we will also use instrumental variable approach in our analysis.

Our second identifying assumption is that entry of a global retail chain into the region should affect some manufacturing sectors but not others. More specifically, we believe that sectors supplying consumer products to supermarkets, as opposed to sectors supplying industrial inputs, should be affected. As food products are the most popular goods sold in all formats of supermarkets, we narrowly define supplying sectors as food manufacturing industries and focus on the impact of global retail chains' expansion on these sectors. We identify food supplying sectors based on products listed on the web pages of retailers operating in Romania and match them with 3-digit industry codes in the NACE classification. For details on the food supplying industry classification see Table 2.7.

For the regional analysis to be meaningful, we would like to make sure that the affected sectors are represented in all regions of the country. This is indeed the case. All sectors are spread across all eight NUTS regions. In particular, manufacturing of fruit and vegetable products is represented in 37 counties in 1998 and 40 counties in 2004; manufacturing of diary products existed in 41 counties; and the remaining four sectors are spread across all 42 counties.

2.6.2 Descriptive Analysis

As the first step in our analysis, we consider some descriptive statistics. We estimate the distributions of the logarithm of total factor productivity for firms operating before and after the entry of global retail chains. We do so separately for food supplying sectors and for the remaining industries. These distributions are plotted in Figure 2.2. We note that the distribution of productivity shifts to the right in the post-entry period in the case of food supplying sectors. The pattern for non-food supplying sectors is less clear.

The difference becomes more significant at the regional level. We calculate the average level of the logarithm of total factor productivity for firms operating in a given region in a given time period. For both food supplying and non-food supplying sectors, we compare the distribution in the period before and after the entry of global retail chains. As shown in Figure 2.3, there is a clear shift of the distribution of productivity to the right in the post-entry period in the case of food supplying sectors. The pattern for non-food supplying sectors is not clear. While we cannot say anything about the direction of causality, these charts hint at a positive relationship between the productivity of the supplying industries and the presence of global retail chains.

As the pattern observed in Figure 2.2 and Figure 2.3 could be capturing effects of macroeconomic shocks or regional trends, we proceed to examine the relationship between the expansion of global retail chains and the total factor productivity in the food supplying industries using a regression analysis.

2.6.3 Empirical Strategy

In our empirical analysis, we use a difference-in-differences approach and compare the TFP in the supplying industries before and after the entry of foreign chains into their region with the TFP of non-supplying industries in the same region during the same period. As explained above, we narrowly define the supplying industries as sectors manufacturing food products.

To take advantage of regional variation in their entry, we use three ways to quantify the presence of global chains. Our first measure is a dummy taking on the value of 1 if at least one global retail chain is present in the region *r* at time *t*, and zero otherwise. As our second measure, we use the number of global retail chain outlets in the region *r* at time *t* in logarithmic form, adding one before taking a log. The third measure is the logarithm of the chains' total selling space in the region at time *t*.

We then conduct our analysis based on the following specification:

$$\ln TFP_{it} = \gamma_0 + \gamma_1 \cdot FOOD_s \times global\_chain_{r,t-1} + \gamma_2 \cdot \ln age_{it} + V_{s,t-1} \cdot \Gamma + \gamma_{rt} + v_i + \mu_{it} \quad \textbf{(2.2)}$$

where $\ln TFP_{it}$ denotes the logarithm of manufacturer *i*'s total factor productivity at time *t*. We calculate two sets of measures on TFP. The first one is a multilateral index measure following Aw, Chen and Roberts (2001). We first express individual firm's outputs and inputs (capital, labor and materials) as deviations from a hypothetical reference firm operating in the same sector at time *t* with average input costs shares, average logarithm of inputs and average logarithm of outputs and then chain-link all reference firms together over time within a sector. These productivity indexes are an extension to the multilateral TFP index derived by Caves et al. (1982) and they allow for consistent comparison of TFP of firm data with panel structure (see Appendix 1 for a detailed formula).

Our second method of obtaining TFP is the semi-parametric approach suggested by Levinsohn and Petrin (2003), which allows us to take into account the possibility that a firm's private knowledge of its productivity (unobserved by the econometrician) may affect the input decisions. This method allows for firm specific productivity differences that exhibit idiosyncratic changes over time and thus addresses the simultaneity bias between productivity shocks and input choices. Since our study relies on correctly measuring firm productivity, obtaining consistent estimates of the production function coefficients is crucial to our analysis. As suggested by Levinsohn and Petrin (2003), the estimation procedure relates value added to capital and labor inputs and employs the information on material usage to proxy for unobservable productivity shocks. The estimated production function coefficients are reported in Appendix 2.

The explanatory variable of interest is the interactive term between the dummy for food supplying industries, denoted as $FOOD_s$, and a measure of regional presence of global retail chains, denoted as $global\_chain_{r,\,t-1}$. We lag the measures by one period to take into account the time lag needed for the effect to manifest itself and to attenuate potential endogeneity problems. We also control for other factors that may affect the performance of manufacturing firms. We use the number of years since establishment of a manufacturer to control for learning-by-doing effects. The variable is denoted as age_t and enters in a logarithmic form. We control for the effects of trade liberalization by including sector imports and exports. Both variables are lagged one period and take the logarithmic form. The level of competition in the industry is another potential factor influencing firm productivity and we use the Herfindahl index to take it into account. Summary statistics for all variables are listed in Table 2.8.

To take into account the uneven economic development across Romanian regions, we control for time-varying regional factors by including a set of region-year fixed effects. We also include firm fixed effects to take into account unobservable firm characteristics, such as managerial ability. These fixed effects will also allow us control for time-invariant sector characteristics, for instance, level of the sector development in the pre-transition period and extent of privatization during the early reform period.

Finally, we correct the standard errors to take into account the fact that the measures of global retail chains' presence are at the region-year level while the dependent variable is at the firm-year level. Failure to correct for such data structure may lead to a downward bias in the estimated errors. We perform the correction by clustering standard errors at the region-year level in all regressions.

2.6.4 Baseline Results

We report the baseline results in Table 2.9 and Table 2.10, with the multilateral TFP index and the TFP measure estimated following Levisohn and Petrin (20003) as the dependent variables, respectively. We present the estimates from the three measures on global chain presence separately, and report results from specifications without time-variant sector variables together with the full model. We find that the expansion of global retail chain leads to a significant increase in the total factor productivity of the food supplying sectors. This effect is statistically significant at the 1 percent level across all specifications using different measures of foreign chain presence. Note that we do not need to include the variable $global\_chain_{r,\, t-1}$ by itself in the model as productivity changes coinciding with the chain's entry and affecting all manufacturing sectors equally will captured by region-year fixed effects.

In terms of multilateral TFP index, according to results from column 1 and 2 of Table 2.9, on average, the presence of foreign chains increases TFP of firms in food supplying sectors by 3.8-4.7 percent. Results from column 3 and 4 indicate that doubling the number of chains will lead to a 3.3-3.7 percent increase in firm productivity among food suppliers. The average regional growth rate of the number of foreign chains' outlets is 50%. If we take this as a benchmark, TFP of food suppliers increases by 1.6-1.8 percent per year for a region where foreign chains expand at the average speed. Finally, the results from column 5 and 6 suggest that doubling the selling space increases TFP of food supplying sectors by 0.4-0.5 percent.

In terms of the TFP calculated following Levisohn and Petrin (20003), the sign pattern of the results are similar to those using TFP index but the magnitudes of the coefficients are larger. In particular, the results imply that the presence of foreign chains leads to a 15.2-16.9 percent increase in the TFP of firms in food supplying sectors, that a doubling in the number of chains will increase productivity among food suppliers by 10.8-11.3 percent and a doubling in the selling space will increases their TFP by 1.7-1.8 percent. As the number of foreign chains' outlets rise by 50% on average in a region, TFP of food suppliers will increases by 5.4-5.7 percent per year for a typical region.

These productivity effects are comparable in magnitude to those found by studies examining spillover effects from FDI. For instance, in terms of intra-industry impact of FDI, Haskel et al. (2007) report that in the UK doubling the share of foreign employment in an industry increases firm TFP in the same industry by about 5 percent. As for inter-industry effects, Javorcik (2004) finds that in Lithuania doubling the foreign presence in downstream sectors is associated with a 3.8 percent rise in the TFP of domestic firms in the supplying industry.

As for the control variables, the coefficient on firm age is positive and significant across all specifications, which is consistent with learning-by-doing effects. The Herfindahl index is found to have a negative and significant coefficient. It suggests that higher concentration is correlated with lower productivity, which is in line with the belief that more competition encourages better performance. Imports are negatively correlated with firm productivity and exports do not appear to matter at all. The results on imports differ from the conclusions of Pavcnik (2002) for Chile and Fernandes (2007) for Colombia, but are in line with the findings of Arnold et al. (2006) for the Czech Republic.

2.6.5 Robustness Checks

We subject our results to several robustness checks. Our analysis is conducted for both measures of TFP and yields conclusions highly consistent with each other. In what follows, to save space we only report the results from using TFP estimated following Levinsohn and Petrin (2003) as it captures technological changes and scale effects on TFP as well and is regarded a superior to the multilateral TFP index.

First, we consider possible outlier issues. Bucharest as the capital of Romania has disproportionate concentration of economic activity and wealth. It produces about 20% of the country's GDP while only accounting for 10% of total population.[11] To check whether our results are affected by the special case of Bucharest, we exclude observations from Bucharest and perform the benchmark analysis. As evident from Table 2.11, all coefficients on the presence of global chains remain positive and significant at the 1 percent level and have the same magnitudes. It indicates that our results are not driven by the observations from Bucharest.

Second, we estimate our model in first, second and long differences, instead of levels with firm fixed effects. As pointed out by Katayama, Lu, and Tybout (2006), there are several difficulties involved in using TFP to capture productivity improvements. Substitution of the data on sales revenues, depreciated capital spending and real input expenditure for information on the physical quantities of output, capital and intermediate inputs may lead to confounding higher productivity with higher markups. In our case, this is less of a concern as global retail chains are likely to press suppliers to lower their markups. Therefore, if our TFP measure is subject to the above problem, it will work against us finding a positive relationship between expansion of global chains and TFP of food supplying sectors. Nevertheless, as Katayama et al. (2006) argue that the problems with using TFP are reduced in difference specifications, we check whether our results are robust to doing so.

In the first and second difference specification, we drop firm age but we still include region-year fixed effects and cluster standard errors at the region-year level. We present the results in Table 2.12 and Table 2.13 respectively. The interactive term between *FOOD* and each of the three measures of the regional presence of global chains remains positive and statistically significant. The magnitude of the impact is smaller when using the dummy on presence of foreign chains. When using the number of outlets and selling space to proxy for foreign chains' regional presence the magnitudes are similar to the baseline results. As for other variables, the Herfindahl index still exhibits a negative correlation with TFP. Imports appear to have positive impact or no impact, which indicates the baseline results on imports are not robust. Exports, however, appear to be negatively

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[11] Calculated according to Eurostat REGIO database.

correlated with TFP. In summary, our main conclusions remain robust.

We also conduct a simple cross-sectional regression on the overall changes in TFP during the period of 1997 to 2005. The measures on regional presence of supermarket and trade variables are lagged by one period covering 1996 to 2004. Correspondingly, we only include region fixed effects and cluster the standard errors at the regional level. The results are presented in Table 2.14. The overall changes in TFP of the food supplying sectors during the period are shown to be positively correlated with changes in the regional presence of global chains.

Furthermore, we want to examine whether our results are not subject to autocorrelation problem when using dummy on the presence of foreign chains. Bertrand et al. (2004) show that estimations with a difference-in-difference method using panel data are likely to be subject to serial correlation problems and the standard errors could be severely underestimated. To check for this potential estimation bias, we take their advice and ignore the time-series information when computing standard errors. We perform the test in three steps. First, we regress the logarithm of TFP on control variables (other than the variable of interest) and fixed effects and keep the residuals for food supplying sectors. Second, we divide the residuals into two groups: residuals from the years before foreign chains' entry and residuals from post-entry period and calculate a within firm average for each period. Finally, we regress the two-period panel of mean residuals on the dummy denoting the presence of global retail chains. In the second stage regression, we examine both contemporaneous value and one-period-lagged value of the dummy. As evident from Table 2.15, the dummy remains positive and significant at the 1 percent level though the magnitude becomes smaller. We, therefore, feel reasonably confident that our baseline results are not subject to the autocorrelation problem.

2.6.6 Potential Endogeneity Problem

To address potential endogeneity problem, we check whether there is evidence of an impact *before* the actual entry of global chains takes place in the region. As regional economic conditions vary across regions, global retail chains may choose to operate in regions where food supplying sectors are highly productive in the first place. If such reverse causality exists, food suppliers in regions that attract global chains should exhibit higher TFP before the entry of global chains. To capture firm performance in the pre-entry period, we define a new variable which takes the value of one in the year *prior* to the entry of global chains into the region, and zero otherwise. We include an interactive term between *FOOD* and this new dummy in our estimation. We report the results in Table 2.16. The new interactive term does not appear to matter while the interactive term between FOOD and global chain presence remains positive and statistically significant. We conduct t-tests and find that the coefficients on these two variables are significantly different from each other. These findings suggest that global retail chains are not attracted to regions with more productive food producers and thus give us confidence that reverse causality is unlikely to be a serious problem in our analysis.

We also employ an instrumental variable approach to take care of potential reverse causality and omitted variable bias. We instrument for the interaction between *FOOD* and global chain presence by taking into account the following factors. First, the expansion of global retail chains in Romania may be part of their business strategy for the whole Central and Eastern Europe (CEE). For instance, Dries et al. (2004) find that global retail chains tend to adopt “anchor” strategy in CEE by establishing their business first in relatively advanced countries, including the Czech Republic, Hungary and Poland, which they classified as “first wave countries”, and then moving into nearby economies. Alternatively, these chains may face capacity limits when considering expanding into the CEE and thus may choose to enter only a subset of countries. Finally, the initial development in supplying industries may affect foreign retailers’ entry decision into specific region. Based on all these factors, we use the following two instruments:

$$sale\_share_{sr} * \ln(global\_chain\_1stWave)_{t-1}$$
$$sale\_share_{sr} * \ln(global\_chain\_2ndWave)_{t-1}$$

The first part of each instrument, $sale\_share_{sr}$, denotes the sector share in the total regional manufacturing sales in 1996, which is prior to the first year of our sample. It captures the initial condition (importance) of the sectors. The second part of each instrument captures annual sales by global retail chains which also operate in Romania in two groups of CEE countries (first wave countries as defined in Dries (2004) and the rest).[12] *global_chain_1stWave* represents total sales in first wave countries by chains having outlets in Romania and *global_chain_2ndWave* represents total sales in second wave countries by those chains. The figures enter in logarithmic form and are lagged by one period. The interaction of these two components creates sector-region-year specific instrumental variables which are consistent with the dimensions of our potentially endogenous variables.

The results from the instrumental variable approach, presented in Table 2.17, are consistent with our baseline results. They suggest that the regional expansion of global retail chains leads to a significant increase in the TFP of the supplying industries. The interactive term between *FOOD* and presence of global chains remains positive and statistically significant across all models. The magnitude is somewhat smaller relative to the baseline results. The Shea's partial R^2 reveals that our instruments are reasonable predictors of the potentially endogenous variable. Almost all instruments bear statistically significant coefficients. The Sargan test does not cast doubt on the validity of the instruments.

2.6.7 Regional Demand as an Alternative Explanation

The demand for consumer products in Romania is likely to increase following a rise in its income level. Being a transition economy, basic necessities, including food products, still dominate consumer consumption in the country. As reported in EIU (2002- 2006), Romania is still one of the poorest countries in Europe. GDP per head at purchasing power parity is estimated to be US$9610 in 2006, just over half of the level in Hungary. Consumption patterns typify those of a developing country of low to medium income. Most monthly earnings are consumed, and most of this spending goes to foodstuffs and housing maintenance. According to the data provided in the report, food retail sales accounted for over 58 percent and over 55 percent of total retail sales in 2001 and in 2005, respectively. Therefore, the demand for food products is likely to be more sensitive to income rise and increase faster than the demand for other manufacturing products. It could be the case that the increase in regional income stimulated regional demand for food sectors more than that for other industries, and that higher demand encouraged food production and attracted global supermarket entering the region at the same time.

To examine our results against this alternative explanation, we compute the average

[12] Sales by retailers in Romania are excluded.

real wage in the region as a measure of the regional income level. We add the interactive term between *FOOD* and logarithm of the average wage to our model and conduct our analysis with firm fixed effects, first differences and long differences. The results are reported in Table 2.18, Table 2.19 and Table 2.20[13], respectively. The interactive term between *FOOD* and wage rate is positively correlated with productivity in fixed-effect models but not in the first differenced model. This implies that the regional income level does affect firm productivity in food supplying sectors differently from non-food sectors. However, in terms of growth in firm productivity, the relationship between regional income level and productivity does not exhibit systematic differences across food and non-food sectors. Our variable of interest, the interactive term between *FOOD* and global chain presence, remains positive and statistically significant in all of the specifications. It implies that despite the impact of regional income changes, our main results still hold and suggest that the regional expansion of global retail chains facilitates productivity growth of food supplying sectors located in the same region.

We also repeat our instrumental variable estimates after including the control for the regional income level. We report the estimation results in Table 2.21. The F-tests and Shea's partial R2 show that the instruments are correlated with the potentially endogenous variable. However, the augmented models pass the Sargan test only in two of six specifications. In terms of estimates, the interactive term between FOOD and the measures of global chains' presence remains positive and significant at conventional levels. The coefficients on the interactive term between FOOD and regional average wage rate are similar to those produced by the fixed-effect estimation.

[13] As the wage data are only available only since 1997 and the explanatory variables are lagged by one period, these regressions are based on the period 1998 to 2005, which explains a smaller number of observations.

2.6.8 Extensions

As an extension we conduct the baseline analysis separately for manufacturing firms of different sizes. The results are reported in Table 2.22. We find that the positive correlation between global chains' presence and the TFP of firms in the food supplying industries is verified across firm sizes, as the interactive term remains positive and significant at the 1 percent level. The estimated coefficient becomes smaller as the size of firms considered falls. This finding implies that the presence of global chains benefits large food suppliers the most and has a smaller impact on smaller firms. For suppliers with more than 25 employees, presence of foreign chains on average can lead to 19 percent increase in their TFP while for firms employing fewer than 5 people the chains' presence would only lead to 12 percent increase in their TFP. Similarly, a doubling in chain stores will lead to a 14.2 percent increase in TFP among suppliers with more than 25 employees but only an 8.5 percent increase among firms with fewer than 5 people. In our data, half of the firms are smaller than 5 employees and only less than a quarter of firms have more than 25 workers.

These results are intuitive in that as large retail chains tend to source large volumes they are more likely to work with larger suppliers. Thus it is not surprising that larger manufacturers are the major suppliers to global chains and hence, benefit most from their expansion. Small firms produce less for foreign chains, because they do not have the technology and financial support to meet the quality or quantity requirements set by the chains. Note, however, that it may be in the interest of retail chains to keep some small suppliers as a way of increasing price pressure on the larger producers (see the example of Wal-Mart in Mexico in Javorcik et al. 2006).

2.7 Conclusions

This study uses Romanian firm-level data to examine the link between the entry of global retail chains and developments in the supplying sectors. The econometric results lead us to the following conclusions. First, the expansion of global retail chains leads to a significant increase in the total factor productivity in the supplying industries. For instance, their presence in a region increases TFP of firms in the supplying industries by 15.2 percent and doubling the number of chains will lead to a 10.8 percent increase in TFP. However, their presence benefits larger firms the most and has a smaller impact on small enterprises. This conclusion is robust to several extensions and specifications, including the instrumental variable approach.

The results indicate that opening of the retail sector to FDI may stimulate faster productivity growth in upstream manufacturing in the context of transition and developing economies. They also extend our understanding of FDI in service sectors and the implications of services liberalization.

2.8 Appendix 1 Calculation of TFP index

Following Aw, Chen and Roberts (2001), we calculate the index according to

$$\ln TFP_{it} = (\ln Y_{it} - \overline{\ln Y_t}) + \sum_{\tau=2}^{t} (\overline{\ln Y_\tau} - \overline{\ln Y_{\tau-1}})$$
$$-[\sum_{j=1}^{m} \frac{1}{2}(S_{jit} + \overline{S}_{jt})(\ln X_{jit} - \overline{\ln X_{jt}}) + \sum_{\tau=2}^{t}\sum_{j=1}^{m} \frac{1}{2}(\overline{S_{j\tau}} + \overline{S_{j\tau-1}})(\overline{\ln X_{j\tau}} - \overline{\ln X_{j\tau-1}})]$$

i denotes firm, ***t*** denotes year, ***j*** denotes types of inputs. ***Y*** denotes output, which is measured in real terms. Inputs (***X***) include labor (number of employees), materials (real value of material costs), and capital stock. ***S*** denotes input shares, that is, the ratio of wage bill (or material costs) to output. The capital share is obtained from the assumption of constant returns to scale. This index is an extension of the multilateral TFP index derived by Caves et al. (1982). It allows for consistent comparison of TFP in plant-level data with a panel structure. To guarantee that comparisons between any two plant-year observations are transitive, the index expresses each individual plant's output and inputs (capital, labor, and materials) as deviations from a single reference point. As the reference point, the index uses a hypothetical plant operating in the base time period and having average input costs shares, average logarithm of inputs and average logarithm of output. The index is calculated separately for each of the 3-digit NACE manufacturing sectors.

2.9 Appendix 2 Production Function Coefficients (Levinsohn-Petrin Estimation*)

NACE code	Sector	Capital	Labor	CRS** test (Wald test)	CRS test (p value)
15	Manufacture of food products and beverages	0.282	0.448	388.213	0.000
17	Manufacture of textiles	0.377	0.672	12.963	0.000
18	Manufacture of wearing apparel; dressing and dyeing of fur	0.353	0.717	65.049	0.000
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0.272	0.728	0.000	0.998
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.378	0.459	57.258	0.000
21	Manufacture of pulp, paper and paper products	0.349	0.430	18.426	0.000
22	Publishing, printing and reproduction of recorded media	0.334	0.671	0.046	0.830
24	Manufacture of chemicals and chemical products	0.294	0.404	89.680	0.000
25	Manufacture of rubber and plastic products	0.365	0.531	10.919	0.001
26	Manufacture of other non-metallic mineral products	0.269	0.506	61.844	0.000
27	Manufacture of basic metals	0.405	0.444	4.689	0.030
28	Manufacture of fabricated metal products, except machinery and equipment	0.354	0.636	0.276	0.599
29	Manufacture of machinery and equipment n.e.c.	0.298	0.549	21.190	0.000
30	Manufacture of office machinery and computers	0.224	0.656	6.297	0.012
31	Manufacture of electrical machinery and apparatus n.e.c.	0.334	0.557	8.765	0.003
32	Manufacture of radio, television and communication equipment and apparatus	0.437	0.488	0.812	0.367
33	Manufacture of medical, precision and optical instruments, watches and clocks	0.297	0.448	45.319	0.000
34	Manufacture of motor vehicles, trailers and semi-trailers	0.329	0.489	6.780	0.009
35	Manufacture of other transport equipment	0.323	0.582	2.126	0.145
36	Manufacture of furniture; manufacturing n.e.c.	0.291	0.497	191.696	0.000

*Value added as dependent variable

**Test on constant return to scale

2.10 Figures of Chapter 2

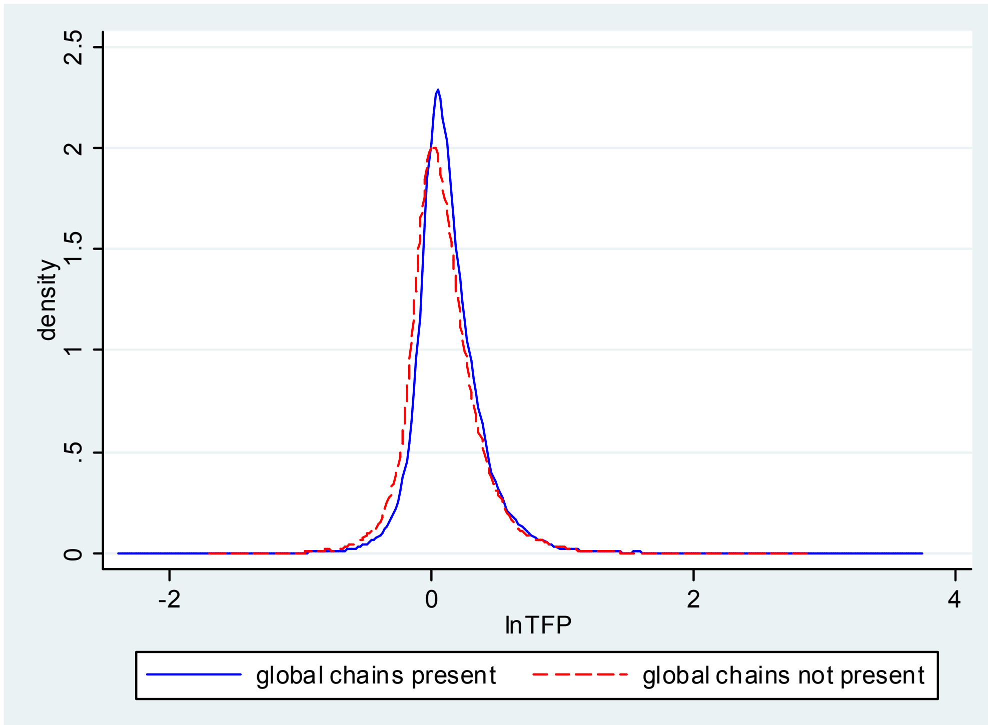
Figure 2.1 Regional Distribution of Global Retail Chains in Romania

1997

2005

Figure 2.2 Logarithm of Total Factor Productivity of Manufacturing Firms
Pre- vs. Post-entry of Global Chains, Firm-Level Data

Food Supplying Sectors



Non-Food Supplying Sectors

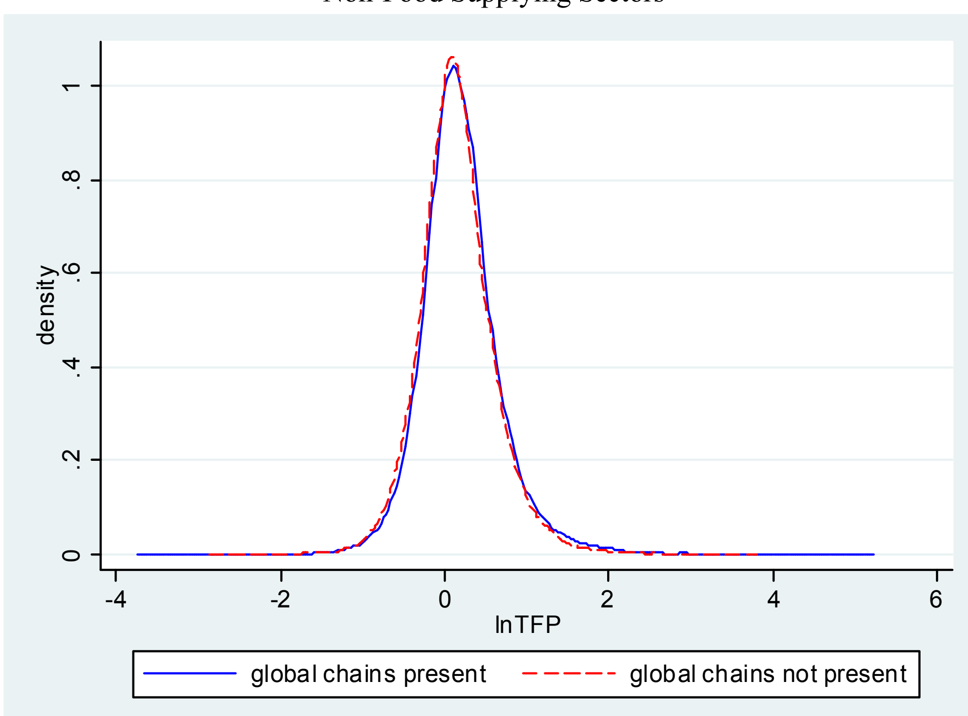
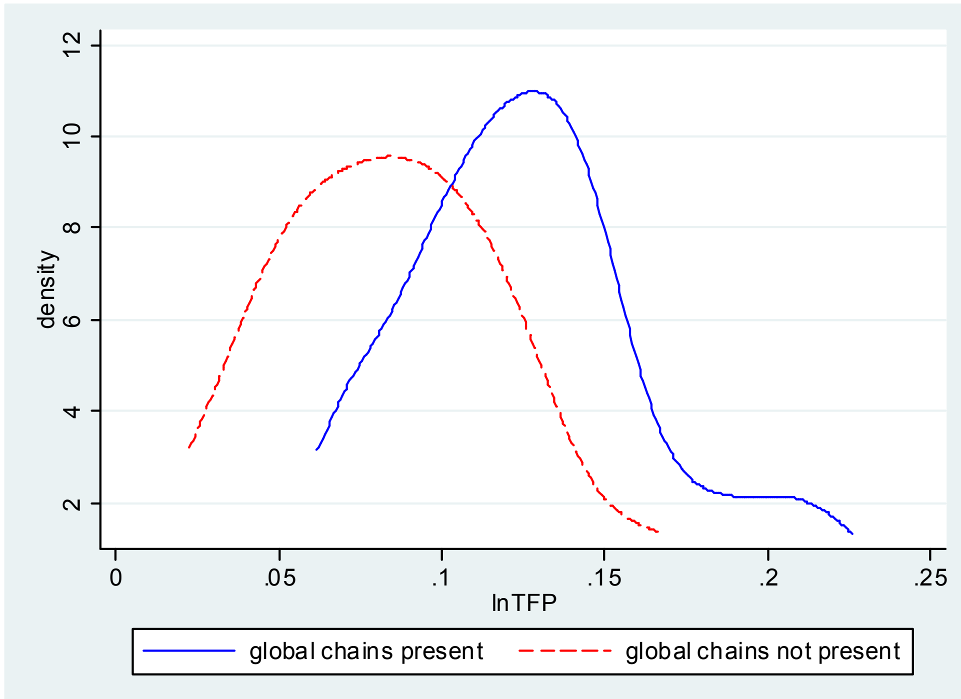
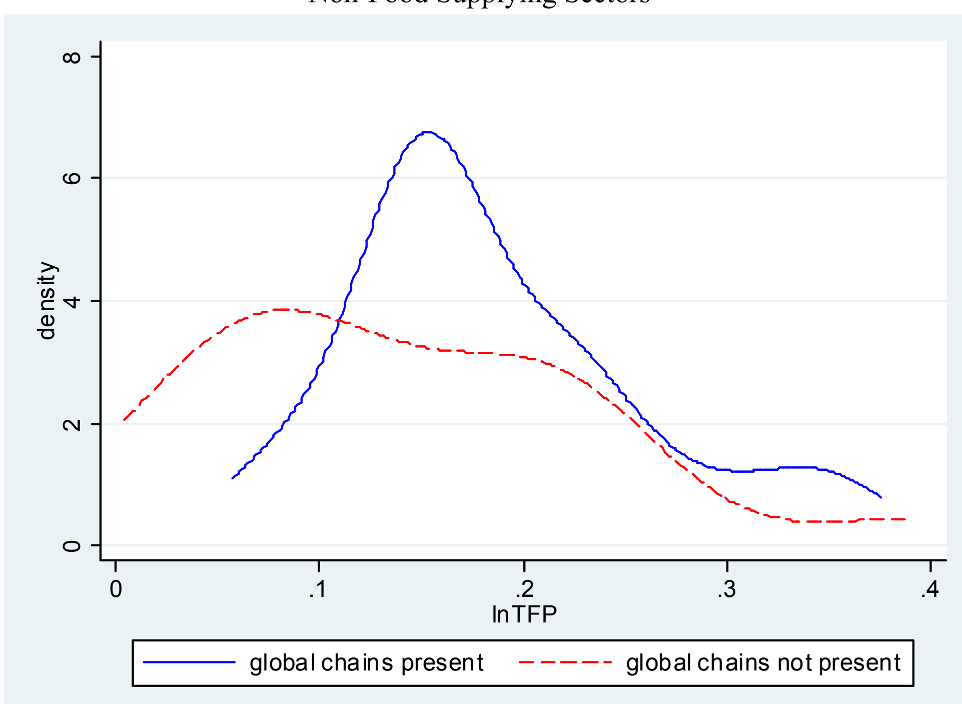


Figure 2.3 Logarithm of Total Factor Productivity of Manufacturing Firms
Pre- vs. Post-entry of Global Chains, Regional Average

Food Supplying Sectors



Non-Food Supplying Sectors



2.11 Tables of Chapter 2

Table 2.1 Information on Global Retail Chains in Romania

Romanian subsidiary	parent company	country of origin	year of entry	employment (2005)	capital stock** (2005)	Sales** (2005)
METRO CASH & CARRY ROMANIA SRL	Metro	Germany	1997	6197	257,056,112	1,544,382,464
SELGROS CASH & CARRY SRL	Rewe	Germany	2001	3933	172,403,312	533,114,112
HIPROMA SA	Carrefour	France	2001	2695	176,409,360	462,004,000
ROMANIA HYPERMARCHE SA	Louis Delhaize	Belgium	2003	1765	14,404,080	205,895,488
BILLA ROMANIA SRL	Rewe	Germany	1999	1613	34,777,012	291,993,056
REWE (ROMANIA) SRL	Rewe	Germany	2001	877	8,246,348	108,265,656
MEGA IMAGE SA*	Delhaize	Belgium	2000	947	14,332,003	63,057,788
PROFI ROM FOOD SRL	Louis Delhaize	Belgium	2000	401	10,242,294	44,535,040
KAUFLAND ROMANIA SCS*	Kaufland	Germany	2005	500	149,145,056	18,232,512

*outlet-specific information is not available
** figures in current US dollars

Table 2.2 Development of Global Retail Chains in Romania

year	number of global chains	employment	sales**	share in total sales of retail sector	share in total sales of retail and wholesale sectors
1997	1	864	125,551,016	3.20%	1.30%
1998	1	1,431	197,606,416	4.60%	1.70%
1999	2	1,455	206,881,506	5.50%	1.80%
2000	4	2,961	306,333,780	7.40%	2.30%
2001	7	5,169	584,568,802	11.60%	3.60%
2002	7	8,239	958,822,398	15.10%	4.60%
2003	8	11,167	1,574,238,984	17.70%	5.40%
2004	8	14,243	2,631,599,836	20.20%	6.10%
2005	9	18,928	3,271,480,116	22.20%	6.90%

** figures in current US dollars

Table 2.3 Development of Global Retail Chains in Romania

year	number of outlets	selling space (m^2)
1997	1	13,000
1998	3	39,000
1999	5	43,000
2000	13	90,686
2001	27	174,024
2002	42	254,317
2003	55	318,013
2004	68	390,220
2005	86	463,996

This table pertains to 7 retail chains for which detailed information is available

Table 2.4 Regional Expansion of Global Retail Chains in Romania

region	year of first entry	number of outlets 2001	2003	2005
Bucharest-Ilfov	1997	7	13	16
West	1998	8	10	19
Central	1998	3	7	13
Southeast	1999	2	5	10
South	2000	1	4	7
Northwest	2000	2	10	14
Northeast	2001	2	4	4
Southwest	2001	2	2	3

region	year of first entry	selling space (m^2) 2001	2003	2005
Bucharest-Ilfov	1997	43,400	96,900	115,900
West	1998	22,266	24,064	62,495
Central	1998	23,958	50,559	69,560
Southeast	1999	15,000	30,500	58,500
South	2000	2,000	23,500	33,286
Northwest	2000	26,000	41,090	62,855
Northeast	2001	26,000	36,000	36,000
Southwest	2001	15,400	15,400	25,400

*This table pertains to 7 retail chains for which detailed information is available

Table 2.5 Summary Statistics of Retailers

Global Retail Chains (9 companies)

Variable	Obs	Mean	Std. Dev.	Min	Max
L	47	1371.43	1469.92	36	6197
K (th lei 2000)	47	84409.71	100424.8	1659.4	328590.3
K/L(th lei 2000)	47	71.82	93.99	9.48	540.04
sales(th lei 2000)	47	313292.4	442300.3	2626	1771543
market share	47	11.78	16.13	0.17	49.59
sales/L (th lei 2000)	47	191.66	116.31	41.83	715.33
wage/L (th lei 2000)	47	8.45	7.23	2.66	53.41
value added/L (th lei 2000)*	47	21.2	15.29	0	90.57
*ROA***	47	-0.01	0.09	-0.22	0.14
*ROS****	47	-0.05	0.19	-1.1	0.05
firm age	47	3.55	2.05	1	9

Other Retailers or Wholesale Traders (Employment >= 50) (923 companies)

Variable	Obs	Mean	Std. Dev.	Min	Max
L	6587	133.28	263.97	1	6163
K (th lei 2000)	3293	258.5	452.7	0.3	13337
K/L(th lei 2000)	3293	5.74	12.96	0	291.92
sales(th lei 2000)	2822	2028.77	2500.4	0.39	54824
market share	2822	0.11	0.14	0	3.51
sales/L (th lei 2000)	2822	47.66	91.19	0	2410.46
wage/L (th lei 2000)	2136	3.16	4.1	0	105.3
value added/L(th lei 2000)*	2732	8.13	17.59	0	511.54
*ROA***	1913	0.05	0.16	-3.01	1.88
*ROS****	1875	0.02	0.17	-5	2.9
firm age	6587	8.69	3.52	1	16

*value added/L = (sales – material costs)/employment

**ROA: return on assets = profits/assets

***ROS: return on sales = profits/sales

Table 2.6 Results on Retailer Performance

	ln(L)	*ln(K)*	*ln(K/L)*	*ln(sales)*	*market share*
global_chain	2.428***	4.639***	3.211***	3.556***	12.555*
	(0.314)	(0.466)	(0.354)	(0.385)	(6.889)
No. of obs.	6634	2651	2651	2282	2282

	ln(sales/L)	*ln(wage/L)*	*ln(value added)/L)*	*ROA*	*ROS*
global_chain	2.803***	1.182***	1.855***	-0.014	-0.006
	(0.324)	(0.149)	(0.282)	(0.049)	(0.018)
No. of obs.	2282	1585	2312	1564	1525

value added/L = (sales – material costs)/L

ROA: return to assets = profits/assets

ROS: return to sales = profits/sales
All models include logarithmic of firm age and lagged value of employment, regional fixed effects and year fixed effects.

Robust standard errors

* significant at 10%, ** at 5%, *** at 1%

Table 2.7 Food Supplying Sectors

NACE	**industry description**
151	Production, processing and preserving of meat and meat products
153	Processing and preserving of fruit and vegetables
155	Manufacture of dairy products
156	Manufacture of grain mill products, starches and starch products
158	Manufacture of other food products
159	Manufacture of beverages

Table 2.8 Summary Statistics of Manufacturing Firms

Firm-specific

Variable	Obs	Mean	Std. Dev.	Min	Max
FOOD					
TFPindex*	49611	0.12	0.28	-2.39	3.74
TFP**	57684	1.49	1.07	-7.16	7.09
output (th lei 2000)	57684	1048.98	7423.96	0.00	410024.10
wage costs (th lei 2000)	56675	85.78	607.40	0.00	49457.04
material costs (th lei 2000)	57684	744.26	5114.54	0.00	361034.50
capital stock (th lei 2000)	57684	355.97	3544.39	0.00	257176.30
employment	57684	23.44	156.12	1.00	30204.00
firm age	57684	7.66	3.43	1.00	15.00
Non-FOOD					
TFPindex*	171625	0.19	0.49	-3.74	5.22
TFP**	191708	1.51	1.10	-16.50	6.87
output (th lei 2000)	191708	1536.68	20379.34	0.00	2917021.00
wage costs (th lei 2000)	187901	268.92	2448.16	0.00	351674.60
material costs (th lei 2000)	191708	901.43	13846.16	0.00	1917256.00
capital stock (th lei 2000)	191708	696.57	13502.77	0.00	2246537.00
employment	191708	57.02	343.78	1.00	36575.00
firm age	191708	7.29	3.61	1.00	16.00

NACE sector-specific

Variable	Obs	Mean	Std. Dev.	Min	Max
FOOD					
imports (th lei 2000)	48	168905.50	174682.00	22423.92	644413.90
exports (th lei 2000)	48	48694.17	58350.96	1496.87	312933.10
Herfindahl Index	48	0.032	0.018	0.009	0.076
Non-FOOD					
imports (th lei 2000)	705	602026.40	952913.20	2712.52	8217282.00
exports (th lei 2000)	705	552159.30	1458871.00	619.63	12900000.00
Herfindahl Index	705	0.160	0.174	0.004	1.000

NUTS region-specific

Variable	Obs	Mean	Std. Dev.	Min	Max
wage/L *(th lei 2000)*	64	4.544	0.926	1.882	7.282

*TFP index calculated following Aw, Chen and Roberts (2001)

**TFP calculated following Levinsohn and Petrin (2003)

Table 2.9 Fixed-effect, ln(TFP) of Manufacturing Firms, TFP index

	chains present		**ln(number of outlets)**		**ln(selling space)**	
Food $_{s}$****(global_chain)*** $_{r,t-1}$	0.047***	0.038***	0.037***	0.033***	0.005***	0.004***
	-0.01	-0.01	(0.005)	(0.005)	(0.001)	(0.001)
ln(firm age) $_{it}$	0.118***	0.117***	0.119***	0.118***	0.118***	0.117***
	(0.008)	-0.008	(0.008)	(0.008)	(0.008)	(0.008)
ln(imports) $_{s,t-1}$		-0.029***		-0.020***		-0.027***
		(0.005)		(0.005)		(0.005)
ln(exports) $_{s,t-1}$		-0.004		-0.004		-0.004
		(0.004)		(0.004)		(0.004)
Herfindahl Index $_{st}$		-0.190***		-0.210***		-0.196***
		(0.040)		(0.039)		(0.040)
R-squared	0.019	0.02	0.02	0.021	0.019	0.02
No. of obs.	221236	220002	221236	220002	221236	220002
No. of groups	49552	49390	49552	49390	49552	49390

All models include firm fixed effects and region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Table 2.10 Fixed-effect, ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

	chains present		ln(number of outlets)		ln(selling space)	
Food $_{s}$*(global_chain) $_{r,t-1}$	0.169***	0.152***	0.113***	0.108***	0.018***	0.017***
	(0.031)	(0.029)	(0.015)	(0.014)	(0.003)	(0.003)
ln(firm age) $_{it}$	0.318***	0.321***	0.323***	0.325***	0.319***	0.321***
	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)
ln(imports) $_{s,t-1}$		-0.059***		-0.036**		-0.052***
		(0.017)		(0.016)		(0.017)
ln(exports) $_{s,t-1}$		-0.037***		-0.038***		-0.037***
		(0.012)		(0.012)		(0.012)
Herfindahl Index $_{st}$		-0.366***		-0.406***		-0.386***
		(0.088)		(0.088)		(0.087)
R-squared	0.03	0.031	0.031	0.032	0.03	0.032
No. of obs.	219397	219397	219397	219397	219397	219397
No. of groups	49333	49333	49333	49333	49333	49333

All models include firm fixed effects and region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Table 2.11 Excluding Bucharest, Fixed-effect
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

	chains present		**ln(number of outlets)**		**ln(selling space)**	
	1	2	3	4	5	6
FOOD$_s$*(global_chain) $_{r,t-1}$	0.158***	0.140***	0.112***	0.108***	0.017***	0.016***
	(0.032)	(0.029)	(0.017)	(0.015)	(0.003)	(0.003)
ln(firm age) $_{it}$	0.307***	0.310***	0.313***	0.314***	0.308***	0.310***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
ln(imports) $_{s,t-1}$		-0.061***		-0.036**		-0.054***
		(0.019)		(0.017)		(0.018)
ln(exports) $_{s,t-1}$		-0.049***		-0.050***		-0.049***
		(0.012)		(0.012)		(0.012)
Herfindahl Index $_{st}$		-0.321***		-0.370***		-0.342***
		(0.100)		(0.102)		(0.100)
R-squared	0.029	0.031	0.031	0.033	0.03	0.032
No. of obs.	185335	185335	185335	185335	185335	185335
No. of groups	41236	41236	41236	41236	41236	41236

All models include firm fixed effects and region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Table 2.12 First Differences
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

	chains present		ln(number of stores)		ln(selling space)	
	1	2	3	4	5	6
FOOD$_s$*Δ(global_chain)$_{r,t-1}$	0.124***	0.122***	0.149***	0.163***	0.016***	0.016***
	(0.040)	(0.037)	(0.036)	(0.036)	(0.003)	(0.003)
Δln(imports)$_{s,t-1}$		0.054**		0.071***		0.056**
		(0.023)		(0.022)		(0.023)
Δln(exports)$_{s,t-1}$		-0.066***		-0.066***		-0.066***
		(0.011)		(0.011)		(0.011)
ΔHerfindahl Index$_{s\ t}$		-0.308**		-0.344**		-0.319**
		(0.131)		(0.133)		(0.130)
R-squared	0.016	0.017	0.017	0.019	0.016	0.018
No. of obs.	168282	168174	168282	168174	168282	168174

All models include region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Table 2.13 Second Differences
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

	chains present		**ln(number of stores)**		**ln(selling space)**	
	1	2	3	4	5	6
$FOOD_s$*Δ(global_chain) $_{r,t-1}$	0.135***	0.147***	0.134***	0.158***	0.016***	0.018***
	(0.045)	(0.043)	(0.024)	(0.024)	(0.004)	(0.004)
Δln(imports) $_{s,t-1}$		0.033		0.063***		0.039
		(0.026)		(0.022)		(0.026)
Δln(exports) $_{s,t-1}$		-0.063***		-0.065***		-0.063***
		(0.018)		(0.017)		(0.018)
ΔHerfindahl Index$_{s\ t}$		-0.292**		-0.333***		-0.309**
		(0.121)		(0.123)		(0.122)
R-squared	0.016	0.018	0.017	0.02	0.016	0.018
No. of obs.	133730	133730	133730	133730	133730	133730

All models include region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Table 2.14 Cross-section on Long Differences (8 year)
ln(TFP) of Manufacturing Firms , Levinsohn-Petrin TFP

	chains present		ln(number of stores)		ln(selling space)	
	1	2	3	4	5	6
$FOOD_s$*Δ(global_chain) $_{r,t-1}$	0.476***	0.404***	0.205***	0.160***	0.045***	0.038***
	(0.048)	(0.053)	(0.031)	(0.026)	(0.005)	(0.005)
Δln(imports) $_{s,t-1}$		-0.080***		-0.109***		-0.081***
		(0.019)		(0.019)		(0.018)
Δln(exports) $_{s,t-1}$		-0.035*		-0.042**		-0.035*
		(0.018)		(0.018)		(0.017)
ΔHerfindahl Index$_{s\ t}$		-0.17		-0.095		-0.166
		(0.270)		(0.248)		(0.269)
R-squared	0.036	0.037	0.033	0.035	0.036	0.037
No. of obs.	11253	11253	11253	11253	11253	11253

All models include region fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Table 2.15 Robustness Check on Autocorrelation, Fixed-effect
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

First Stage Estimation

	1	2
ln(firm age) $_{it}$	0.405***	0.405***
	(0.009)	(0.009)
ln(imports) $_{s,t-1}$	-0.092***	-0.092***
	(0.006)	(0.006)
ln(exports) $_{s,t-1}$	-0.032***	-0.032***
	(0.004)	(0.004)
Herfindahl Index $_{st}$	-0.283***	-0.283***
	(0.074)	(0.074)
R-squared	0.025	0.025
No. of obs.	248008	248008
No. of groups	51765	51765

Second Stage Estimation, only FOOD producing sectors

	1	2
(global_chain) $_{r,t-1}$	0.063***	
	(0.006)	
(global_chain) $_{r,t}$		0.064***
		(0.007)
R-squared	0.006	0.006
No. of obs.	15901	15931

First stage estimation includes firm fixed effects and region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Table 2.16 Pre-entry Impact, Fixed-effect
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

	chains present		**ln(number of outlets)**		**ln(selling space)**	
	1	2	3	4	5	6
***FOOD** $_s$ ***(global_chain)** $_{r,t-1}$*	0.164***	0.135**	0.103***	0.096***	0.019***	0.016***
	(0.060)	(0.059)	(0.020)	(0.019)	(0.006)	(0.006)
***FOOD** $_s$ ***(1_year_before)** $_{r,t}$*	0.014	0.003	0.004	0	0.03	0.018
	(0.068)	(0.066)	(0.052)	(0.051)	(0.067)	(0.065)
***ln(firm age)** $_{it}$*	0.317***	0.320***	0.322***	0.324***	0.318***	0.320***
	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)
***ln(imports)** $_{s,t-1}$*		-0.067***		-0.041**		-0.060***
		(0.018)		(0.016)		(0.018)
***ln(exports)** $_{s,t-1}$*		-0.036***		-0.038***		-0.036***
		(0.011)		(0.011)		(0.011)
***Herfindahl Index** $_{st}$*		-0.336***		-0.405***		-0.363***
		(0.093)		(0.087)		(0.092)
F test on FOOD*(global_chain) = FMCG *(1_year_before)	12.397	9.878				
p-value of F test	0.001	0.002				
R-squared	0.029	0.03	0.03	0.032	0.029	0.031
No. of obs.	219397	219397	219397	219397	219397	219397
No. of groups	49333	49333	49333	49333	49333	49333

All models include firm fixed effects and region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Table 2.17 IV Approach, Fixed-effect
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

First Stage Estimation

	chains present		ln(number of stores)		ln(selling space)	
sale_share$_{sr}$*ln(global_chain_1stWave)	-0.018***	-0.012***	-0.070***	-0.056***	-0.218***	-0.153***
	(0.003)	(0.002)	(0.004)	(0.004)	(0.025)	(0.024)
sale_share$_{sr}$*ln(global_chain_2ndWave)	1.074***	0.588***	2.937***	1.823***	12.286***	7.044***
	(0.034)	(0.032)	(0.059)	(0.054)	(0.334)	(0.317)
ln(firm age)$_{it}$	0.304***	0.299***	0.405***	0.394***	2.930***	2.877***
	(0.007)	(0.007)	(0.012)	(0.011)	(0.069)	(0.065)
ln(import)$_{s,t-1}$		-0.204***		-0.478***		-2.217***
		(0.002)		(0.003)		(0.016)
ln(export)$_{s,t-1}$		-0.011***		-0.004**		-0.098***
		(0.001)		(0.002)		(0.011)
Herfindahl Index$_{st}$		0.663***		1.156***		6.783***
		(0.020)		(0.034)		(0.197)
R-squared	0.32	0.382	0.318	0.428	0.324	0.397
No. of obs.	209619	209619	209619	209619	209619	209619
No. of groups	39555	39555	39555	39555	39555	39555
Shea's Partial R-squared	0.095	0.066	0.113	0.077	0.104	0.072
F test on IVs	8961	6038	10843	7042	9846	6603
p-value of F test	0.000	0.000	0.000	0.000	0.000	0.000

Table 2.17 IV Approach, Fixed-effect
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP (Cont.)

Second Stage Estimation

$FOOD_s$*(global_chain) $_{r,t-1}$	0.122***	0.104***	0.065***	0.058***	0.012***	0.010***
	(0.022)	(0.029)	(0.012)	(0.016)	(0.002)	(0.003)
ln(firm age) $_{it}$	0.317***	0.320***	0.320***	0.322***	0.318***	0.320***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
ln(import) $_{s,t-1}$		-0.070***		-0.063***		-0.068***
		(0.008)		(0.010)		(0.009)
ln(export) $_{s,t-1}$		-0.037***		-0.038***		-0.037***
		(0.003)		(0.003)		(0.003)
Herfindahl Index $_{st}$		-0.318***		-0.318***		-0.319***
		(0.069)		(0.068)		(0.069)
R-squared	0.029	0.031	0.03	0.031	0.03	0.031
No. of obs.	209619	209619	209619	209619	209619	209619
No. of groups	39555	39555	39555	39555	39555	39555
Sargan test	1.666	0.412	0.513	0.042	1.333	0.292
p-value for Sargan test	0.197	0.521	0.474	0.838	0.248	0.589

All models include firm fixed effects and region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Table 2.18 Adding Regional Wage Rate Fixed-effect
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

	chains present		**ln(number of outlets)**		**ln(selling space)**	
$FOOD_s$*(global_chain) $_{r,t-1}$	0.093***	0.072***	0.077***	0.065***	0.011***	0.009***
	(0.027)	(0.025)	(0.014)	(0.012)	(0.003)	(0.002)
$FOOD_s$*(wage_per_L) $_{r,t-1}$	0.337***	0.282***	0.176**	0.160*	0.316***	0.268***
	(0.076)	(0.074)	(0.085)	(0.090)	(0.073)	(0.074)
ln(firm age) $_{it}$	0.325***	0.326***	0.328***	0.329***	0.326***	0.327***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
ln(imports) $_{s,t-1}$		-0.066***		-0.049***		-0.061***
		(0.018)		(0.016)		(0.017)
ln(exports) $_{s,t-1}$		0.009		0.008		0.009
		(0.008)		(0.008)		(0.008)
Herfindahl Index $_{st}$		-0.515***		-0.562***		-0.530***
		(0.094)		(0.096)		(0.094)
R-squared	0.026	0.028	0.027	0.028	0.027	0.028
No. of obs.	199710	199710	199710	199710	199710	199710
No. of groups	48269	48269	48269	48269	48269	48269

As wage rates are only available since 1997 and several explanatory variables are lagged by one period these analyses are based on observations from 1998 to 2005.
All models include firm fixed effects and region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

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Table 2.19 Adding Regional Wage Rate, First Differences
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

	chains present		ln(number of stores)		ln(selling space)	
FOOD $_{s}$****Δ(global_chain)*** $_{r,t-1}$	0.122***	0.119***	0.168***	0.165***	0.016***	0.016***
	(0.037)	(0.038)	(0.036)	(0.037)	(0.003)	(0.003)
FOOD $_{s}$****Δ(wage_per_L)*** $_{r,t-1}$		0.135		0.039		0.131
		(0.125)		(0.093)		(0.122)
Δln(imports) $_{s,t-1}$	0.078**	0.081***	0.102***	0.102***	0.080***	0.083***
	(0.030)	(0.030)	(0.028)	(0.028)	(0.030)	(0.029)
Δln(exports) $_{s,t-1}$	-0.047***	-0.048***	-0.048***	-0.048***	-0.047***	-0.047***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
ΔHerfindahl Index $_{s\ t}$	-0.326**	-0.320**	-0.371**	-0.368**	-0.339**	-0.333**
	(0.141)	(0.141)	(0.143)	(0.142)	(0.141)	(0.140)
R-squared	0.007	0.007	0.008	0.008	0.007	0.007
No. of obs.	150866	150866	150866	150866	150866	150866

As wage rates are only available since 1997 and several explanatory variables are lagged by one period these analyses are based on observations from 1998 to 2005.
All models include region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Table 2.20 Adding Regional Wage Rate, Cross-section on Long Differences (7 years)
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

	chains present		ln(number of stores)		ln(selling space)	
$FOOD_s$*Δ(global_chain)$_{r,t-1}$	0.165***	0.156***	0.068***	0.065***	0.015***	0.015***
	(0.031)	(0.030)	(0.015)	(0.015)	(0.003)	(0.003)
$FOOD_s$*Δ(wage_per_L)$_{r,t-1}$		0.242**		0.166		0.211**
		(0.081)		(0.119)		(0.071)
Δln(imports)$_{s,t-1}$	-0.216***	-0.217***	-0.224***	-0.225***	-0.216***	-0.217***
	(0.012)	(0.011)	(0.015)	(0.015)	(0.012)	(0.011)
Δln(exports)$_{s,t-1}$	-0.009	-0.01	-0.01	-0.01	-0.009	-0.01
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
ΔHerfindahl Index$_{s\ t}$	0.03	0.031	0.057	0.062	0.03	0.033
	(0.183)	(0.182)	(0.175)	(0.174)	(0.182)	(0.181)
R-squared	0.027	0.028	0.027	0.027	0.027	0.028
No. of obs.	12538	12538	12538	12538	12538	12538

As wage rates are only available since 1997 and several explanatory variables are lagged by one period these analyses are based on observations of 1998 and 2005.
All models include region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Table 2.21 Adding Regional Wage Rate, IV Approach
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

First Stage Estimation

	chains present		ln(number of stores)		ln(selling space)	
sale_share$_{sr}$*ln(global_chain_1stWave)	1.469***	1.379***	8.210***	6.684***	20.663***	18.833***
	(0.053)	(0.054)	(0.089)	(0.086)	(0.518)	(0.523)
sale_share$_{sr}$*ln(global_chain_2ndWave)	0.222***	0.231***	-0.191***	-0.036***	1.661***	1.846***
	(0.008)	(0.008)	(0.013)	(0.012)	(0.074)	(0.074)
Food$_s$*(wage_per_L)$_{r,t-1}$		0.106***		1.807***		2.166***
		(0.010)		(0.016)		(0.095)
ln(firm age)$_{it}$	-0.014***	-0.013***	-0.061***	-0.052***	-0.174***	-0.163***
	(0.002)	(0.002)	(0.004)	(0.004)	(0.024)	(0.024)
ln(import)$_{s,t-1}$	-0.176***	-0.173***	-0.485***	-0.432***	-1.985***	-1.922***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.017)	(0.018)
ln(export)$_{s,t-1}$	0.024***	0.023***	0.050***	0.049***	0.242***	0.240***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.013)	(0.013)
Herfindahl-hirschman Index$_{st}$	0.515***	0.515***	0.959***	0.960***	5.344***	5.345***
	(0.023)	(0.023)	(0.039)	(0.037)	(0.226)	(0.226)
R-squared	0.359	0.359	0.451	0.495	0.379	0.382
No. of obs.	189710	189710	189710	189710	189710	189710
No. of group	38269	38269	38269	38269	38269	38269
Shea's Partial R-square	0.06	0.059	0.12	0.108	0.071	0.068
F test on IVs	4829.29	4728.183	10361.994	9147.254	5783.63	5553.815
p-value of F test	0.000	0.000	0.000	0.000	0.000	0.000

Table 2.21 Adding Regional Wage Rate, IV Approach
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP (Cont.)

Second Stage Estimation

FOOD$_s$*(global_chain)$_{r,t-1}$	0.145***	0.122***	0.072***	0.062***	0.014***	0.012***
	(0.031)	(0.032)	(0.013)	(0.014)	(0.003)	(0.003)
FOOD$_s$*(wage_per_L)$_{r,t-1}$		0.273***		0.167***		0.258***
		(0.030)		(0.041)		(0.031)
ln(firm age)$_{it}$	0.326***	0.327***	0.328***	0.329***	0.326***	0.327***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
ln(import)$_{s,t-1}$	-0.061***	-0.056***	-0.050***	-0.050***	-0.057***	-0.054***
	(0.008)	(0.008)	(0.009)	(0.009)	(0.008)	(0.008)
ln(export)$_{s,t-1}$	0.008*	0.008*	0.007*	0.008*	0.007*	0.008*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Herfindahl-hirschman Index$_{st}$	-0.564***	-0.554***	-0.568***	-0.557***	-0.570***	-0.558***
	(0.075)	(0.075)	(0.074)	(0.074)	(0.075)	(0.075)
R-squared	0.026	0.027	0.028	0.028	0.027	0.028
No. of obs.	189710	189710	189710	189710	189710	189710
No. of group	38269	38269	38269	38269	38269	38269
sargan test	12.763	5.388	2.068	0.807	9.761	4.014
p-value for sargan test	0.000	0.02	0.15	0.369	0.002	0.045

All models include firm fixed effects and region-year fixed effects. Standard errors are clustered at the region-year level. * significant at 10%, ** at 5%, *** at 1%

Table 2.22 Firms with Different Sizes, Fixed-effect
ln(TFP) of Manufacturing Firms, Levinsohn-Petrin TFP

	chains present	**ln(number of stores)**	**ln(selling space)**
Employment > 25			
$FOOD_s$*(global_chain) $_{r,t-1}$	0.190***	0.142***	0.021***
	(0.029)	(0.031)	(0.003)
R-squared	0.038	0.04	0.039
No. of obs.	48236	48236	48236
Employment <= 25			
$FOOD_s$*(global_chain) $_{r,t-1}$	0.142***	0.097***	0.016***
	(0.030)	(0.015)	(0.003)
R-squared	0.033	0.033	0.033
No. of obs.	171161	171161	171161
Employment <= 15			
$FOOD_s$*(global_chain) $_{r,t-1}$	0.140***	0.093***	0.015***
	(0.031)	(0.015)	(0.003)
R-squared	0.035	0.035	0.035
No. of obs.	149854	149854	149854
Employment <= 5			
$FOOD_s$*(global_chain) $_{r,t-1}$	0.120***	0.085***	0.013***
	(0.032)	(0.015)	(0.003)
R-squared	0.041	0.042	0.041
No. of obs.	86702	86702	86702

All models include firm age, sector-level imports, exports and concentration as well as firm fixed effects and region-year fixed effects.
Standard errors are clustered at the region-year level.
* significant at 10%, ** at 5%, *** at 1%

Chapter 3

Foreign Direct Investment and Firms' Markups: Evidence from Romania

3.1 Introduction

During the past decade, cross-border investment has emerged as the most visible driver of globalization. Annual flow of foreign direct investment (FDI) now exceeds $780 billion. While FDI flows to developed countries still dominate the picture， the flows to developing countries have been growing dramatically and attained their highest levels ever of $445 billion in 2006 (UN 2007). Despite its rapid growth, governments around the world still place FDI promotion high on their agendas. From 1991 through 2002, over 1500 national regulatory changes created more favorable conditions for FDI and fewer than 100 changes made conditions less favorable (UN 2003). The policy consensus to promote FDI arouses considerable interest in the spillovers from FDI, especially for developing countries. The generally held assumption is that foreign companies[14] bring with them advanced technology, management know-how, and superior marketing tactics which may spread out to indigenous companies and accelerate their growth. Numerous empirical studies have been done to determine the spillovers of FDI, but the results are mixed at best[15].

Existing empirical literature to date has focused largely on productivity spillovers postulating a constant marginal effect. However, FDI can influence firm performance in

[14] Most literature uses the term multinational companies (MNCs). We use foreign companies and MNCs interchangeably in what follows but note that firms owned by host countries could also be MNCs.
[15] For surveys of the literature on spillovers from FDI see Görg and Strobl (2001), Lipsey (2002), Keller

many ways, and the marginal spillovers of FDI may depend on the levels of FDI. Both may help to explain why extant studies of FDI spillovers fail to find consistent evidence. In this study, we attempt to advance current understanding in the two aspects.

Departing from current literature, we use markup as an alternative measure of firm performance, exploring multiple dimensions of the impact of FDI, namely, technological spillovers, pecuniary externalities, and competition effects. Indigenous firms could benefit from technological spillovers from various aspects. One aspect is increasing efficiency in generating output from inputs which is explicitly accounted for by productivity. Indigenous firms may also be able to improve in pricing, marketing and other capabilities essential to creating revenue and raising profitability (Gorodnichenko et al. 2007). Recently, it has been suggested that FDI may generate pecuniary externalities that does not affect the capabilities of indigenous companies but raise their profitability indirectly, for instance through reduced costs (Görg and Strobl 2005). Markup over marginal costs represents profits per unit output and is a broader measure of profitability than productivity. It can better take into account of overall improvements in firm capabilities due to technological spillovers, including productivity increases, and the benefits brought by pecuniary externalities. Both spillovers will increase firm profitability and tend to push up markups. Additionally, markup is a measure of market power and can help to assess the competition effects of FDI. Aitken and Harrison (1999) argue that foreign firms can produce at lower costs and will increase competition pressure. Blalock and Gertler (2008) also point out that, through backward linkages, foreign buyers may induce entry and intensify competition in local supplying markets. Markup is a function of market structure and a natural candidate to explicitly examine this aspect of the impact of FDI. In particular,

(2004), Görg and Greenaway (2004), and Javorcik (2007).

competition effects of FDI will press firms to price closer to costs and tend to reduce markups.

Existing literature has been largely studying FDI spillovers in a linear framework assuming that the marginal spillovers stay constant. We, instead, consider the possibility that marginal spillovers diminish due to “Veblen-Gerschenkron” effect (Findlay 1978). The idea is that if positive spillovers from foreign to indigenous companies do exist, the technological gap between the two will narrow as foreign presence continuously increases. The scope for indigenous firms to catch-up becomes smaller. As a result, marginal spillovers may fall as the levels of FDI rise. The marginal competition effects of FDI, on the contrary, are likely to stay constant or increase as the levels of FDI rise. Interestingly, spillovers and competition effects push markups in opposite directions. The observed impact of FDI on markups reflects the relative strength of the two forces and should depend on the level of FDI. In other words, the relationship between FDI and firm markups is likely to be nonlinear. We empirically investigate this hypothesis.

Our analyses are based on a rich firm-level data from Romania over 1999 to 2003. To allow for a variant marginal effect of FDI, we include the quadratic terms of the standard measures on foreign presence in our markup determination function. Given that markup is not observable, we follow Konings et al. (2005) and take a Tornqvist growth decomposition approach to estimate markups. In particular, we embed the markup determination function into a differencing function between the primal and the dual Solow residuals, and estimate the effects of foreign presence and its square terms on industry markups. This approach solves the potential endogeneity problem of Tornqvist growth decomposition approaches, and allows us to use the nominal values of sales and input costs avoiding unreliable deflators. We also compute simple price-cost margins as alternative estimates of markups and conduct similar analyses.

The empirical analyses yield two conclusions. First, we show that the relationship between downstream FDI and upstream markups is in the shape of an inverse-U: the marginal effect of downstream FDI is positive at low levels of FDI and falls as the levels of FDI increase; and at some threshold level, the marginal effect turns from positive to negative. The results support previous findings on positive productivity spillovers through backward linkage, and illustrate the relative strength of spillovers versus competition effects. What's more, our results support the hypothesis of diminishing marginal spillovers, and suggest a more cautious view toward spillovers through backward linkage. Second, we find that the relationship between FDI and the markup of own sector is weak, depending on ownership structures of foreign companies. When considering projects with minority foreign ownership, we find that the relationship also displays an inverse-U shape, which supports the idea of diminishing marginal spillovers in terms of intra-industry impact of FDI. The findings provide a potential explanation on why previous studies find ambiguous evidence on the existence of horizontal spillovers from FDI.

In what follows, we briefly review existing literature of the impact of FDI on host country economy in Section 3.2 and discuss how using markup can help to extend our understanding of the phenomenon in Section 3.3; we introduce our empirical specification in Section 3.4, and describe the FDI in Romania and the data in Section 3.5; we then discuss our results in Section 3.6 and conclude in Section 3.7.

3.2 Related Literature

3.2.1 FDI Impact: Intra-industry and Inter-industry

Presence of a foreign company can affect a domestic firm in various ways. Following existing literature, we analyze the effects from two tiers based on the market relationship of firms. The first tier is intra-industry which occurs when the two firms operate in the same product market as competitors. The second one is inter-industry which takes place through backward linkage when foreign and domestic firms have buyer-supplier relationship.

With respect to the first tier (intra-industry), the current literature has put forward three kinds of impacts: the first and foremost is positive technological spillover. The generally held assumption is that foreign companies possess some sort of firm-specific assets[16] that allow them to compete successfully in the host country. These firm-specific assets, which can display themselves in various forms—advanced technology, superior marketing, or modern management—are often described as "technological advantages". The technology can transfer indirectly to indigenous firms and improve their performance. The major channels through which such spillovers occur include: i) imitation or reverse engineering; ii) skill acquisition; and iii) competition where entry of advanced foreign rivals prompts local firms to use existing technology more efficiently (Görge and Greenaway 2005, Wang and Blömstrom 1992).

The second impact foreign companies can have on local firms is pecuniary externality as recently pointed out by Görg and Strobl (2005). In contrast to technological spillovers, pecuniary externalities do not affect the capabilities of benefiting firms; rather they affect firm profits indirectly via reduced costs or increased revenues. For instance, Markusen and Venables (1999) show formally under imperfect competition and increasing return to scale, an increase in the production of foreign companies can lead to 0an expansion of demand for intermediates and ultimately reduces the price that both foreign and local final good producers pay for intermediates. Another potential channel is through exports where local firms get to know foreign markets by observing the export activities of foreign firms and subsequently explore the markets. Regardless of potential benefits of economies of scale, entry into foreign markets could help local firms to spread risk and reduce inventory costs associated with domestic economic fluctuations.

Finally, entry of FDI may increase competition pressure. Foreign companies produce at lower marginal costs due to technological advantages and are able to charge lower prices. Under imperfect competition, their entry tends to put more pressure on local firms (Aitken and Harrison 1999) and forces them to place price closer to costs than entry of indigenous firms does. By analyzing a survey on local firms in Czech Republic, Javorcik and Spatareanu (2005) provide some evidence on the competition effects of FDI.

When foreign and indigenous companies have buyer-supplier relationship, the inter-industry impact of FDI through backward linkage can take the same forms, namely technological spillovers, pecuniary externalities, and competition effects. Technological spillovers could take place as (Javorcik 2004): i) foreign customers directly transfer knowledge to local suppliers; ii) higher requirements for product quality and on-time delivery introduced by foreign buyers provide incentives for technology or management improvement; and iii) foreign entry increases demand for intermediate goods which allows local suppliers to reap the benefits of economies of scale. Pack and Saggi (2001) formally show how foreign companies may voluntarily transfer knowledge to local suppliers.

Analogous to the case of intra-industry pecuniary externalities, indigenous suppliers may learn about potential export markets by serving foreign companies. The

[16] See Caves (1996) and Markusen (1995).

information allows them to explore buyers located abroad subsequently. Expansion into foreign markets can alleviate inventory costs due to domestic economic volatilities.

Additionally, entry of foreign buyers may induce entry of local suppliers and intensify competition in supplying markets. Pack and Saggi (2001) demonstrate that if it only transfers knowledge to one supplier, a foreign company is vulnerable to hold-up problem. It is, therefore, in the interests of the foreign company to transfer technology to multiple local suppliers. Wider diffusion of knowledge would then encourage entry into the supplying market, thereby increasing competition. Moreover, thanks to their broader access to global supply network, foreign buyers often have the option of importing products rather than purchasing them locally. This stronger position (relative to local buyers) allows foreign companies to require lower prices from suppliers and increase competition pressure in the supplying market.

3.2.2 Empirical Methodology and Findings

The empirical literature to date has largely focused on measuring productivity spillovers of FDI, using labor productivity and total factor productivity (TFP) [17]. This literature has its origins in studies by Caves (1974), Globerman (1979) and Blömstrom and Persson (1983). These papers typically involve an econometric analysis in which labor productivity or TFP of host industries is regressed on a number of independent variables. One variable is a measure on the presence of foreign firms in either the same industry (for horizontal spillovers, intra-industry impact) or in supplying industries (for spillovers

[17] For surveys of the literature on spillovers from FDI, see Görg and Strobl (2001), Lipsey (2002), Keller (2004), Görg and Greenaway (2004), and Javorcik (2007).

through backward linkage, inter-industry impact), usually defined as the share of employment, sales, or capital by foreign investors (Barrios et al. 2005).

Employing firm-level data, most empirical analyses of developing countries suggest that horizontal productivity spillover of FDI is negligible or negative (e.g. Haddad and Harrison (1993) on Morocco, Aitken and Harrison (1999) on Venezuela, Djankov and Hoekman (2000) on the Czech Republic and Konings (2001) on Bulgaria, Romania, and Poland)[18]. On the contrary, studies of developed countries find evidence of positive horizontal productivity spillovers, for instance, Keller and Yeaple (2003) on the United Kingdom and Haskel et al. (2007) on the United States.

While studies of horizontal spillovers are numerous, until recently there were few empirical studies on spillovers through backward linkage. In contrast to the works on horizontal spillovers, recent empirical papers find consistent evidence supporting positive productivity spillovers of FDI through backward linkage in developing countries, for example, Lithuania (Javorcik, 2004), Romania (Javorcik et al. 2004, Javorcik and Spatareanu 2008), and Indonesia (Blalock and Gertler 2007).

To sum up, current empirical studies to date have largely focused on the productivity spillovers of FDI assuming a constant marginal effect. They find consistent positive spillovers through backward linkage but ambiguous results for horizontal spillovers in the context of developing host economies.

3.3 FDI and Markup

3.3.1 Markup as an Alternative Measure

In this study, we use markup as an alternative measure of firm performance, in order to capture the multiple dimensions of the impact of FDI. First, markup over marginal costs, p/c, represents profits per unit output, and is a broader measure on firm performance than productivity. In particular, it can assess overall improvement in firm capabilities due to technological spillovers and can capture the benefits from pecuniary externalities as well. Technological spillovers can affect the capabilities of indigenous firms from various factors. Increasing efficiency in generating outputs from inputs is one aspect that is captured by productivity measures. By imitating marketing tactics of foreigners, indigenous firms may also be able to charge higher prices. By learning to outsource, indigenous firms may reduce input costs (Gorodnichenko et al. 2007). However, productivity measures do not explicitly account for these changes in firm capabilities. As all changes will affect firm profitability, markups can capture the improvements instead. Pecuniary externalities benefit firm indirectly via reduced costs or increased revenue not through affecting firm productivity. The benefits are reflected in profitability changes and hence, can also be captured by markups. Since both technological spillovers and pecuniary externalities increase firm profitability they tend to push markup up.

Secondly, markup is a function of market structure and can help to assess the competition effects of FDI. Under imperfect competition, which typifies the protected developing economies, market power leads firms to set price above marginal cost. The markup is, therefore, used to measure the level of competition. Studies of liberalization policy, for instance implementation of competition law, privatization in transition

[18] Most of early industry-level studies find positive correlation between foreign direct investment and productivity in the sector, including Caves (1974), Blömstrom and Persson (1983), and Blömstrom and

economies, and regional economic integration[19], have often used markup to access the pro-competition impact of liberalization. The studies on trade policy and imports are especially ample[20]. Treating firms' decisions as determined by static profit maximization, markup, represented by Lerner index, is typically a decreasing function of the elasticity of demand (e) that firms face: $(p-c)/p = 1/e$. Reducing trade barriers will increase competition and the elasticity of demand. As a result, firms have to price closer to its marginal cost and markup should fall. The competition effects of FDI are analogous to those of imports. Foreign presence will intensify competition in both the same industry and supplying industries and, hence, increase the elasticity of demand. As a result, competition effects of FDI tend to dampen the markups of competitors and suppliers. In assessing productivity spillovers, existing studies often simply control for the competition levels of industries. Using markup as a measure on firm performance, we can explicitly check this aspect of the impact of FDI.

A handful of studies have begun to directly examine the intra-industry effects of FDI on markups[21]. Using data on the manufacturing industries of the United States, Co (2001) finds that for industries with low levels of concentration the presence of MNCs leads to higher markups in the industry. Using data on Spanish firms, Sembenelli and Siotis (2008) find evidence of short-run negative impact and long-run positive impact of FDI on markups. They also show that long-run positive impact is limited to R&D intensive sectors. Both studies provide evidence on intra-industry impact of FDI, and suggest the impact is

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Wolff (1994). These studies are subject to reverse causality issue. See Javorcik (2004) for an explanation.

[19] For examples, see Konings et al. (2001), Kee and Hoekman (2007), Konings et al. (2005), and Siotis (2003)

[20] For example, see Levinsohn (1993) on Turkey, Harrison (1994) on Cote d'Ivoire, and Krishna and Mitra (1998) on India. For a literature review see Tybout (2001).

[21] Konings et al. (2005) find that foreign ownership is correlated with higher markups in Romania and Bulgaria but do not look at the spillover effects of FDI.

complex and depends on other factors. Their analyses, however, are based on data from industrial countries. The conclusions may not be applicable to the context of developing economies. In this study, we use data from Romania as a step to fill in this gap in literature. Additionally, following recent literature, we also consider inter-industry impact of FDI on markups through backward linkages.

3.3.2 Nonlinear Impact of FDI on Markup

Existing literature has been largely studying FDI spillovers in a linear framework assuming a constant marginal effect. However, marginal spillovers of FDI may diminish as the levels of FDI increase due to the "Veblen-Gerschenkron" (VG) effect. The original formulation of VG effect, proposed by Findlay (1978), states that technologically disadvantaged regions may experience stronger productivity growth relative to more advanced regions. The reason is that the more disadvantaged the region, the larger the technological gap between foreign and indigenous companies. The scope for catch-up is the main factor that determines the magnitude of spillover. Using firm-level data for German and Italian firms, Petri and Urban (2006) find evidence supporting the existence of VG effect. In particular, they find that rather than overall concentration of foreign firms, it is their productivity advantage that determines the positive effect on domestic firms. Here, we argue that VG effect could be present in a dynamic process. For simplicity, assume all foreign firms have the same level of technological advantage. If technological spillovers from foreign to indigenous companies do exist, the technological gap between the two should narrow as foreign presence continuously increases. As the scope for catch-up becomes smaller, according to VG effect, the benefits brought by additional FDI will fall. That is, marginal spillovers of FDI should diminish as the levels of FDI rise. Since only the technological distance between foreign and indigenous companies matter, the idea applies to both intra-industry and inter-industry spillovers.

The marginal competition effect of FDI, on the contrary, can stay constant or increase as the level of FDI rises. Concerning intra-industry impact, we have no prior reasons to believe why competition effects will change. In terms of inter-industry impact, marginal competition effects may increase with the levels of FDI. As they grow to be more dominant in markets or adapt better to local markets, the bargaining power of foreign buyers' vis-à-vis local suppliers' may strengthen. The improved position may allow foreign companies to be more effective in cutting supplying prices and disproportionately increase competition among local suppliers. As a result, competition effects associated with additional FDI become larger.

Interestingly, spillovers and competition effects push markups in opposite directions. The observed impact of FDI on markups reflects the relative strength of the two forces. Since marginal spillovers diminish and marginal competition effects stay constant or increase, the relative strength of spillovers over competition effects will fall when the levels of FDI increase. Accordingly, the marginal effect of FDI should depend on the levels of FDI, i.e. the relationship between FDI and firm markups should be nonlinear. In particular, the relationship either is increasingly negative when competition effects always dominate, or in a shape of inverse-U when positive spillovers first dominate and are eventually outweighed by competition effects. This may help to explain why extant literature fails to find consistent evidence on the existence of horizontal spillovers.

To the best of our knowledge, only a few scholars have begun to consider the possibility that the impact of FDI depends on the level of FDI. Based on Romanian data, Altomonte and Pennings (2008) show that entry of multinationals in an industry positively affects domestic firms' TFP but, as the number of multinationals increases, the impact of foreign presence turns into negative. Their results imply that, as the levels of foreign presence increase, positive spillovers become weaker due to rising competition levels, which is consistent with our expectation. For Ireland, Barrios et al. (2005) find a U-shaped relationship between net entry rate and foreign presence within an industry. Their findings indicate, instead, that positive spillovers become stronger relative to competition effects as foreign presence continuously increase. In order to provide more insights, we re-examine the issue from a different angle—impact of FDI on markups. In addition, we also consider the nonlinearity of the inter-industry impact of FDI, which have not been investigated by current studies.

3.4 Empirical Specification

3.4.1 Determination of Markup

We construct an estimation function for markup, including measures on foreign presence in the same industry and in downstream sectors to take into account both intra- and inter-industry impacts. To check the potential nonlinearity of the FDI impact, we include corresponding quadratic terms of measures on foreign presence.

$$\begin{aligned} Markup_{it} &= \mu_0 + \mu_t + \mu_1 Horizontal_{st} + \mu_2 Horizontal_{st}^{\,2} \\ &+ \mu_3 Backward_{st} + \mu_4 Backward_{st}^{\,2} + \mu_5 \ln(N_{st}) + \mu_6 IMP_{st} + \varepsilon_{it} \end{aligned} \qquad \textbf{(3.1)}$$

where *i* denotes firm, *s* denotes industry and *t* denotes time. $Markup_{it}$ denotes the markup of firm *i* at time *t*. μ_0 represents average markups. μ_t represents time dummies to control for the impact of business cycle and policies, for instance changes of regulations, on markups. $Horizontal_{st}$ measures the presence of FDI in industry *s*. $Backward_{st}$ represents the presence of FDI in downstream sectors of industry *s*. Following the standard approach in current literature (Javorcik 2004), we compute $Horizontal_{st}$, as foreign shares in the total outputs of industry *s* based on equity information

$$Horizontal_{st} = \left[\sum_{i \in s} ForeignEquityShare_{it} \times outputs_{it} \right] \Big/ \sum_{i \in s} outputs_{it} \,. \qquad \textbf{(3.2)}$$

$ForeignEquityShare_{it}$ denotes the share of foreign owners in firm *i*'s total equity at time *t*. $outputs_{it}$ denotes the firm total outputs. $Backward_{st}$, is computed as foreign shares in downstream industries' outputs

$$Backward_{st} = \sum_{s \neq r} \alpha_{sr} \times Horizontal_{rt} \,. \qquad \textbf{(3.3)}$$

α_{sr} denotes the portion of output taken from industry *s* to industry *r*, assuming the input-output structure is stable over the period under consideration.

μ_1 and μ_2 measure the intra-industry impact of FDI and the marginal effect equals $\mu_1 + (2 \times \mu_2 Horizontal)$. When the marginal effect is greater than zero, FDI is positively associated with the markups of own industry and vice versa. As of the dynamics of the impact, negative values of both μ_1 and μ_2 represent an increasingly negative impact of FDI on markups. This implies that competition effects always dominate. A positive μ_1 and negative μ_2 indicate that the marginal effect of FDI on markup is positive at low levels of FDI but decreases as the levels of FDI increase. A threshold value is obtained when setting marginal effect equals zero, i.e. $Horizontal^* = -\mu_1 / (2 \times \mu_2)$. The level of FDI cannot be below zero. Therefore, only when $\mu_1 > 0$ $\mu_2 < 0$ and $-\mu_1 / (2 \times \mu_2)$ is significantly different from zero, there exists a critical value of *Horizontal*, below which the marginal effect of FDI on markup is positive and above which the marginal effect becomes negative. It suggests that spillovers first dominate but become outweighed by competition effects. μ_3 and μ_4 measure the intra-industry impact of FDI and the same interpretation applies.

As of other variables, entry of firms will increase the intensity of competition which may lead firms to lower prices and get smaller margins. Firm exit may have the opposite influence. Following Kee and Hoekman (2007), we include the logarithm of the number of firms of industry *s* at time *t*, $ln(N_{st})$, to take this into account. It is expected to be negatively associated with markups. Finally, the literature on trade liberalization has suggested that trade has a pro-competition effect. Greater imports will dampen markups of importing countries (Tybout 2001). We add a measure on imports, IMP_{st}, to control for import pressure. We mainly use import penetration ratios. Only in a few cases, we use logarithm of imports as robustness check.

3.4.2 Estimation of Markup

One empirical difficulty is that markups are not observable as economic marginal cost cannot be directly or straightforwardly observed. Among approaches used to infer markup, the Tornqvist growth decomposition approach is the most popular[22]. The framework is first put forward by Hall (1988). Hall notes that when product markets are imperfect, a regression of output growth rate on share-weighed input growth rates should reveal the markup as the slope coefficient. It is, however, subject to endogeneity problem between firm input decision and productivity shocks. Roeger (1995) overcomes the problem by subtracting the dual Solow residual from the primal, and consistently estimate

[22] For examples see Levinsohn (1993), Harrison (1994), Krishna and Mitra (1998), and Kee and Hoekman (2007). For a survey, see Tybout (2001).

the markups as slope coefficient[23]. Following Konings et al. (2005) and Konings and Vandenbussche (2005), we employ this approach.

Assume the production function takes the form $Q = \Theta_{it} F(L_{it}, K_{it}, M_{it})$, where *i* denotes firm, *t* denotes time, Q is output, Θ is the firm- and period-specific productivity shock, and $F(L_{it}, K_{it}, M_{it})$ is linear homogeneous in labor (L), capital (K) and material (M). Under imperfect competition, the primal Solow residual, SR_{it}, can be decomposed into an imperfect competition term (a) and a productivity term (b), following Hall (1998)

$$SR_{it} = \hat{Q}_{it} - \alpha_{Lit}\hat{L}_{it} - \alpha_{Mit}\hat{M}_{it} - (1 - \alpha_{Lit} - \alpha_{Mit})\hat{K}_{it} = \underbrace{\beta_{it}(\hat{Q}_{it} - \hat{K}_{it})}_{(a)} + \underbrace{(1 - \beta_{it})\hat{\Theta}_{it}}_{(b)}, \tag{3.4}$$

where carets denote the growth rates. $\alpha_{Jit} = P_{Jit} J_{Jit} / P_{it} Q_{it}$ $(J = L, K, M)$ is the cost share of input factor *J*, P_J is the unit cost of input factor *J*. β_{it} is Lerner index, $\beta_{it} = (P_{it} - c_{it}) / P_{it} = 1 - (1/\mu_{it})$, where $\mu_{it} = P_{it} / c_{it}$ is the markup of price over marginal cost.

The problem in estimating equation (3.4) is that both Lerner index and productivity shocks are not observable, and that productivity shocks may be correlated with input factors. To deal with this problem, Roeger (1995) derives the dual Solow residual, with R_{it} referring to the rental price of capital,

$$DSR_{it} = -[\hat{P}_{it} - \alpha_{Lit}\hat{P}_{Lit} - \alpha_{Mit}\hat{P}_{Mit} - (1 - \alpha_{Lit} - \alpha_{Mit})\hat{R}_{it}] = -\underbrace{\beta_{it}(\hat{P}_{it} - \hat{R}_{it})}_{(a)} + \underbrace{(1 - \beta_{it})\hat{\Theta}_{it}}_{(b)}. \tag{3.5}$$

Subtract equation (3.5) from (3.4), we obtain the net Solow residual

[23] Another solution is using valid instruments such as what proposed by Olley and Pakes (1996) and Levinsohn and Petrin (2003). For an example see Hoekman and Kee (2007).

$$SR_{it} - DSR_{it}$$
$$= (\hat{Q}_{it} + \hat{P}_{it}) - \alpha_{Lit}(\hat{L}_{it} + \hat{P}_{Lit}) - \alpha_{Mit}(\hat{M}_{it} + \hat{P}_{Mit}) - (1 - \alpha_{Lit} - \alpha_{Mit})(\hat{K}_{it} + \hat{R}_{it}). \quad \textbf{(3.6)}$$
$$= \beta_{it}[(\hat{Q}_{it} + \hat{P}_{it}) - (\hat{K}_{it} + \hat{R}_{it})]$$

The productivity term which causes the endogeneity problem is cancelled out. Equation (3.6) can be estimated consistently without having to rely on instrumental variable. Rewrite equation (3.6), we can obtain a direct measure of markup, $\mu_{it} = P_{it} / c_{it}$,

$$(\hat{Q}_{it} + \hat{P}_{it}) - (\hat{K}_{it} + \hat{R}_{it}) = \mu_{it}\{\alpha_{Lit}[(\hat{L}_{it} + \hat{P}_{Lit}) - (\hat{K}_{it} + \hat{R}_{it})] + \alpha_{Mit}[(\hat{M}_{it} + \hat{P}_{Mit}) - (\hat{K}_{it} + \hat{R}_{it})]\}. \quad \textbf{(3.7)}$$

Each single parentheses term can be interpreted as the growth rate of nominal values of outputs and inputs. The left-hand side of equation (3.7) can be interpreted as the growth rate in sales per value of capital and terms in between the braces of the right-hand side can be interpreted as the growth rate in input factors per value of capital weighted by their respective cost shares. The formula allows us to use nominal values of outputs and input costs avoiding unreliable deflators. For simplicity, we denote the left-hand side of equation (3.7) as *ΔY* and the terms in between the braces of the right-hand side as *ΔX* in what follows.

In our case, we incorporate the markup determination function into the modified Tornqvist growth decomposition equation, i.e. substituting equation (3.1) into equation (3.7). For empirical tractability, we further need to make the assumption that the markups of all firms within an industry can be reasonably represented by an industry-level markup, and drop the firm-year specific term in equation (3.1). It is not possible to estimate a markup for each firm separately. The final specification takes the following form:

$$\Delta Y_{it} = [\mu_0 + \mu_t + \mu_1 Horizontal_{s,t-1} + \mu_2 Horizontal_{s,t-1}{}^2 +$$
$$\mu_3 Backward_{s,t-1} + \mu_4 Backward_{s,t-1}{}^2 + \mu_5 \ln(N_{s,t-1}) + \mu_6 IMP_{s,t-1}]\Delta X_{it} + \alpha_i + \alpha_t + v_{it} \quad . \quad \textbf{(3.8)}$$

It may take time for the impact to materialize. We, therefore, lag the variables determining markups by a certain period. It also mediates potential endogeneity problem. We include firm-fixed effects and year-fixed effects to control for the residual impact of firm characteristics and macro economic factors on markups. To take care of potential bias on error terms, we also cluster the standard errors at the industry-year level.

3.5 Data

The main data used in this study come from the commercial database Amadeus published by Bureau van Dijk. It contains information on about 9 million public and private companies operating in 38 European countries over 1996-2005. We use information on Romania to take advantage of the following factors. The first factor is the trend of FDI inflows to Romania. FDI in Romania is not substantial until 1997. It means that our data covers an important growth period of FDI. The cautious approach to transition taken by Romanian government led to relatively slow FDI inflows during the early 1990s. Only in 1997 substantial privatization efforts and changes in the legislative framework provided new opportunities for foreign investors. Consequently, the volume of FDI saw a dramatic increase. It was seven and three times larger in 1998 and 1999 than the amount received in 1996 (Javorcik et al. 2004). The second factor is the visible role played by FDI in the country's economy. At the end of 2000, 77241 companies had foreign capital which represented about 9 percent of all companies registered in Romania. Foreign companies accounted for two-fifths of Romanian sales and exports. About 45 percent of FDI stock in 2000 was concentrated in manufacturing industries (Dumitriu and Hunya 2002, and Voinea 2002). Javorcik and Spartareanu (2008) also report that joint ventures in Romanian lead to higher productivity of local firms through backward linkages. The importance of MNCs in the economy makes Romania a good candidate to examine the impact of FDI on markups.

Amadeus includes data on industry classification, standard financial statements and detailed shareholder information including the country of origin. For the markup determination function, we employ the 2000 input-output (IO) matrix provided by the Statistical Institute of Romania and the shareholder information from Amadeus to compute the measures on FDI presence[24]. When calculating the number of firm in an industry, we use the original dataset without trimming to capture the whole picture. We also use trade information obtained from the UN's *Commodity Trade Statistics Database* (COMTRADE) to compute import penetration.

For the modified Tornqvist growth decomposition equation, because each single parentheses term can be interpreted as the growth rate of nominal values of outputs and inputs, we use turnovers, total wage bills, and the nominal value of material costs. Following Hsieh (2002), we use the book value of the fixed tangible assets for capital, and compute rental price at time t as $R_t = (p_{Kt}/p_t)(i_t - \pi_t + \delta_t)$, where p_k and p stand for deflators for capital goods and for GDP, respectively, and i, π, δ are nominal interest rates, inflation rates and depreciation rate. The deflator for capital goods is obtained from the EU *Annual Macro-Economic Database* (AMECO). Other information is from IMF's *International Financial Statistics* (IFS) and the World Bank's *World Development Indicators* (WDI).

We drop observations with negative values of turnover, materials and tangible fixed assets and unusually large fluctuations in variable values. Due to the availability of the deflator for capital goods, we restrict ourselves to the period of 1999 to 2003. We end up with 51,192 manufacturing companies in the final sample which belong to fifty-eight

[24] We thank Javorcik and Spatareanu for sharing their data on the measures of FDI presence.

2-digit level industries defined by the IO matrix. Table 3.1 reports the summary statistics.

3.6 Results

3.6.1 Markups of Romanian Manufacturing Industries

Before proceeding to access the impact of FDI, we estimate the average markups for individual manufacturing industry in Romania[25] to check whether there exists market power. The results are shown in Table 3.2. The mean value of industry markups is 1.201 and the standard deviation is 0.078. The results are consistent with Konings et al. (2005) which reports Romanian industry markups varying between 1.10 and 1.33[26]. We further test whether industry markups are statistically different from unity. Among the forty-seven industries, forty-four sectors have markups greater than unity, indicating some level of market power concentration. The values of markups range from 1.065 of meat production and processing sector to 1.410 of other none-metallic mineral products manufacturing sector. The remaining three industries have markups no different from unity, suggesting perfect competition. They are cutting, shaping and finishing of stone, processing and preserving of fish, and railway transportation means and rolling equipment manufacturing industries.

3.6.2 Inter-industry Impact of FDI

In this section, we pool the data across sectors and test how markups vary with industry-year specific characteristics as specified in equation (3.8). We find significant inter-industry impact of FDI but not intra-industry impact. In particular, our results imply

[25] We do not perform the estimation when the number of observations of an industry is less than 70.
[26] They classify industries based on 2-digit NACE.

that the relationship between downstream FDI and upstream markup is in the shape of an inverse-U.

Table 3.3 and table 3.4 report the results of our baseline model specified in equation (3.8) when lagging the variables by one period and two periods, respectively. We only report the estimates on the interaction terms between ΔX and variables in markup determination function, including the constant representing average markups, year fixed effects, the measure on FDI presence and the square terms, the logarithm of number of firms, and measures on imports. All the models also include firm fixed-effects and year fixed-effects.

As reported in the first row of each table, the average markup across all industries for year 1999 is between 1.014 and 1.165 in table 3.3 and between 1.039 and 1.197 in table 3.4. It is consistent with Konings et al. (2005) which finds the average markup of Romanian manufacturers during 1994-1998 ranging from 1.015 to 1.21. Year trends do not seem to affect markup with the exception of year 2000, which is associated with significantly lower markups.

We do not find evidence on the intra-industry impact of FDI. The coefficients on *Horizontal* and its square term do not appear to be statistically significant. The reason could be that both externalities and competition effects are negligible. An alternative explanation is that both effects exist but neutralize each other, and the relative strength does not change along with the levels of FDI. A third possibility is that not all but some type of foreign companies affects the performance of local competitors within the same industry but the foreign companies account for a small share in aggregated foreign presence, measured by *Horizontal*. We examine this possibility in the next section.

In terms of inter-industry impact of FDI, we find a positive significant coefficient for *Backward* and a negative significant coefficient for its square term. The results are robust regardless controlling for *Horizontal* or not. When we lag variables by one period (table 3.3), the coefficient on *Backward* is between 0.489 and 0.635, and that on $Backward^2$ is between -1.686 and -1.386. All are significant at a level of 0.1 or lower. The impact is larger when the variables are lagged by two periods (table 3.4). The estimate is about 0.707 -0.755 on *Backward* and around -2.333 to -2.493 on b$ackward^2$. All of the coefficients, except one, have a significant level of 0.05 or lower. The results are in line with the idea that the impact of downstream FDI needs time to materialize, and suggest that the impact is not because of reverse causality.

We calculate the critical values of *Backward* by setting the marginal effect to zero, i.e. $Backward^* = -\hat{\mu}_3 / (2 \times \hat{\mu}_4)$. The results are around 0.176-0.188 in one-period lagged model, and about 0.151-0.153 in two-period lagged model. In order to check whether they are meaningful, we also test the critical values against zero, and find that all are statistically different greater than zero. Therefore, we interpret our results as indicating that the relationship between downstream FDI and upstream markup displays an inverse-U shape: when *Backward* is less than the critical value, the marginal effect of downstream FDI is positive; as *Backward* increases, the marginal effect becomes smaller; and when *Backward* rises above the critical value, the marginal effect turns into negative.

To illustrate the magnitude and dynamics of the impact, we further calculate the marginal effect of *Backward* ($\hat{\mu}_1 + 2 \times \hat{\mu}_2 Backward_s$) at its median and 75 percentile value of each year. The coefficients are draw from column 1 of tables 3.3 and table 3.4, respectively. As reported in table 3.5, that the marginal effect is economically significant.

Using results from the two-period lagged model, a 1 percentage point increase in *Backward* will lead to a 0.45 percentage point increase in markups in year 1999 (0.01*0.454 = 0.0045) when *Backward* equals median. In addition, the marginal effect falls and turns from positive to negative as the levels of FDI in Romania increase over time. Based on results from two-period lagged model, a 1 percentage point increase in *Backward* will lead to an increase in markups of at least 0.45 percentage points in 50 percent of the firms in 1999 (0.01*0.454 = 0.0045) while the same change will lead to a fall in markups of at least 0.31 percentage points in over 50 percent of the cases in 2003 (0.01*(-0.310) = -0.0031).

Our results are indicative of the existence of both spillovers and competition effects. The findings are consistent with previous studies on FDI spillovers through backward linkages, for instance Javorcik (2004), Javorcik and Spatareanu (2008), and Blalock and Gertler (2007), and illustrate the relative strength of spillovers versus competition effects. Moreover, our results support the hypothesis that marginal spillovers diminish as the levels of downstream FDI increase. Current literature seems to have reached a consensus on positive FDI spillovers through backward linkages. Our findings, however, suggest a more conservative view toward inter-industry spillovers.

As for other variables, we find the logarithm of firm number negatively correlated with markups. The result is in line with the idea that entry of firms leads to more fierce competition and lowers markups of the industry. For instance, according to table 3.4, doubling the number of firms in an industry will lead to a fall in its markups by 1.1 to 2.6 percentage points. In term of our measure of imports, when using import penetration, we find that imports have a positive impact on markups which is statistically significant. The result contradicts the market discipline idea of trade liberalization but supports the finding by Konings et al. (2005) on Romania data[27]. They discuss the reason as that imports have both cost-cutting impact and price-cutting impact, and that the former dominates the latter in the case of Romania. An alternative explanation could be that imports provide firms with cheaper and better inputs and help to increase profitability. As a result, markups may be positively correlated with imports. We replace import penetration with the logarithm of real imports and find the same positive effect. The results are reported in columns 3 and 4 in table 3.3 and table 3.4. It suggests the pattern is robust for Romania.

To check the robustness of baseline results, we replace firm-fixed effect model with differencing models. We first experiment with first-differencing. Note differencing is calculated for the interaction terms not just the variables in markup determination function. For instance, for $Backward * \Delta X$, first- differencing term equals $(Backward_{st} * \Delta X_{it}) - (Backward_{s,t-1} * \Delta X_{i,t-1})$. We also drop year-fixed effects and their interaction terms with ΔX. We then compute long-differencing over four years and conduct a simple cross-section analysis. The results are reported in table 3.6. Overall, the patterns from all specifications are consistent with our baseline results. *Horizontal* and its square terms appear to be insignificant. *Backward* is positively associated with upstream markups and its quadratic term is negatively significant. The critical values are close to baseline results and statistically different from zero. The main results seem to be robust to both firm-fixed effects and differencing models.

[27] Konings et al. (2001) also find that import competition does not lead to lower price cost margins.

As a second type of robustness check, we refine the industry classification of firm number and import penetration, from fifty-eight 2-digit industries defined by IO matrix to 226 4-digit NACE industries. The results, as reported in table 3.7, are consistent with the baseline pattern. The coefficients on *Horizontal* are small and insignificant. A positive significant coefficient is found for *Backward* and a negative significant coefficient is found for its quadratic term. The critical values are about 0.21 in one-period lagged model and around 0.17 in two-period lagged model, which is close to the critical values from baseline analyses. What's more, all are statistically different from zero. The coefficients on firm number are negative and statistically significant and those on import concentration are positive and statistically significant. The industry classifications do not appear to affect our main results.

Finally, we use accounting price-cost margins as an alternative approach to estimate markup and conduct equivalent analyses. Accounting price-cost margins are defined as sales net of expenditures on labor and materials over sales, $PCM_{it} = (P_{it}Q_{it} - P_{Lit}L_{it} - P_{Mit}M_{it})/(P_{it}Q_{it})$. Assuming that average cost equal marginal cost, it could be used as an estimate for Lerner index. Following current literature (Tybout 2001), we control for capital intensity, defined as the ratio of capital stocks to sales, and examine what impact *Backward*, *Horizontal* and their quadratic terms have on price-cost margins. The specification is the following:

$$\begin{aligned} PCM_{it} &= \beta_1 Capital\_Intensity_{it} + \beta_2 Horizontal_{s,t-1} + \beta_3 Horizontal_{s,t-1}^{2} \\ &+ \beta_4 Backward_{s,t-1} + \beta_5 Backward_{s,t-1}^{2} + \beta_6 \ln(N_{s,t-1}) + \beta_7 IMP_{s,t-1} + \alpha_i + \alpha_t + v_{it} \end{aligned} \quad \textbf{(3.9)}$$

We also include firm-fixed effect and year-fixed effect to control for firm specific characteristics and macroeconomic trend or policy changes. The advantage of this approach is that it allows us to have firm-level markups. In addition, our baseline approach directly estimates markup as price over marginal cost, which should be around unity, but this approach estimates Lerner index, which should be less than unity. We, therefore, expect the magnitude of the coefficients to be different.

The results are reported in table 3.8. We again find a positive significant coefficient on *Backward* and a negative significant coefficient on its quadratic term. The magnitudes of coefficients are different from baseline but the critical values of *Backward* are reasonably close. All of the critical values are statistically different from zero. The coefficients on *Horizontal* and its quadratic terms are not statistically significant. As of other controls, capital intensity is negatively associated with firm markups, which is consistent with Konings and Vadenbusshche (2005). Thus, irrespective of the approach used for markup estimation, we find evidence of inter-industry impact of FDI on markups through backward linkages, and that the marginal effect of foreign presence in downstream industries on upstream markups is positive at low levels of downstream FDI and negative at high levels of downstream FDI.

3.6.3 Ownership Structure and Intra-industry Impact of FDI

In this section, we focus on the intra-industry impact of FDI and try to provide more insights into the puzzle of why horizontal spillovers are negligible while spillovers through backward linkages are significant. We consider the possibility that the ownership structure of foreign firms may affect the impact of FDI. On one hand, foreign investors have less authority in their minority-owned subsidiaries than in majority-owned ones. The autonomy of local partners may influence spillovers in short term. For instance, in a company with minority foreign ownership, a local partner may find it easier to appoint local employees on key positions to absorb new knowledge, or to apply knowledge acquired in joint venture to its own operation not related to the foreign partner. In such a company, a local manager may have less incentive to control employee turnovers as well as knowledge leakage[28]. We, therefore, expect stronger spillovers from the projects with minority foreign ownership. On the other hand, a company with minority foreign ownership may pose a more serious threat to indigenous competitors than a company with majority foreign ownership due to its deeper insights of host markets and closer local ties on top of its technological advantages. The competition pressure associated with the expansion of minority owned foreign companies may, therefore, be higher. Given these arguments, we expect the intra-industry impact of FDI to be more prominent when considering companies with minority foreign ownership.

We modify our measure on the presence of FDI in own industry to check the hypothesis. We replace the original *Horizontal* variable with two separate measures. One is on projects with minority foreign ownership, *Horizontal_Minority*, defined as

$$Horizontal\_Minority_{st} = \left[\sum_{i \in s} I(Minority) \times ForeignEquityShare_{it} \times outputs_{it}\right] \Big/ \sum_{i \in s} outputs_{it}, \qquad \textbf{(3.10)}$$

where *I(Minority)* is a dummy and takes the value of unity when foreign capital participation is above 10 percent but below 50 percent. The other is on projects with majority foreign ownership, *Horizontal_Majority*, defined in an analogous manner. All other variables are as defined in equation (3.8). We conduct the analysis using two-period lagged model.

[28] For anecdotal evidence, see The Economist (April 19, 1997) for a case of Unilever and its joint venture in China, and Djankov and Hoekman (1997) for cases of foreign companies in Bulgaria.

The results reported in table 3.9 support the above hypothesis. The estimates on *Backward* and other controls are consistent with baseline results. We find a positive significant coefficient on *Horizontal_Minority* and a negative significant coefficient on its square term. On the contrary, coefficients on *Horizontal_Majority* and its square term are statistically insignificant. The coefficients on *Horizontal_Minority* are about 0.599-0.704, and those on its square term are between -1.524 and -1.314. We also compute the critical values for *Horizontal_Minority*, and find they are about 0.23 and statistically different from zero. The results suggest that not all foreign companies exert an influence on their domestic competitors. The influence depends on ownership structure. Firms with majority foreign ownership have negligible impact. Firms with minority foreign ownership affect industry markups nonlinearly, in particular, inverse-U shaped: when *Horizontal_Minority* is lower than the critical value, the marginal effect of FDI is positive; when *Horizontal_Minority* increases, the marginal effect falls; when *Horizontal_Minority* rises above the critical value, the marginal effect becomes negative.

Recall using the aggregated measure on foreign presence, *Horizontal*, we are not able to detect the intra-industry impact associated with minority foreign ownership. The reason is that the share of *Horizontal_Minority* in *Horizontal* is small. Accordingly, the associated impact is assigned litter weight when using the aggregated measure and neutralized by the impact associated with majority foreign ownership. To illustrate the point, we calculate the percentage share of *Horizontal_Minority* in *Horizontal*[29] and report the distribution in table 3.10. For each year, the share of *Horizontal_Minority* is less than fifty percent even when it takes its 90 percentile value.

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[29] We conduct the calculation for two-period lagged values as they are used in the analyses.

Turn to the magnitude and dynamics of the intra-industry impact on markups, table 3.11 shows the marginal effects when *Horizontal_Minority* obtains the median and 75 percentile values of each year. The coefficients are based on results reported in column 1 of table 3.9. The impact is economically significant. Using results calculated for 1999, at its median value,1 percentage point increase in *Horizontal_Minority* will lead to 0.67 percentage point increase in markups (0.01*0.665=0.0067). In terms of dynamics, marginal effects become smaller as the value of *Horizontal_Minority* increases over time. However, as *Horizontal_Minority* are less than the critical value of 0.23 in most cases, the reported marginal effects are all positive. It suggests that over 1999-2003, the expansion of firms with minority foreign ownership is positively associated with markups in most industries.

Our results suggest that intra-industry impact of FDI on markups is weak, and that the direction and the scope of the impact depend on ownership structure of foreign companies. The findings are in line with previous studies on intra-industry impact of FDI on markups based on data from developed countries, for example, Co (2001) and Sembenelli and Siotis (2008). In addition, when distinguishing companies with minority foreign ownership from those with majority foreign ownership, our analyses show that the relationship between FDI and markups of own industry is also in a shape of inverse-U: the marginal impact of FDI falls as the level of FDI increases, and at some threshold level of FDI, the marginal effect of FDI turns from positive to negative. The results suggest that marginal spillovers diminish with the levels of FDI. Our findings support the conclusion of Altomonte and Pennings (2008) for Romania but contrast against the results of Barrios et al. (2005) for Ireland. Further investigations are needed to check whether the differences in data or those in methodology, including both measures on firm performance and on foreign presence, lead to contrast conclusions. Overall, by showing that the ownership structure matters and that the relationship between FDI and own sector markups display an inverse-U shape, our analyses provide a potential explanation to the previous ambiguous results on intra-industry spillovers.

To check the robustness of our results, we conduct further analyses on the model with two separate measures on *horizontal*. We, first, change the estimation approaches to first differencing and cross-section estimation on 4 –year-differenced variables. Columns 1 and 2 of table 3.12 show the results. The basic patterns are consistent with the results from firm-fixed effect estimation. One exception is the coefficient on the square term of *Horizontal_Minority* when using cross-section estimation. The t value is about -1.56, which is close to the conventional significant levels though not statistically significant. As a third robustness check, we refine the industry classification to 4-digit NACE. The results, as reported in column 3 of table 3.12, are consistent with what we find when using the industry classification based on input-output table. Finally, we also use accounting price-cost margins to estimate Lerner index and conduct an analysis analogous to equation (3.9). Column 4 of table 3.12 shows the results. We find that *Horizontal_Minority* is positively associated with firm price-cost margins, its square term is negatively correlated with margins, and *Horizontal_Minority* do not exert statistically significant impact. The coefficients on Backward and other controls are also consistent with baseline results. The magnitudes of the estimates on *Horizontal_Minority* are smaller than what we find when using the Tornqvist growth decomposition approach but the resulting critical values from the two approaches are close. In short, the basic results on intra-industry impact of FDI on are robust when we use alternative ways to estimate markups.

3.7 Conclusion Remarks

This study investigates the impact of FDI on industry markups of host economies. In the case of Romania, our analyses yield two conclusions: the relationship between downstream FDI and upstream markups is in the shape of an inverse-U, i.e. there is some critical value of downstream FDI, above which the marginal effect turns from positive to negative; the intra-industry impact of FDI is weak, depending on ownership structure of foreign companies, and when considering affiliates with minority foreign ownership, the relationship between FDI and industry markup is also inverse-U shaped. Our results illustrate the relative strength of positive spillovers versus competition effects and support the idea of diminishing marginal spillovers for both inter- and intra-industry impact of FDI. The findings extend current belief of positive spillovers of FDI through backward linkage and offer a potential explanation on why horizontal spillovers of FDI have not been consistently detected by existing studies.

In terms of policy implications, our analyses suggest that simple FDI promotion policies should not placed in industries where FDI has exceeded the threshold value and exerted fierce competition effects. Policies should be designed to help indigenous companies to improve absorbing capabilities and competitiveness. If, as we suggested, VG effect is the reason that spillovers diminish, policies should target FDI with more technological advantage or potential in technological growth, for instance, R&D intensive industries or R&D centers of foreign companies rather than simple assembling plants. In addition, future studies are needed to examine the exact reason(s), VG or some other explanations, cause the diminishing of spillovers. Our results on the differences between ownership structures, when looking at intra-industry impact of FDI, should also be interpreted with caution. They should not be taken as suggesting restrictions on foreign ownership as carefully designed case studies (Moran 2005) have show that restrictions will reduce both the quantity and quality of FDI inflows. Instead, in light of the results, policies should aim at facilitating local engagement of foreign companies. More studies should look at the reasons why ownership structure affects the impact of FDI.

3.8 Tables of Chapter 3

Table 3.1 Summary Statistics

Variable	No. of obs.	Mean	Std. Dev.
Firm-specific variables			
Output (th lei 2000)	51192	4080.75	40252.56
Capital stock (th lei 2000)	51192	1721.51	27803.25
Wage costs (th lei 2000)	51192	608.64	4322.11
Material costs (th lei 2000)	51192	2424.72	26465.33
ΔY	51192	0.02	0.70
ΔX	51192	0.04	0.55
Markup (ratio)*	51192	0.24	0.16
Capital intensity**	51192	0.35	6.31

*: Markup = (Output - Wage costs - Material costs)/ Output

**: Capital intensity = Capital stock/Output

Industry-specific variables, One-period lagged			
Backward	283	0.18	0.08
Horizontal	283	0.31	0.24
Horizontal (minority foreign owned)	283	0.04	0.08
Horizontal (majority foreign owned)	283	0.27	0.23
No. of firms	283	773.48	1246.99
Import Penetration	283	0.36	0.24
Imports (th lei 2000)	283	946238.20	1748937.00

Industry-specific variables, Two-period lagged			
Backward	275	0.14	0.08
Horizontal	275	0.25	0.23
Horizontal (minority foreign owned)	275	0.03	0.08
Horizontal (majority foreign owned)	275	0.21	0.22
No. of firms	275	745.84	1182.23
Import Penetration	275	0.39	0.25
Imports (th lei 2000)	275	904207.60	1690191.00

Table 3.2 Estimates of Price-Cost Markups in Different Industry

Input-output Industry Code	Industry Description	Markup	F-test Markup = 1	No. of obs.	R-squared
18	Meat production and processing	1.065**	71.53	1667	0.98
19	Processing and preserving of fish and fish products	1.166	2.73	72	0.86
20	Processing and preserving of fruits and vegetables	1.115**	46.14	255	0.93
21	Production of vegetal and animal oil and fat	1.157**	20.57	312	0.84
22	Production of milk products	1.097***	124.94	1041	0.95
23	Production of milling products, starch and starch products	1.066**	29.65	1705	0.88
24	Manufacture of fodder	1.093*	7.51	144	0.90
25	Processing of other food products	1.108***	119.71	7054	0.94
26	Beverages	1.126**	50.15	1096	0.85
27	Tobacco products			19	
28	Textile industry	1.198***	202.01	2332	0.84
29	Textile clothing	1.220***	1385.91	5058	0.81
30	Manufacture of leather and fur clothes	1.182**	25.71	246	0.77
31	Footwear and other leather goods	1.199***	137.99	1840	0.81
32	Wood processing (excluding furniture)	1.167***	233.66	4881	0.81
33	Pulp, paper and cardboard; related items	1.211***	116.30	693	0.89
34	Publishing, printing and reproduction of recorded media	1.259***	158.01	2913	0.78
36	Crude oil processing			17	
38	Basic chemical products	1.169**	36.95	393	0.91
39	Pesticides and other agrochemical products			29	
40	Dyes and varnishes	1.212***	119.32	342	0.92
41	Medicines and pharmaceutical products	1.374***	104.45	287	0.84
42	Soaps, detergents, upkeeping products, cosmetics, perfumery	1.262***	160.29	275	0.87
43	Other chemical products	1.248**	58.18	284	0.87
44	Synthetic and man made fibres			16	
45	Rubber processing	1.147***	200.22	494	0.82
46	Plastic processing	1.181***	283.67	1845	0.86
47	Glass and glassware	1.211**	30.49	507	0.84
48	Processing of refractory ceramics (excluding building items)	1.189**	68.58	313	0.83
49	Ceramic boards and flags			31	
50	Brick, tile and other building material processing	1.265***	103.61	217	0.89

Table 3.2 Estimates of Price-Cost Markups in Different Industry (cont.)

Input-output Industry Code	Industry Description	Markup	F-test Markup = 1	No. of obs.	R-squared
51	Cement, lime and plaster			47	
52	Processing of concrete, cement and lime items	1.182***	94.58	580	0.84
53	Cutting, shaping and finishing of stone	1.058	2.73	294	0.76
54	Other non-metallic mineral products	1.410**	30.17	99	0.83
55	Metallurgy and ferroalloys processing	1.207**	15.75	82	0.91
56	Manufacture of tubes			48	
57	Other metallurgy products			17	
58	Precious metals and other non-ferrous metals			55	
59	Foundry	1.172**	31.55	251	0.84
60	Metal structures and products	1.178***	276.54	4592	0.83
61	Manufacture of equipment for producing and using of mechanical power (except for plane engines, vehicles and motorcycles)	1.251**	24.03	290	0.83
62	Machinery for general use	1.223***	256.54	421	0.84
63	Agricultural and forestry machinery	1.207**	70.10	129	0.93
64	Machine tools	1.355**	52.29	188	0.76
65	Other machines for special use	1.217**	20.89	451	0.83
67	Labour-saving devices and domestic machinery	1.168**	35.11	125	0.85
68	Computers and office means	1.174**	164.51	176	0.96
69	Electric machinery and appliances	1.243***	210.55	752	0.86
70	Radio, TV-sets and communication equipment and apparatus	1.387***	140.12	171	0.84
71	Medical, precision, optical, watchmaking instruments and apparatus	1.238***	176.49	894	0.77
72	Means of road transport	1.181***	218.61	556	0.91
73	Naval engineering and repair	1.325**	19.82	215	0.73
74	Production and repair of railway transport means and rolling equipment	1.216	2.78	131	0.82
75	Aircraft engineering and repair			25	
76	Motorcycles , bicycles and other transport means (including cripple transport means)			7	
77	Furniture	1.178***	313.47	3203	0.88
78	Other industrial activities	1.186**	26.23	832	0.76

Note: the estimated markup is the industry average markup across years. We test whether it is statistically different from 1.

* significant at 10%, ** at 5%, *** at 1%

Note: we do not perform the estimation when observation of an industry is less than 70.

Table 3.3 Baseline Result, One-period Lagged, FE

	1	2	3	4
markup	1.161***	1.165***	1.014***	1.021***
	(0.042)	(0.039)	(0.042)	(0.044)
year = 2000	-0.034**	-0.034**	-0.039***	-0.037***
	(0.013)	(0.013)	(0.012)	(0.011)
year = 2001	-0.001	0.001	-0.01	-0.006
	(0.020)	(0.019)	(0.016)	(0.016)
year = 2002	0.006	0.009	-0.005	-0.001
	(0.021)	(0.020)	(0.017)	(0.015)
year = 2003	0.014	0.018	0.004	0.009
	(0.023)	(0.022)	(0.018)	(0.017)
Horizontal lagged	-0.011		0.087	
	(0.095)		(0.094)	
$(\text{Horizontal})^2$ lagged	0.059		-0.097	
	(0.125)		(0.125)	
Backward lagged	0.573*	0.635**	0.489*	0.517*
	(0.306)	(0.306)	(0.281)	(0.276)
$(\text{Backward})^2$ lagged	-1.521*	-1.686*	-1.386*	-1.457*
	(0.884)	(0.872)	(0.844)	(0.814)
ln(Firm No.) lagged	-0.009**	-0.010**	-0.025***	-0.024***
	(0.004)	(0.004)	(0.004)	(0.004)
Import Penetration lagged	0.103***	0.100***		
	(0.024)	(0.025)		
ln(Imports) lagged			0.023***	0.022***
			(0.003)	(0.003)
No. of Obs.	51192	51192	51192	51192
No. of Groups	21717	21717	21717	21717
F test	5879.42	6468.94	6095.18	6930.84
R-squared	0.85	0.85	0.85	0.85
Critical Value, Backward[a]	0.188	0.188	0.176	0.178
F test: Critical Value Backward[b]	21.15	25.52	26.17	28.15
P-value	0.00	0.00	0.00	0.00

Only variables interact with ΔX are reported. All models include firm fixed effects and year fixed effects. Standard errors are clustered at the industry-year level.

* significant at 10%, ** at 5%, *** at 1%

(a): Critical Value: $FDI^* = -\mu_1/(2*\mu_2)$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward}

(b): H0: $\mu_1/(2*\mu_2) = 0$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward}

Table 3.4 Baseline Result, Two-period Lagged, FE

	1	2	3	4
markup	1.193***	1.197***	1.039***	1.041***
	(0.038)	(0.037)	(0.041)	(0.042)
year = 2000	-0.049***	-0.049***	-0.055***	-0.052***
	(0.017)	(0.017)	(0.015)	(0.015)
year = 2001	-0.015	-0.015	-0.026	-0.02
	(0.021)	(0.020)	(0.018)	(0.017)
year = 2002	-0.002	-0.001	-0.018	-0.01
	(0.030)	(0.026)	(0.024)	(0.021)
year = 2003	0.006	0.009	-0.01	-0.002
	(0.029)	(0.026)	(0.023)	(0.020)
Horizontal lagged	-0.012		0.07	
	(0.105)		(0.095)	
$(\text{Horizontal})^2$ lagged	0.058		-0.072	
	(0.139)		(0.131)	
Backward lagged	0.707*	0.750**	0.743**	0.755**
	(0.376)	(0.374)	(0.335)	(0.331)
$(\text{Backward})^2$ lagged	-2.333**	-2.457**	-2.457**	-2.493**
	(1.165)	(1.157)	(1.058)	(1.037)
ln(Firm No.) lagged	-0.011**	-0.012***	-0.026***	-0.025***
	(0.005)	(0.004)	(0.005)	(0.004)
Import Penetration lagged	0.081***	0.079***		
	(0.021)	(0.022)		
ln(Imports) lagged			0.022***	0.021***
			(0.003)	(0.003)
No. of Obs.	51060	51060	51060	51060
No. of Groups	21679	21679	21679	21679
F test	5717.07	6153.55	6188.29	6943.12
R-squared	0.85	0.85	0.85	0.85
Critical Value, Backward[a]	0.152	0.153	0.151	0.151
F test: Critical Value Backward[b]	29.26	31.98	52.13	51.67
P-value	0.00	0.00	0.00	0.00

Only variables interact with ΔX are reported. All models include firm fixed effects and year fixed effects. Standard errors are clustered at the industry-year level.

* significant at 10%, ** at 5%, *** at 1%

(a): Critical Value: FDI* = $-\mu_1/(2*\mu_2)$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward}

(b): H0: $\mu_1/(2*\mu_2) = 0$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward}

Table 3.5 Marginal Effect of Backward

One-period Lagged (0.573-2*1.521*Backward)				
year	Value of Backward		Marginal Effect	
	Median	75 percentile	Median	75 percentile
1999	0.111	0.162	0.236	0.079
2000	0.135	0.168	0.163	0.063
2001	0.216	0.235	-0.084	-0.141
2002	0.218	0.240	-0.090	-0.157
2003	0.234	0.244	-0.140	-0.169

Two-period Lagged (0.707-2*2.333*Backward)				
year	Value of Backward		Marginal Effect	
	Median	75 percentile	Median	75 percentile
1999	0.054	0.072	0.454	0.369
2000	0.111	0.162	0.190	-0.050
2001	0.135	0.168	0.078	-0.075
2002	0.216	0.235	-0.301	-0.388
2003	0.218	0.240	-0.310	-0.412

Table 3.6 Robustness Check, Difference Models

	First Differences		Long Differences (4 year)	
	1	2	3	4
markup	1.112***	1.119***	1.022***	1.036***
	(0.049)	(0.045)	(0.096)	(0.090)
Horizontal	-0.088		0.031	
	(0.119)		(0.227)	
$(\text{Horizontal})^2$	0.215		0.051	
	(0.157)		(0.302)	
Backward	0.834**	1.033***	1.447*	1.673**
	(0.333)	(0.336)	(0.762)	(0.704)
$(\text{Backward})^2$	-2.223**	-2.682***	-4.180**	-4.711**
	(0.903)	(0.913)	(1.998)	(1.918)
ln(Firm No.)	-0.006	-0.010*	-0.003	-0.005
	(0.005)	(0.005)	(0.012)	(0.011)
Import Penetration	0.128***	0.121***	0.187***	0.180***
	(0.029)	(0.031)	(0.051)	(0.053)
No. of Obs.	27222	27222	2428	2428
F test	7362.54	9724.47	1814.89	2255.35
R-squared	0.85	0.85	0.88	0.88
Critical Value, Backward[a]	0.188	0.193	0.173	0.178
F test: Critical Value Backward[b]	68.33	98.41	54.19	85.99
P-value	0.00	0.00	0.00	0.00

Only variables interact with ΔX are reported. All models include year fixed effects.
Standard errors are clustered at the industry-year level.
* significant at 10%, ** at 5%, *** at 1%
(a): Critical Value: $FDI^* = -\mu_1/(2*\mu_2)$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward}
(b): H0: $\mu_1/(2*\mu_2) = 0$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward}

Table 3.7 Robustness Check, 4-digit NACE Industry Measure, FE

	One-period Lagged		Two-period Lagged	
	1	2	3	4
markup	1.185***	1.185***	1.213***	1.213***
	(0.036)	(0.034)	(0.029)	(0.029)
year = 2000	-0.038***	-0.038***	-0.055***	-0.054***
	(0.012)	(0.012)	(0.015)	(0.015)
year = 2001	-0.011	-0.009	-0.025	-0.023
	(0.018)	(0.017)	(0.019)	(0.019)
year = 2002	-0.006	-0.003	-0.02	-0.015
	(0.018)	(0.016)	(0.026)	(0.024)
year = 2003	0.000	0.004	-0.011	-0.006
	(0.020)	(0.018)	(0.025)	(0.022)
Horizontal lagged	-0.007		0.006	
	(0.084)		(0.093)	
$(\text{Horizontal})^2$ lagged	0.051		0.038	
	(0.112)		(0.123)	
Backward lagged	0.636**	0.677**	0.799**	0.830**
	(0.301)	(0.306)	(0.367)	(0.368)
$(\text{Backward})^2$ lagged	-1.494*	-1.607*	-2.389**	-2.484**
	(0.886)	(0.888)	(1.157)	(1.157)
ln(Firm No.) lagged	-0.012***	-0.013***	-0.014***	-0.014***
	(0.004)	(0.004)	(0.003)	(0.004)
Import Penetration lagged	0.055***	0.055***	0.041**	0.041**
	(0.018)	(0.018)	(0.016)	(0.016)
No. of Obs.	50859	50859	50741	50741
No. of Groups	21554	21554	21525	21525
F test	6637.56	7379.99	6747.37	7419.86
R-squared	0.85	0.85	0.85	0.85
Critical Value, Backward[a]	0.213	0.211	0.167	0.167
F test: Critical Value Backward[b]	21.33	25.14	40.36	42.32
P-value	0.00	0.00	0.00	0.00

Only variables interact with ΔX are reported. All models include firm fixed effects and year fixed effects. Standard errors are clustered at the industry-year level.

* significant at 10%, ** at 5%, *** at 1%

(a): Critical Value: FDI* = $-\mu_1/(2*\mu_2)$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward}

(b): H0: $\mu_1/(2*\mu_2) = 0$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward}

Table 3.8 Robustness Check, Alternative Measure on Markup, FE

	One-period Lagged		Two-period Lagged	
	1	2	3	4
Capital Intensity	-0.019***	-0.019***	-0.019***	-0.019***
	(0.004)	(0.004)	(0.004)	(0.004)
Horizontal lagged	0.016		-0.001	
	(0.027)		(0.023)	
$(\text{Horizontal})^2$ lagged	-0.039		-0.005	
	(0.033)		(0.029)	
Backward lagged	0.162***	0.135**	0.100**	0.097**
	(0.062)	(0.056)	(0.048)	(0.046)
$(\text{Backward})^2$ lagged	-0.266**	-0.209*	-0.251**	-0.242**
	(0.132)	(0.123)	(0.114)	(0.110)
ln(Firm No.) lagged	-0.029**	-0.026*	-0.037**	-0.037**
	(0.015)	(0.015)	(0.016)	(0.016)
Import Penetration lagged	-0.003	-0.001	0.004	0.004
	(0.010)	(0.010)	(0.008)	(0.008)
No. of Obs.	51192	51192	51060	51060
No. of Groups	21717	21717	21679	21679
F test	25.33	29.44	24.79	28.13
R-squared	0.015	0.014	0.015	0.015
Critical Value, Backward[a]	0.305	0.323	0.199	0.200
F test: Critical Value Backward[b]	26.23	14.36	18.61	17.36
P-value	0.00	0.00	0.00	0.00

All models include firm fixed effects and year fixed effects.
Standard errors are clustered at the industry-year level.
* significant at 10%, ** at 5%, *** at 1%

(a): Critical Value: FDI* = $-\mu_1/(2*\mu_2)$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward}

(b): H0: $\mu_1/(2*\mu_2) = 0$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward}

Table 3.9 Ownership Structure and Intra-Industry Impact, Two-period Lagged, FE

	1	2	3	4
markup	1.196***	1.204***	1.047***	1.050***
	(0.037)	(0.036)	(0.040)	(0.041)
Horizontal_Minority lagged	0.704***	0.642***	0.651***	0.599***
	(0.231)	(0.222)	(0.229)	(0.225)
$(\text{Horizontal\_Minority})^2$ lagged	-1.524***	-1.402***	-1.400***	-1.314***
	(0.447)	(0.435)	(0.447)	(0.443)
Horizontal_Majority lagged	-0.081		-0.003	
	(0.102)		(0.091)	
$(\text{Horizontal\_Majority})^2$ lagged	0.204		0.068	
	(0.136)		(0.125)	
Backward lagged	0.751**	0.820**	0.777**	0.820**
	(0.363)	(0.364)	(0.325)	(0.323)
$(\text{Backward})^2$ lagged	-2.631**	-2.809**	-2.697***	-2.819***
	(1.123)	(1.130)	(1.030)	(1.023)
ln(Firm No.) lagged	-0.012***	-0.014***	-0.026***	-0.027***
	(0.004)	(0.004)	(0.005)	(0.004)
Import Penetration lagged	0.079***	0.077***		
	(0.021)	(0.022)		
ln(Imports) lagged			0.021***	0.021***
			(0.003)	(0.003)
No. of Obs.	51060	51060	51060	51060
No. of Groups	21679	21679	21679	21679
F test	5799.39	6198.06	6385.48	7156.22
R-squared	0.854	0.853	0.854	0.854
F test: Horizontal_Minority = Horizontal_Majority	10.80		7.37	
P-value	0.00		0.01	
F test: $(\text{Horizontal\_Minority})^2 = (\text{Horizontal\_Majority})^2$	13.93		9.94	
P-value	0.00		0.00	
Critical Value, Horizontal_Minority[a]	0.231	0.229	0.232	0.228
F test: Critical Value, Horizontal_Minority[b]	332.68	364.93	327.96	334.08
P-value	0.00	0.00	0.00	0.00
Critical Value, Backward[a]	0.143	0.146	0.144	0.145
F test: Critical Value Backward[b]	32.96	38.46	55.63	60.20
P-value	0.00	0.00	0.00	0.00

Only variables interact with ΔX are reported. All models include firm fixed effects and year fixed effects. Standard errors are clustered at the industry-year level.
* significant at 10%, ** at 5%, *** at 1%
(a): Critical Value: FDI* = $-\mu_1/(2*\mu_2)$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward, Horizontal_Minority}
(b): H0: $\mu_1/(2*\mu_2) = 0$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward, Horizontal_Minority}

Table 3.10 Relative Importance of Firms with Minority Foreign Ownership
Horizontal_Minority/Horizontal (two-period Lagged) (%)

year	25 percentile	Median	75 percentile	90 percentile
1999	8.2	13.0	28.8	48.4
2000	6.1	11.4	17.9	34.0
2001	7.3	11.1	22.9	35.4
2002	7.2	9.5	17.7	31.5
2003	5.9	7.4	16.2	29.4

Table 3.11 Marginal Effect of Horizontal_Minority

Two-period Lagged (0.704-2*1.524*Backward)

year	Value of Horizontal_Minority		Marginal Effect	
	Median	75 percentile	Median	75 percentile
1999	0.013	0.021	0.665	0.640
2000	0.024	0.028	0.631	0.618
2001	0.020	0.040	0.643	0.582
2002	0.029	0.035	0.615	0.596
2003	0.029	0.042	0.614	0.575

Table 3.12 Ownership Structure and Intra-Industry Impact, Robustness Check

	First Difference[c]	Long Difference (4 year)	4-digit NACE FE[d]	Alternative Measure on Markup[e]
	1	2	3	4
markup	1.102***	1.014***	1.207***	
	(0.046)	(0.095)	(0.028)	
Horizontal_Minority	0.474**	1.053**	0.608***	0.069**
	(0.229)	(0.521)	(0.209)	(0.033)
$(\text{Horizontal\_Minority})^2$	-0.894**	-3.354	-1.363***	-0.170**
	(0.452)	(2.156)	(0.401)	(0.068)
Horizontal_Majority	-0.117	-0.095	-0.065	-0.015
	(0.102)	(0.201)	(0.089)	(0.023)
$(\text{Horizontal\_Majority})^2$	0.313	0.297	0.189	0.012
	(0.343)	(0.309)	(0.119)	(0.031)
Backward	0.718**	1.354*	0.809**	0.133***
	(0.306)	(0.750)	(0.354)	(0.051)
$(\text{Backward})^2$	-1.929**	-4.196**	-2.571**	-0.323***
	(0.831)	(1.922)	(1.114)	(0.115)
ln(Firm No.)	-0.006	-0.003	-0.014***	-0.041**
	(0.005)	(0.012)	(0.003)	(0.016)
Import Penetration	0.130***	0.205***	0.042**	0.003
	(0.030)	(0.048)	(0.016)	(0.008)
Capital Intensity				-0.019***
				(0.004)
No. of Obs.	27222	2428	50741	51060
No. of Groups			21525	21679
F test	4914.24	1808.88	7138.93	22.38
R-squared	0.853	0.877	0.854	0.015
F test: Horizontal_Minority = Horizontal_Majority	6.00	3.52	9.47	5.79
P-value	0.02	0.07	0.00	0.02
F test: $(\text{Horizontal\_Minority})^2 = (\text{Horizontal\_Majority})^2$	6.51	2.53	13.36	6.24
P-value	0.01	0.12	0.00	0.01

Table 3.12 Ownership Structure and Intra-Industry Impact, Robustness Check (cont.)

	First Difference[c]	Long Difference (4 year)	4-digit NACE FE[d]	Alternative Measure on Markup[e]
Critical Value, Horizontal_Minority[a]	0.265	0.157	0.223	0.204
F test: Critical Value, Horizontal_Minority[b]	36.75	8.49	241.35	26.45
P-value	0.00	0.01	0.00	0.00
Critical Value, Backward[a]	0.186	0.161	0.157	0.206
F test: Critical Value, Backward[b]	48.02	43.85	44.36	32.18
P-value	0.00	0.00	0.00	0.00

Standard errors are clustered at the industry-year level.

* significant at 10%, ** at 5%, *** at 1%

(a): Critical Value: FDI* = $-\mu_1/(2*\mu_2)$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward, Horizontal_Minority}

(b): H0: $\mu_1/(2*\mu_2) = 0$ given $\mu_1 FDI+\mu_2 FDI^2$, FDI = {Backward, Horizontal_Minority}

(c): Year fixed effects are omitted

(d): All variables are lagged by two periods. Interact terms between ΔX and year fixed effects, and firm fixed effects and year fixed effects are omitted

(e): All variables are lagged by two periods. Firm fixed effects and year fixed effects are omitted

Chapter 4

Productivity Dispersion, Input Intensity and Trade in Intermediates

4.1 Introduction

The past two decades have seen a spectacular international vertical specialization of production and a surge of trade in intermediate inputs. Improvements in communication technology as well as reduction of trade barriers gave rise to international vertical specialization, in which production has turned into a multinational process, and different stages are carried out in specialized plants around the world. Following this trend, the growth of trade in intermediates has far outpaced, in recent years, the growth of trade in final goods. The United States imported 11.6 percent of its intermediates in 1990 up from 5.3 percent in 1972 and similar evidence has been found for Canada, the United Kingdom and France[30]. Trade in intermediates is estimated to account for over 30% of world trade in manufactures[31].

The extent of international specialization, however, varies across industries as only certain companies take advantage of international procurement of intermediates. For instance, in electric and electronic machinery sector the share of imports in total material purchases is approximately 1.5-1.75 times higher than the average value found for manufacturing industries of the United States while in chemical industry the share is much lower[32]. In addition, some companies choose to produce intermediates in-house in foreign affiliates (*Foreign Direct Investment (FDI)*), for example Intel, while others contract

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[30] See Feenstra and Hanson (1996, 1997, 2003), Campa and Goldberg (1997) and Strauss-Kahn (2003).
[31] See Yeats (2001). Other evidence can be found in Yi (2003).
[32] See Feenstra and Hanson (1996) and Campa and Goldberg (1997).

production out to foreign companies (*Foreign Outsourcing*), such as Nike. As a result, intermediates traded within firm boundary coexist with those through arm's length transactions and the relative importance of the two modes differs across industries. In a number of countries, auto, chemical and non-metallic mineral sectors exhibit higher levels of FDI than other industries. In Japan, chemical industry has a much larger fraction of firms engaging in FDI than, for instance, leather and fur product industry[33].

As trade in intermediates has become a distinguishing feature of the recent wave of globalization what account for these cross-industry variations in the relative importance of imports and the variations in the prevalence of intra-firm trade relative to arm's length transactions? In order to answer questions alike, a theoretical literature has evolved to formally model recent changes in firm investment decisions regarding intermediate procurement and explain the current development in trade pattern. Until now, empirical studies on this front, however, remain limited partially because firm-level data with detailed procurement information is hardly available. In a recent study on the topic, Antras and Helpman (2004) provide a new framework to examine the pattern of trade in intermediates using industry-level data. To the best of our knowledge empirical literature has not fully explored these predictions. Motivated to understand the current cross-industry variations in trade pattern we take available industry-level data and conduct an empirical analysis following the framework. The goal of our study is three folded: i) to explain the relationship between industry characteristics and cross-industry variations of trade patterns based on the model, ii) to gain some understanding of firm behavior taking advantage of available industry level data, and iii) to check the explanatory power of new modeling techniques adopted by international trade literature.

[33] See Hanson et al. (2003) and Tomiura (2007).

To explain the growing importance of international trade in intermediate inputs either through outsourcing or FDI, researchers have been motivated to enrich trade theory with concepts from industrial organization and contract theory that explain the organization form of the firm[34]. One branch of studies embeds incomplete contract model into traditional trade model and has provided explanations to various questions on international vertical specialization[35]. Building on this strand of model, Antras and Helpman (2004) introduce firm productivity dispersion as pioneered by Melitz (2003) and construct a North-South trade model which allows a firm to endogenously choose one of four organization forms including domestic in-house production of intermediates, domestic outsourcing, FDI and foreign outsourcing. Based on firm behavior the model further yields rich implications concerning how industry and country characteristics can affect the relative prevalence of organization forms in an industry.

Inspired by the model we take two steps in this study to explain cross-industry variations in the current trade pattern. First of all, we make a simple extension of the model based on the intuition that the relative prevalence of organization forms essentially determines the structure of trade in intermediates. The extension allows us to derive two hypotheses relating industry characteristics with the imports of intermediates by a North country. The first one is about the relative importance of imports as a means to obtain intermediates which says high degree of productivity dispersion and low "headquarter service" intensity are associated with a larger share of imports in total intermediates purchases. The second one concerns the importance of intra-firm trade relative to arm's length transactions and says high degree of productivity dispersion and high "headquarter

[34] For surveys see Spencer (2005) and Helpman (2006).
[35] For instance Antras (2003).

service" intensity are associated with a larger share of intermediates imported through intra-firm transactions in total intermediate imports. As the second step, we specify two reduced-form models corresponding to the hypotheses and conduct analyses on an industry-level panel data of the United States' manufacturers. As data on intermediate imports are not directly available, following Feenstra and Hanson (1996, 1997) and Campa and Goldberg (1997), we use input-output table, trade and production data to compute the share of imports in total intermediate purchases and use the imports by US parent MNCs from their foreign affiliates[36] as intermediates imported within firm boundary.

The empirical analyses provide several evidences supporting the first hypothesis. First of all, the results show that a higher degree of productivity dispersion is associated with a greater share of imports from developing countries in total intermediate purchases. In particular, a 10 percentage point increase in productivity dispersion is associated with a 2.2-3 percentage point increase in the share of imports. It indicates that firm heterogeneity plays an important role in determining the relative importance of trade in intermediates procurement by affecting firms' choice between imports vs. domestic procurement. This provides another piece of evidence supporting the introduction of firm heterogeneity in trade model[37]. It also suggests that imports require higher productivity than domestic procurement which is a major assumption of the model. We use capital intensity, human capital intensity and R&D intensity to capture the idea of "headquarter service" intensity. The results show that capital intensive and/or human capital intensive industries are less likely to acquire intermediates from developing countries. It supports the prediction based on the key insight of incomplete contract theory. The results also show that R&D intensive

[36] The data does not distinguish imports of intermediates or components from final goods.
[37] Helpman et al. (2004) show the importance of firm heterogeneity in explaining FDI vs. exports.

industries have higher propensity to import intermediates. Overall the results indicate the importance of input intensity in explaining firms' organization choices. Our analyses also show that the model can explain cross-industry variations in the dependent variable reasonably well. In addition, in consistent with the setting of North-South trade model the model fit the data on US imports from developing countries much better than the data on imports from developed countries, which is another evidence supports the theory model.

Our analyses only provide weak evidence in line with the second hypothesis partially due to data limitations. When include productivity dispersion and measures on "headquarter service" intensity variables in the model one at a time the results show that industries with high productivity dispersion may tend to import intermediates through intra-firm trade than through arm's length trade and that industries with high "headquarter service" intensity have higher propensity for intra-firm trade. It is in line with the predications. When include multiple explanatory variables in the model the impact of the variables cannot be distinguished from each other. In sum, the results only provide a little evidence supporting the power of firm heterogeneity and incomplete contract theory in explaining the relative prevalence of FDI versus foreign outsourcing.

The remainder of the paper is organized as follows. Section 4.2 summarizes current empirical findings and some related theoretical work on international vertical specialization and trade in intermediates. Section 4.3 briefly reviews the model of Antras and Helpman (2004) and extends the comparative statistics analysis to the hypotheses relating industry productivity dispersion and input intensity with intermediate imports. Section 4.4 discusses the reduced form econometric models and explains data sources.

Section 4.5 discusses summary statistics and reports the estimation results. Section 4.6 concludes the paper.

4.2 Literature Review

4.2.1 Empirical Findings

International vertical specialization has been labeled quite extensively: "slicing the value chain", "international fragmentation", "multi-stage production", "intra-product specialization", "disintegration", "production sharing", "outsourcing", "offshore sourcing", and "foreign outsourcing".[38] The basic idea is that the production value-added chain is cut into ever smaller slices, and some of them can be conducted outside of the boundaries of a company and need not be confined by the limits of a region or a country. If a company chooses to keep these activities at home, it engages in either *standard vertical integration* or *domestic outsourcing*. Alternatively, a company can extend these activities abroad and procure intermediates internationally, the so-called *foreign sourcing* or offshore sourcing. If so, it may undertake all activities within its boundaries by engaging in *foreign direct investment* (FDI) and becomes a multinational company (MNC), or it may procure specialized components or services from arms-length providers and engages in *foreign outsourcing*. When companies find it more profitable than ever to extend increasing amounts of activities abroad international trade in intermediates has become a distinguishing feature of globalization in the past two decades.

Feenstra and Hanson (1996, 1997) use input-output table and estimate the share of imported intermediates in total intermediate purchases for U.S. manufacturing industries.

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[38] See, for example Krugman (1995), Feenstra and Hanson (1996, 1997), Feenstra (1998), Deardorff(1998), Arndt (1997), Hummels et al.(1998), Grossman and Helpman (2002, 2004, 2005), Kohler(2004), Jones et al.(2005).

They find that the value has increased from 5.3 percent in 1972 to 11.6 percent in 1990. Campa and Goldberg (1997) make similar calculations for Canada, Japan, the United Kingdom and the United States, and find that in the cases of Canada and U.K., over 20 percent of inputs are purchased from abroad in 1993. Strauss-Kahn (2003) finds similar evidence for France. Yeats (2001) explores the OECD trade data coded in Standard International Trade Classification system (revision 2) and measures the trade in components for OECD countries. He reports that US imports of components rose about six-fold over 1978-95 period. Feentra et al. (1999) investigate the data set on U.S. offshore assembly program (OAP) and illustrate the impressive increases of component imports by several industries.[39]

The extent of international procurement of intermediates, however, varies across industries according to available studies. Feenstra and Hanson (1996) report that certain industries show a much higher propensity to import intermediates. In footwear, electric and electronic machinery, instruments, the share of imported intermediate inputs in material purchases is approximately 1.5-1.75 times higher than the average value observed for manufacture industries. The results from Campa and Goldberg (1997) also indicate that in U.S., U.K., and Canada, chemical industry has a lower share of imported inputs than average, whereas machinery and transportation equipment have higher shares. Yeats (2001) finds that imports of parts and components are concentrated in relatively few product groups. Especially, "4 of the 44 SITC product groups account jointly for over 70 percent of total trade in components with parts of motor vehicles alone (SITC 784) accounting for over $91 billion, or about one-quarter of the total exchange in these goods…

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[39] Also see, Hummels et al. (1998) and Hummels et al. (2001) for evidence from trade in components. See, for example, James Bamford (1994), and Peter Buxbaum (1994) for facts in particular industries.

Outside these four groups the largest remaining products generally account for no more than one to five percent of the total."

The data distinguishing intermediates imported through arm's length from those traded within the boundary of MNCs is much scarcer. The available information, however, indicates considerable variations across industries regarding the prevalence of FDI relative to foreign outsourcing. In the case of Japanese manufacturing sectors, in chemical product industry more than 7 percent of firms engage in FDI and less than 2 percent of firms outsource abroad. Leather and fur product industry is on the other end of the spectrum, in which about 3.9 percent of firms subcontract to foreign companies and less than 1 percent of firms involve in FDI (Tomiura 2007). For other countries, auto, chemical and non-metallic mineral sectors, for instance, exhibit higher levels of foreign direct investment than other industries (Hason et al. 2003).

In sum, recent empirical studies have documented the growing importance of trade in intermediates and its characteristics, including cross industry variations. A few works, however, go beyond to provide theoretically informed analyses on the forces driving firms' organization choice and factors affecting cross-industry differences. It is partially because theory literature on this front is still emerging. The other reason is that the detailed firm-level data needed for understanding firm internal investment and procurement decision is hardly available.

4.2.2 Related Theory

The new development in the world economy has triggered studies designed to capture the changes in investment and trade patterns and the reorganization of world production across nations. Traditional trade theory literature abstract from vertical fragmentation and contractual relationship can not fully explain the recent growth and pattern of international trade in intermediates. Early literature on firm organization and international trade classifies the problems faced by a firm engaging in international activities, typically a MNC, into three interrelated aspects, ownership of an asset, location of produce, and whether to keep asset internal to the firm, the so-called OLI framework of multinational activity[40]. Traditional theory literature has addressed the location problem of a firm[41] but fail to formalize the internalization issue, with only a few exceptions. Even when they introduce firm boundary issue together with location decision, the focus is on whether contract out all production activities or integrate all to better serve foreign market[42]. The question as of whether to acquire intermediate inputs through arm's length transactions or in-house production is left untouched. These models are well suited to interpret the intra-firm trade of final goods but not applicable to understand the trade in intermediates.

Recently, a new literature has evolved which enriches international trade theory with concepts from industrial organization and contract theory that explain firm organization forms with respect to intermediate procurement, including incomplete contract, incentive systems, transaction costs, and delegation of authority (for a complete survey see Spencer (2005)). One branch of studies embeds the incomplete contract model of Grossman and Hart (1986) and Hart and Moore (1990) into general equilibrium monopolistic competition model of Krugman (1984). As discussed by Helpman (2006) this approach is arguably the most fruitful method on this topic as it has enabled researchers to

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[40] See Feenstra (2004), ch11.
[41] See seminal work by Helpman and Krugman (1985) and Markusen (1984, 2002).
[42] See, for example, Ethier (1986), Ethier and Markusen (1996), Hortsmann and Markusen (1996) and Markusen (2001).

study various questions concerning firm intermediate procurement and the associated trade patterns[43].

The common assumptions of property rights model are relationship-specific investment and incomplete contracting between two agents. As a result, investment cannot be fully awarded due to potential hold-up problem and ownership ultimately determines agents' investment incentive. The key insight is that in equilibrium ownership should be assigned to the agent whose investment contributes more to the production process to increase efficiency. Combining this insight with the input intensity of production process allows one to determine the internal boundary of a firm. For instance, Antras (2003) takes this approach assuming final good producer contributes capital and intermediate supplier provides labor to the production, respectively, and countries have different endowment. The boundaries of firms and the international location of production are, then, pined down simultaneously in the model. Firm boundary is determined by the relative capital intensity of the industry, with firms in the relative capital-intensive sector assigning ownership to final good producers—integrating, and those in the relative labor-intensive sector assigning ownership to intermediate suppliers–outsourcing. The location choice is determined by the Heckscher-Ohlin type of relative endowment character of countries.

Comparing with Antras (2003) and previous work, the major contribution of Antras and Helpman (2004) is introducing firm productivity heterogeneity. Recent empirical studies, for instance Bernard et al. (2003) and Bernard et al. (2007), have shown that only a small fraction of firms involve in international activities which challenges the traditional approach of assuming "representative firm". By modeling productivity heterogeneity

[43] For instance, Grossman and Helpman (2002) model make-or-buy decision and Grossman and Helpman (2005) study location choice of outsourcing, Antras (2005) construct a dynamic model.

Antras and Helpman (2004) allow firms in the same industry to choose different ways to obtain intermediates and cross-industry variations in the relative importance of different organization forms. It offers a deeper insight of the current investment and trade patterns.

First of all, Antras and Helpman (2004) incorporate the incomplete contract idea into their North-South trade model and assume final good producer from the North contributes “headquarter service” and supplier provides intermediates. Based on the insight of incomplete contract model, in “headquarter service” intensive industries vertical integration is more profitable than outsourcing. In addition, following Melitz (2003), Antras and Helpman (2004) model firms with different productivity—a random draw from a Pareto distribution—and organization choices with different fixed cost–higher costs to import from South and higher fixed to integrate. As a result, firms must weigh the trade offs associated with different organization forms. Even in relative “headquarter service” intensive sectors only the most productive firms choose to FDI as they find the combination of lower wage costs and higher revenue from ownership to be sufficient to overcome the largest fixed costs. The less productive ones will outsource from the South to take advantage of lower wage costs. The least productive ones will in-house produce in the North and outsource from the North, respectively. This sorting pattern implies that industries with greater dispersion in productivity should feature a larger share of firms offshoring and a larger share of firms engaging in FDI among all off-shoring firms. It also implies that industries requiring “headquarter services” more intensively should have a larger fraction of firms choosing FDI and a smaller share of firms offshore outsourcing.

In sum, Antras and Helpman (2004) yields predictions relating industry characteristics, productivity dispersion and input intensity, with the relative prevalence of different firm organization modes. As different firm organization choices will channel trade in intermediates the predictions provide a new framework to examine the pattern of trade in intermediates using industry-level data. This advantage has not been fully explored by current empirical studies[44] and this study will take a step to fill in this gap in literature.

4.3 Model and Extensions to Trade

In this section, we briefly review the basic setting and results from Antras and Helpman (2004) and extends the predictions to hypotheses directly about industry characteristics and the pattern of trade in intermediates.

4.3.1 Model

The basic structure is a one-factor multi-sector general equilibrium model of two trading countries, North and South. Labor is the only factor with perfect elastic supply. Wage rates are fixed at w^N in the North and at w^S in the South, where $w^N > w^S$. There are $1+J$ sectors and aggregate consumption in sector j, X_j, is defined by a constant elasticity function of consumption of all varieties $x_j(i)$, with elasticity of substitution $1/(1-\alpha)$. The derived inverse demand function for variety i in sector j is

$$p_j(i) = X_j^{\mu-\alpha} x_j(i)^{\alpha-1} . \qquad \textbf{(4.1)}$$

Output of any variety in a sector is defined by a sector-specific Cobb-Douglas function:

$$x_j(i) = \theta \left[\frac{h(i)}{\eta_j} \right]^{\eta_j} \left[\frac{m(i)}{1-\eta_j} \right]^{1-\eta_j} , \quad 0 < \eta_j < 1 . \qquad \textbf{(4.2)}$$

$h_j(i)$ represents headquarter services provided by a final-good producerand $m_j(i)$ denotes intermediate inputs supplied by a manufacturing plant operator. η_j is the sector-specific

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[44] Yeaple (2006) studies the second hypotheses examined in this paper. The approach is similar but the data is different.

indicator for "headquarter service" intensity. A larger η_j implies that the final-good producer contributes more to the production process.

Productivity parameter θ is firm specific which is assumed to have a Pareto distribution $G_j(\theta)$,

$$G_j(\theta) = 1 - \left(\frac{b}{\theta}\right)^{z_j}, \qquad \text{for } \theta \geq b > 0. \tag{4.3}$$

A larger θ indicates the producer is more productive and located to the further right of the distribution. z_j represents the dispersion of productivity within sector j. A decline in z indicates an increase in the dispersion of productivity which means more mass is pushed to the right tail of the distribution. In other words, as productivity dispersion increases a random firm is more likely to be productive.

The production of any variety in a sector proceeds as follows[45]: first, a North final-producer pays entry cost to enter. After that, the final-producer draws a productivity level and decides whether to exit or not. If it continues operating, he needs to contract with a manufacturing plant operator for the provision of components. In other words, the final-producer must choose one of the four organization forms: vertically integrating a supplier from North, outsourcing inputs from North, vertically integrating a supplier from South (FDI), or outsourcing inputs from South through arm's-length trade. Each organization form has unique fixed costs. It is assumed that production in South requires higher fixed costs, ($f^S_k > f^N_k$), and integration demands higher fixed cost ($f^l_V > f^l_O$). The resulting order is

$$f_V^S > f_O^S > f_V^N > f_O^N. \tag{4.4}$$

[45] For simplicity, the index j is dropped.

Regardless organizational form, no enforceable contract can be signed ex ante and both parties have to make relationship-specific investment. Ex post, the final good producer obtains a fraction $\beta \in (0, 1)$ of the gains from the relationship which depending on organizational forms. When intermediates are produced in North the final good producer can get a larger fraction than otherwise and the final good producer can seize intermediates when parties fail to reach agreement under integration but not under outsourcing. The final order is

$$\beta_V^N > \beta_V^S > \beta_O^N = \beta_O^S . \quad \textbf{(4.5)}$$

Given incomplete contract, each party chooses output levels independently to maximize its own payoffs. That is

$$h(i) = \arg\max_{h(i)} \beta_k^l R(i) - w^N h(i) , \quad \textbf{(4.6)}$$

$$m(i) = \arg\max_{m(i)} (1-\beta_k^l) R(i) - w^l m(i) , \quad \textbf{(4.7)}$$

where *R(i)* denote total revenue $R(i) = X^{\mu-\alpha}\theta^{\alpha}\left[\frac{h(i)}{\eta}\right]^{\alpha\eta}\left[\frac{m(i)}{1-\eta}\right]^{\alpha(1-\eta)}$. **(4.8)**

The resulting total profits is

$$\pi_k^l(\theta, X, \eta) = X^{(\mu-\alpha)/(1-\alpha)}\theta^{\alpha/(1-\alpha)}\psi_k^l - w^N f_k^l , \quad \textbf{(4.9)}$$

where $\psi_k^l = \frac{1-\alpha[\beta_k^l\eta + (1-\beta_k^l)(1-\eta)]}{\{(1/\alpha)(w^N/\beta_k^l)^{\eta}[w^l/(1-\beta_k^l)]^{1-\eta}\}^{\alpha/(1-\alpha)}}$. **(4.10)**

In equilibrium, after observing its productivity level, the final good producer exits the industry if the firm cannot earn nonnegative profits. Otherwise he chooses one organization form that maximizes total profits. Only producers with sufficient high productivity could overcome the higher fixed cost in south ($f^S_k > f^N_k$) and reap the benefits of lower labor costs ($w^N > w^S$). Similarly, only producers with sufficient high productivity could afford higher fixed cost of integration ($f^l_V > f^l_O$) and receive larger fraction of revenue ($\beta^l_V > \beta^l_O$). As a result, firms of an industry with sufficient "headquarter service" intensity will be sorted into the following pattern[46]: the least productive firms, ($\underline{\theta} < \theta < \theta^N_O$), integrate input production in North; firms with moderate productivity, ($\theta^N_O < \theta < \theta^N_V$), outsource inputs in North; sill higher productivity firms, ($\theta^N_V < \theta < \theta^S_O$), outsource in South; and the most productive firms, ($\theta > \theta^S_O$), integrate input production in South. The cutoff values of productivity can be solved in the equilibrium.

4.3.2 Extension to Trade

Based on the sorting of heterogeneous firms, Antras and Helpman(2004) show that the relative prevalence of organization forms will depend on industry characteristics, including headquarter intensity and levels of productivity dispersion, and country characteristics, including wage rates and levels of property righter protection. Intuitively, the relative prevalence of organization forms as defined in the model essentially determines the relative importance and the structure of trade in intermediates. As the primary interest is to understand cross-industry variations in the trade of intermediates, we make a simple extension and derive hypotheses in which the patterns of trade in intermediates are related with industry characteristics.

Solve the first order conditions of payoff maximization as defined in (4.6) and (4.7), the equilibrium value of intermediate inputs is

$$m^l_k(i) = (1-\eta) X^{(\mu-\alpha)/(1-\alpha)} \theta^{\alpha/(1-\alpha)} \tilde{\rho}^l_k, \qquad \textbf{(4.11)}$$

46 They specify two benchmark cases for headquarter-intensive sector and component-intensive sector, respectively. In the latter case, no integration happens while my data indicates FDI occurs in every aggregated sector. Therefore, only the former case is considered in this paper.

where $$\tilde{\rho}_k^l = \left[\frac{1}{\alpha} \left(\frac{w^N}{\beta_k^l} \right)^{\alpha\eta} \left(\frac{w^l}{1-\beta_k^l} \right)^{1-\alpha\eta} \right]^{-1/(1-\alpha)} . \quad \textbf{(4.12)}$$

Then, the total value of intermediate inputs purchased by firms with ownership type k obtain intermediate from location l, denoted by M_k^l, will be the aggregation of $m_k^l(i)$. Given the cutoff values of productivity for different organization forms, M_k^l can be expressed as the follows

$$\begin{aligned}
M_O^N &= (1-\eta)X^{(\mu-\alpha)/(1-\alpha)}[V(\theta_O^N) - V(\underline{\theta})]\tilde{\rho}_O^N , \\
M_V^N &= (1-\eta)X^{(\mu-\alpha)/(1-\alpha)}[V(\theta_V^N) - V(\theta_O^N)]\tilde{\rho}_V^N , \\
M_O^S &= (1-\eta)X^{(\mu-\alpha)/(1-\alpha)}[V(\theta_O^S) - V(\theta_V^N)]\tilde{\rho}_O^S , \\
M_V^S &= (1-\eta)X^{(\mu-\alpha)/(1-\alpha)}[V(\infty) - V(\theta_O^S)]\tilde{\rho}_V^S , \quad \textbf{(4.13)}
\end{aligned}$$

where $$V(\theta) = \int_0^\theta y^{\alpha/(1-\alpha)} dG(y) . \quad \textbf{(4.14)}$$

The share of intermediates purchased by firms which have ownership structure k and obtain intermediates in $l, \tilde{\sigma}_k^l$, is

$$\begin{aligned}
\tilde{\sigma}_O^N &= \frac{[V(\theta_O^N) - V(\underline{\theta})]\tilde{\rho}_O^N}{\tilde{M}} , \\
\tilde{\sigma}_V^N &= \frac{[V(\theta_V^N) - V(\theta_O^N)]\tilde{\rho}_V^N}{\tilde{M}} , \\
\tilde{\sigma}_O^S &= \frac{[V(\theta_O^S) - V(\theta_V^N)]\tilde{\rho}_O^S}{\tilde{M}} , \\
\tilde{\sigma}_V^S &= \frac{[V(\infty) - V(\theta_O^S)]\tilde{\rho}_V^S}{\tilde{M}} , \quad \textbf{(4.15)}
\end{aligned}$$

where $$\begin{aligned}\tilde{M} = {} & [V(\theta_O^N) - V(\underline{\theta})]\tilde{\rho}_O^N + [V(\theta_V^N) - V(\theta_O^N)]\tilde{\rho}_V^N + \\ & [V(\theta_O^S) - V(\theta_V^N)]\tilde{\rho}_O^S + [V(\infty) - V(\theta_O^S)]\tilde{\rho}_V^S \end{aligned} . \quad \textbf{(4.16)}$$

Because the primary interest is about intermediate imports, we consider how industry characteristics affect two variables in what follows. One is the share of imports in total industry intermediate purchases, $\tilde{\sigma}_O^S + \tilde{\sigma}_V^S$, which represents how important import is as a mean of obtaining intermediates in an industry. The other one is the share of intermediates traded through intra-firm transactions in total imports, $\tilde{\sigma}_V^S / (\tilde{\sigma}_V^S + \tilde{\sigma}_O^S)$. It shows with respect to importing intermediate how important intra-firm trade is relative to arm's length transaction.

First, we consider an increase in the degree of productivity dispersion, represented by a decline in *z*. Based on the characteristics of Pareto distribution both $\tilde{\sigma}_O^S + \tilde{\sigma}_V^S$ and $\tilde{\sigma}_V^S / (\tilde{\sigma}_V^S + \tilde{\sigma}_O^S)$ increase. When productivity, θ, is Pareto distribution with shape parameter *z*, $V(\theta)$ could be treated as an index for firm sales and follows the properties of Pareto distribution with shape parameter $z - \alpha/(1-\alpha)$. A fall in z implies a fall in $z - \alpha/(1-\alpha)$. It means a heavier right tail than before. As a result, both $\tilde{\sigma}_V^S$ and $\tilde{\sigma}_O^S + \tilde{\sigma}_V^S$ increase and $\tilde{\sigma}_V^S$ increases more relative to $\tilde{\sigma}_O^S$. The intuition is that when the degree of dispersion increases more firms have high productivity and find it profitable to acquire intermediates abroad as well as to integrate production. In sum, the share of imports in total intermediate purchases and the share of imports through intra-firm trade in total imports both increase when the degree of sector productivity dispersion rises.

Next consider the impact of "headquarter service" intensity, η_j. As η_j increases $\tilde{\sigma}_O^S + \tilde{\sigma}_V^S$ falls while $\tilde{\sigma}_V^S / (\tilde{\sigma}_V^S + \tilde{\sigma}_O^S)$ increases because ψ_O^N / ψ_O^S and ψ_V^l / ψ_O^l as well as $\tilde{\rho}_O^N / \tilde{\rho}_O^S$ and $\tilde{\rho}_V^l / \tilde{\rho}_O^l$ (for *l=N, S*) become larger. Intuitively, when each party chooses output level separately under incomplete contract, both have incentives to under-invest in the supply. Ex ante efficiency requires assigning a larger share of the revenue to the party who contributes more to the production process. As a result, when a product needs more contribution from "headquarter"/final good producer, integration is more profitable. As "headquarter service" become more important some firms once outsource from the South will find integration more profitable and either move to integrate in the North or FDI. The direct result is the share of intermediates traded through arm's length, $\tilde{\sigma}_O^S$, falls and the share of intermediates imported through intra-firm trade, $\tilde{\sigma}_V^S$, increases. The former effect outweighs the latter. As a result, higher headquarter intensity is associated with a smaller share of imports in total intermediates purchases, $\tilde{\sigma}_O^S + \tilde{\sigma}_V^S$, and a larger share of imports through intra-firm trade in total imports, $\tilde{\sigma}_V^S / (\tilde{\sigma}_V^S + \tilde{\sigma}_O^S)$.

In sum, through affecting firms' organization choices industry characteristics influence the pattern of trade in intermediates. The relationship can be summarized into two hypotheses with respect to the two shares of interests. One relates industry characteristics with the importance of imports in total intermediate purchases. It says that the higher the degree of productivity dispersion and the lower the "headquarter service" intensity, the larger the share of imports in total intermediate purchases. The other links industry characteristics with the importance of intra-firm trade relative to foreign outsourcing. It says that the higher the degree of productivity dispersion and the higher the "headquarter service" intensity, the greater the share of intermediates traded through intra-firm transactions in total intermediate imports.

4.4 Specifications and Data

4.4.1 Empirical Specification

In our empirical analyses, we specify two reduced-form models corresponding to the above two hypotheses. The goal is three folded: i) to explain the cross-industry variations of trade patterns with industry characteristics indicated by the model, ii) to gain some understanding of firm behavior taking advantage of available industry level data, and iii) to check the explanatory power of the modeling techniques against data, including introducing firm heterogeneity and incomplete contracting.

The first model (Model 1) is about the relative importance of imports in total intermediate purchases which takes the following form

$$\begin{aligned}(IMP\_IN/Intermediates)_{it} &= \beta_0 + \beta_1 (Dispersion)_{it} + \beta_2 KIntensity_{it} + \\ \beta_3 HIntensity_{it} &+ \beta_4 RDIntensity_{it} + \beta_5 (Scale)_{it} + \gamma_t + \varepsilon_{it}\end{aligned} \quad \textbf{(4.17)}$$

$(IMP\_IN/Intermediates)_{it}$ represents the share of imports in total intermediate purchases of industry *i* at *t*, i.e. $\tilde{\sigma}_V^S + \tilde{\sigma}_O^S$. Following Feenstra and Hanson (1996, 1997) and Campa and Goldberg (1997), we compute it as a weighed sum of import-to-consumption ratios over all input industries where the weight is the share of production expenditure attributable to each input. The underlining assumption is that regardless of output industry, the fraction of each intermediate input acquired through imports equals the respective import-to-consumption ratio of the input industry. The formula is

$$(IMP\_IN/Intermediates)_{it} = \left[\sum_j \alpha_{ij} \times \frac{IMP_{jt}}{COM_{jt}}\right] \quad \textbf{(4.18)}$$

α_{ij} is the amount of input *j* required to produce one dollar worth of *i*. We include all manufacture industries, with the exception of three natural-resource industry, as input industries. $\frac{IMP_{jt}}{COM_{jt}}$ is the import-to-consumption ratio of input *j* at *t*, and total consumption, *COM*, is computed as (domestic sales + imports – exports) [47]. The model is a North-South trade model based on labor cost differences. We expect it to fits data on the imports from developing countries the best. To capture this idea, we calculate two different shares, one based on imports from developing countries and the other based on imports from developed countries[48]. We focus on the first one in our baseline analysis and use the second as a robustness check.

The first explanatory variable of interest is the degree of productivity dispersion of an industry, denoted as $(Dispersion)_{it}$. This variable is of particular interest in that its impact is rooted in the introduction of firm heterogeneity and the assumptions on productivity requirements by different organization forms. Regardless of the sign, the significance of *Dispersion* will imply that productivity differences do drive firms to obtain intermediates differently, in this case imports vs. domestic procurement, and hence, play a role in the structure of international trade in intermediates. In other words, it allows us to directly check the explanatory power of introducing productivity heterogeneity in modeling international trade. Additionally, based on the first hypothesis we expect a positive coefficient on *Dispersion,* which will suggest that importing intermediates in particular and engaging in international transactions in general do require higher capability.

As productivity dispersion is not observable, we use firm size dispersion in terms of final good sales as the measure. Based on model, the degree of sale dispersion, $z-\alpha/(1-\alpha)$, is a linear transformation of the degree of productivity dispersion, *z*, when productivity

[47] Following Feenstra and Hanson (1996) we also compute the variable where consumption = domestic sales + imports and conduct the same analysis as a robustness check.
[48] The classification is based on the definition by United Nations Statistics Division http://unstats.un.org/unsd/methods/m49/m49regin.htm#developed.

have a Pareto distribution with shape parameter *z*. The intuition is that more productive firms sell more. Following Helpman et al. (2004)[49] we compute sale dispersion as the standard deviation of the logarithm of sales. The available industry level information includes total sales, total number of establishments and concentration ratios[50]. In order to calculate the standard deviation of the logarithm of sales, we divide the establishments into five classes based on concentration ratios and assume all establishments in the same class have the logarithm of sales equal to the mean of the category. As a robustness check, we also measure dispersion in terms of employment sizes assuming more productive firms have larger size, which computed as the standard deviation of the logarithm of employment.

The second group of explanatory variables is designed to measure the “headquarter service” intensity. In order to examine the share of sectoral FDI in total US imports, Antras (2003) use capital intensity, human capital intensity and R&D intensity to capture potential contributions by final good producers. Following the idea, we include these three variables in the model to measure “headquarter service” intensity. The underlining assumption is that when a firm structured itself vertically the responsibilities of acquiring capital stock, training skilled labors and conducting R&D mainly fall on “headquarters”/final good producers. The intensity of these variables will, therefore, reflect the relative importance of headquarters services in total production process. We expect these variables to be negatively correlated with the dependent variables as predicted in the model. In our model, capital intensity, *KIntensity*, is measured as the logarithm of capital per labor,

[49] Helpman et al. (2004) show that the standard deviation of the logarithm of sales is a theoretically sound estimate for sale dispersion.
[50] CR4, CR8, CR20 and CR50 measure the shares in total industry sales by the largest 4, largest 8, largest 20 and largest 50 establishments, respectively.

human-capital intensity, *HIntensity*, is measured as the ratio between the number of non-production workers to total number of workers and R&D intensity, *RDIntensity*, is measured as the ratio of R&D expenditures to sales.

In the model, the assumptions on the fixed costs differences among organization forms affect the relative prevalence of different organization forms. It inspires us to check the impact of fixed costs. When comparing different motives for FDI, Yeaple (2003) use the plant scale of an industry to control for fixed costs assuming it captures the costs of maintaining additional capacity. Following the idea we add several measures on plant scale to our model, denoted as *Scale*. The measures include the logarithm of capital stock per establishment, *KScale*, the logarithm of the number of non-production worker per establishment, *HScale*, and the logarithm of the number of production worker per establishment, *LScale*. Note that, as we only have production data of the United States the scale measures are industry specific without accounting for the differences between firm organization forms. Our goal here is limited to check whether cross-industry differences in fixed costs will influence the patterns of intermediate imports by affecting the firm organization decision. At prior we do not know the direction of the impact.

In Antras and Helpman (2004), countries specific factors, including wage rate and level of property right protection, also affect firm organization decisions. These factors only vary over time in our model because we do not distinguish among developing countries. In order to control for these time-variant factors we include year fixed-effects, γ_t, in our analyses which also take care of other macroeconomic shocks.

The second model (Model 2) is about the importance of intermediates imported through intra-firm trade relative to total imports:

$$(MNC/IMP\_IN)_{it} = \theta_0 + \theta_1(Dispersion)_{it} + \theta_2 KIntensity_{it} + \theta_3 HIntensity_{it} + \theta_4 RDIntensity_{it} + \theta_5(Scale)_{it} + \gamma_t + \varepsilon_{it} \quad \textbf{(4.19)}$$

(MNC / IMP_IN) $_{it}$ denotes the share of intermediates imported through intra-firm trade in total imported intermediates, i.e. $\tilde{\sigma}_V^S / (\tilde{\sigma}_V^S + \tilde{\sigma}_O^S)$. The numerator, *MNC*, denotes the value of intermediates imported within the boundary of MNCs, i.e. through intra-firm trade. We use the imports by US parent MNCs from majority-owned foreign affiliates[51] to approximate the value because the available data does not allow us to distinguish the imports of intermediates from those of final products. The denominator, *IMP_IN*, denotes the value of intermediates imported through both intra-firm and arm's-length trade. It is computed by multiplying the share of imports in total intermediate purchases defined in equation (4.18) by the costs of total intermediate. Again, as the model is about North-South trade based on labor cost differences, ideally, we should compute the variable based on imports from developing countries. The available data, however, does not have country specific information so we calculate the variable for US imports from the world rather than from the developing countries.

All the other variables are defined as the same as in equation (4.17). Analogously, *Dispersion* is of particular interest in that the significance of *Dispersion* will imply that productivity differences do drive firms to obtain intermediates differently, in this case intra-firm trade vs. arm's length trade, and hence, affect the composition of international trade in intermediates. It will help to check the explanatory power of introducing productivity heterogeneity in modeling international trade. We expect *Dispersion* to be

[51] We also compute the variable using information on all foreign affiliates and conduct the same analysis as robustness check.

positively related with the share of intra-firm trade, which will suggest that obtaining intermediates with FDI requires higher productivity than with foreign outsourcing.

We use capital intensity, human capital intensity and R&D intensity to measure "headquarter service" intensity. We expect all variables to have positive coefficients, which will confirm that industries requiring more "headquarter services" will tend to import intermediate through intra-firm trade rather than arm's length transactions. It allows us check on the key insight of the incomplete contract theory that for ex ante efficiency firms are more inclined to assign ownership to the final good producer when "headquarter" contributes more to the production. Finally, measures on plant scale and year fixed-effects are included to take into account the impact of fixed costs and time-variant factors.

4.4.2 Data

We base our analysis on an industry-level panel data of the United States manufacturers from 1987 to 1999. We exclude the natural-resource industries to be close to the setting of the model and the press and ordnance sectors due to lack of information. All other manufacture industries are included.

In terms of data used to compute the dependent variables of the two models the trade data are extracted from "*U.S. Imports by SAS and Stata, 1972-2001*"dataset[52] and "*U.S. Exports by SAS and Stata, 1972-2001*"dataset[53] provided by NBER. The information of industry output values is collected from "*Manufacturing Industry Productivity Database*"[54] provided by NBER. The input-output information is from "*Input-Output Accounts*" dataset compiled by US Bureau of Economic Analysis (BEA) and we use 1992

[52] See Feenstra (1996) for description of the data
[53] See Feenstra (1997) for description of the data.
[54] Put together by Bartelsman, Becker, and Gray. The data I am using is an updated version given by Gray.

benchmark table for our analysis assuming production structure is stable over the period. The trade data of MNCs is extracted from "*U.S. Imports of Goods Associated with U.S. Parents and Their Foreign Affiliates, by Industry of U.S. Parent*" table of BEA's *US Direct Investment Abroad* dataset. The table reports i) the value of the imports of parent companies from affiliates located outside of the United States, ii) information on imports from all affiliates and those from majority-owned affiliates, respectively, and iii) the industry of the US parent companies. The data allows us to map the information with the value of intermediate imports and then with other explanatory variables based on the industry classification of parent companies.

As of explanatory variables, the information on industry-level sales, number of establishment and concentration ratios, including CR4, CR8, CR20 and CR50, is extracted from "*Census of Manufacturing*" by US Census Bureau. The data is available for 1987, 1992 and 1997. The information of industry output values and input information, including production labor, non-production labor and capital, are from NBER's "*Manufacturing Industry Productivity Database*". The data on R&D is collected from *"the Industrial Research and Development Information System, Historical data 1953-98"* compiled by the National Science Foundation (NSF).

The original data series are classified under different systems, including 4-digit SIC, 4-digit NAICS, industries defined by input-output matrix and industries defined in BEA *US Direct Investment Abroad* dataset. We convert data series into the finest industries available for consistency. As a result, we end up with forty-seven industries based on the input-output matrix for the first model specified in equation (4.17), and more aggregated twenty-two industries as defined in the BEA *US Direct Investment Abroad* dataset for the second model specified in equation (4.19) (See Appendix A and Appendix B for concordance between different classification systems)[55]. In terms of time span, we further restricted ourselves to year 1987, 1992 and 1997 in most analyses because the Census Bureau data used to compute *Dispersion* is only available in those years.

4.5 Results

4.5.1 Summary Statistics

Before proceeding to the analyses we begin with the estimated share of imports from developing countries in total intermediate purchases for each industry (table 4.1). First of all, for all the industries the value saw an increase over 1987-1997. The largest increase is in computer equipment production industry (51) with a 5.7 percentage point, which is followed by apparel production (18) and footwear production (33+34) industries. We further plot the average share of imports in total intermediate purchases for a broader period of 1982-2001 (figure 1) which also illustrates a rising trend. It is consistent with what found by Feenstra and Hanson (1996) and Campa and Goldberg (1997) that imports have become increasingly important as a mean of acquiring intermediates.

Another notable feature of the variable is that the cross-industry differences dominate the inter-temporal variations. The former is what we are mostly interested in. In table 4.1, the industries are ordered according to the value of 1987. For footwear (33+ 34), apparel (18), computer equipment (51), and communication equipment (56) production industries the share of imports is over 4 percent but for food (14), drugs (29A) and the other two sectors the share is less than 1 percent. The pattern is stable over the ten-year period.

[55] The definition and concordance between SIC and NAICS are available from data compiled by Jon Haveman.

The Spearman's rank correlations between the values of three years are all significant and greater than 0.975. It implies that some industries have higher propensity to import intermediates as noted by Feenstra and Hanson (1996), Campa and Goldberg (1997) and Yeats (2001), and the relative propensity to import does not change much over the ten years.

To further check the pattern of our data we calculate the summary statistics for all of the variables decomposing the standard deviations, maximum and minimum values into between and within components (See table 4.2). There apparently exist much more variations cross industry (between) than over time (within). This is true for all variables and does not depend on the industry classification system used. It implies that industry characteristics are stable over the period and in order to check the hypotheses of interests we need to take full advantage of cross-industry differences. The popular fixed-effect approach or first-differencing approach will get rid of most of these interesting variations. Additionally, we only have a relatively short panel with three years. Finally, we are mostly interested in explaining the cross-industry variations in trade patterns. We, therefore, rely on Pooled regressions on the panel data as our benchmark estimation approaches. We also cluster standard errors at industry level to avoid potential downward bias in standard errors.

Finally, we also report the pair-wise correlation coefficients among explanatory variables in table 4.3. *Dispersion* seems to be highly positively correlated with three variables on plant scale. There are also considerable positive correlation between capital intensity and capital scale variable, between human capital intensity and human capital scale variable, and among the three scale measures. To avoid collinearity, we experiment with different specifications in the following analyses. Finally, the alternative measures on *Dispersion* are highly positively correlated.

4.5.2 Results for Model 1

For equation (4.17) we conduct Pooled OLS as baseline analyses and present our results in table 4.4. Column 1 shows the results when we only include *Dispersion* and "headquarter service" intensity variables. Columns 2 to 4 report the results when plant scale variables are also added. To avoid collinearity we add the scale variable one at a time and exclude "headquarter service" intensity variable when it is highly correlated with the scale variable. All models include year fixed-effects which are not reported in the table.

The results provide several evidences in support of the first hypothesis. First of all, we find a positive significant coefficient on *Dispersion* as predicted by the model. The results are stable across all specifications reported in table 4.4. It suggests that a higher degree of dispersion is associated with greater share of imports from developing countries in total intermediate purchases. In particular, a 10 percentage point increase in *Dispersion* is associated with a 2.2-3 percentage point increase in the share. We interpret it as indicating that firm heterogeneity plays an important role in determining the relative importance of trade in intermediates procurement by affecting firms' choice between imports vs. domestic procurement. It provides another piece of evidence supporting the introduction of firm heterogeneity in trade model[56]. In addition, it suggests that importing intermediates requires higher productivity than domestic procurement as assumed by the model.

[56] Helpman et al. (2004) show the importance of firm heterogeneity in explaining FDI vs. exports.

As of the three "headquarter service" intensity variables we find they are all significant and provide some support to the model. In particular, the coefficients on capital intensity, *KIntensity*, and on human capital intensity, *HIntensity*, are both negative. The magnitudes are (-.026 and -0.024) and (-.073 and -0.114), respectively. It implies that capital intensive and/or human capital intensive industries are less likely to acquire intermediates from developing countries. These results are consistent with the model prediction. Based on the basic insight of incomplete contract model we could interpret it as indicating that higher capital intensity and/or human capital intensity lead firms to choose vertically integration over outsourcing to protect their investments. Fewer firms involve in foreign outsourcing and more firms choose FDI than otherwise. In the case of high (human) capital intensity the former outweighs the latter and the net result is fewer firms purchase intermediates abroad. At first glance, the results seem to be in line with the traditional Heckscher-Ohlin type of prediction that a country with relative high (human) capital endowment, in this case US relative to developing countries, tends to specialize in industries with high (human) capital intensity and hence, import less in those industries. Our dependent variable, however, characterize imports of intermediates and the explanatory variables characterize the industry of final good production. Input intensity of intermediates are not necessarily as the same as that of the final good. As a result, Heckscher-Ohlin theory is not fully applicable here.

The coefficient on R&D intensity, *RDIntensity*, however, is positive, between 0.003 and 0.007. It contradicts the model prediction and suggests that R&D intensive industries tend to go to developing countries for intermediates. Antras (2003) shows that R&D intensive industries tend to conduct FDI. Taking these findings, one explanation following the idea of incomplete contract could be that although R&D intensity also encourages FDI and discourages foreign outsourcing but the former effect dominates the latter. As a result, net share of imports in total intermediates increase. In sum, the results show that the intensity of capital investment, human capital investment and R&D do have significant influence on the relative importance of intermediate imports. It implies that input intensity of an industry may affect firms' organization decision in terms of procurement. In addition, the results on (human) capital intensity support the predictions based on incomplete contract theory and the results on R&D intensity contradicts the model prediction. Overall, our results on "headquarter service" intensity provide some support to the model.

We add the three plant scale variables in the model one at a time. We find a negative and significant coefficient for capital scale, a negative but statistically insignificant coefficient for human capital scale and a positive insignificant coefficient for production labor scale. It suggests that the industries requiring large capital stock for capacity building are less likely to import intermediates from developing countries. The same may apply to human capital scale requirement while industries requiring large plant-level production worker may tend to import intermediates from developing countries.

Finally, the R-squares are between 0.28 and 0.42. Given the fact that the main variations are cross-industry changes the model has reasonable power in explaining why the relative importance of imports in total intermediates purchases vary across industries. It further confirms that by carefully modeling firm internal organization behavior the theory model helps us to understand the recent phenomenon in international trade.

We further subject the model to several robustness checks. One potential argument against our results is reverse causality. It might be the case that when an industry imports more intermediates from developing countries the productivity dispersion increases. In order to attenuate the problem, we lag the explanatory variables by one- and two-year. Recall that for explanatory variables we only have data for 1987, 1992 and 1997. We, therefore, use one- and two-year forwarded value of the dependent variable and re-conduct the analyses. The results are reported in table 4.5 and table 4.6. We find the same pattern of signs and the magnitudes of the coefficients are close to baseline. First, *Dispersion* is positively correlated with the share of imports in total intermediates purchases; second, capital intensity and human capital intensity are negative significant while R&D intensity is positive significant; finally, among the scale measures, only capital scale seems to have statistically significant impact on the share. Reserve causality does not seem to be a serious concern.

As our primary interest is to interpret cross-industry variations, we further conduct between estimation for our panel data. Different from Pooled OLS, between estimation examines the relationship among variables which have been averaged over the three years eliminating all inter-temporal variations. As reported in table 4.7, the results are not only consistent with but also stronger than the baseline. This is expected as the summary statistics reveals that cross-industry variations dominate inter-temporal changes. The R-squares are between 0.31 and 0.46 which confirms that the model explains the cross-industry variations reasonably well.

In baseline results, we allow the intercept to be different across years. In order to check if time-variant factors, for instance wages, levels of property right protection and macroeconomic shocks, affect the slope coefficients, we conduct cross-section OLS analysis for each year. Table 4.8 presents the results[57]. The basic sign patterns and the magnitudes of the slope coefficients are consistent across years and in line with the baseline results: *Dispersion* is positively associated with the share of imports and is significant in majority of the specifications; capital intensity and human capital intensity negatively affect the relative importance of imports and R&D intensity is positively related with the relative importance of imports; the signs on the scale variables are consistent with the baseline results, and human capital scale and production worker scale are estimated to be significant in 1992 and 1997, respectively. It implies that our results are not sensitive to the changes in time-variant variables.

As *Dispersion* is the variable of the most interest we check it robustness using the alternative measure based on employment size (table 4.9). Coefficient on *Dispersion* is still positive and significant with magnitude, 0.27-0.63. Results on other variables are consistent with baseline, too. In addition, we also conduct the analyses based on a second set of dependent variable. In particular, when calculating the share of imports in total intermediate purchases defined in equation (4.18) consumption is computed as (domestic sales + imports) following Feenstra and Hanson (1996). As reported in table 4.10, the main results do not seem to be affected by the change in computation method.

As a final robustness check, we compute the share of imports from developed countries in total intermediate purchases and conduct the same analysis as specified in equation (4.17). Because the theoretical model is a North-South trade model based on labor

[57] The specifications where plant scale variables are significant are not reported.

cost differences the empirical model should fit the data of imports from developing countries better than the data of imports from developed countries. Table 4.11 shows the results. As expected, when using imports from developed countries, the results are not consistent with the predictions in that *Dispersion* and "headquarter service" intensity variables do not seem to be significant in majority of the specifications. Only scale factors seem to be positively correlated with the dependent variables. The model does fit data of trade with developing economies better which is another piece of evidence in support of the theory.

4.5.3 Results for Model 2

The dependent variable of the second model defined in equation (4.19) is the share of intermediates imported through intra-firm trade in total intermediates imports, *MNC / IMP_IN*. It indicates the importance of FDI relative to foreign outsourcing as a means to obtain intermediates abroad. As discussed previously the data is subject to two limitations. First of all, we do not have sufficient information to create a separate measure for imports from developing countries to better fit the North-South trade model. Results on the previous model suggest that there could be considerable differences between trade with developing countries and trade with developed countries. It may affect the explanatory power of the model.

Secondly, the data used to valuate the numerator, the intermediates imported through intra-firm trade, possibly includes the imports of both intermediates and final good by US parent firms. As a result, the share exceeds unity in some cases as shown in the summary statics (table 4.2) and the maximum is over 4 which is quite large. In order to reduce the problem caused by these outliers and preserve as much information as possible we employ Pooled Tobit estimation in our baseline analyses. Tables 4.12 and 4.13 report the results when the sample is censored at the value of 1 and 0.8, respectively. All models include year fixed-effects which are not reported in the tables. The results do not seem to be affected by the cutoff values. We only find a little evidence supporting the second hypothesis partially because of the limitations of the data.

In terms of *Dispersion*, when we only include the variable and year fixed-effects we find a positive significant coefficient as predicted by the theory. When we add other explanatory variables into the analysis the results on *Dispersion* is not stable and statistically insignificant in most cases. It implies that industries with high productivity dispersion may tend to import intermediates through intra-firm trade than through arm's length trade. We interpret it as suggesting that productivity heterogeneity influences firms' choice of FDI versus foreign outsourcing and that FDI requires higher productivity. However, once variables of input intensity and plant scale are controlled for this higher propensity of intra-firm trade associated with *Dispersion* turns to be statistically insignificant. The result only weakly supports the second hypothesis.

The results on "headquarter intensity" measures show a similar pattern. When we include one intensity measure at a time together with year fixed-effects in the model we find positive significant coefficient for all measures, namely capital intensity, human capital intensity and R&D intensity which is consistent with model prediction. When we add *Dispersion* and other explanatory variables into the analyses capital intensity and human capital intensity turn to be statistically insignificant. In other words R&D intensive industries import more intermediates through intra-firm trade than through arm's length trade; (human) capital intensive industries have more propensity for intra-firm trade which is not statistically significant. It offers weak evidence supporting the key insight of incomplete contract that efficiency favors integration over outsourcing when “headquarter service” intensity is high. It indicates that i) R&D intensity strongly encourages FDI relative to foreign outsourcing and ii) capital and human capital intensity may encourage FDI over foreign outsourcing but the impact cannot be separately identified from productivity dispersion, R&D intensity and plant scale.

As of measures on plant scale, we find positive coefficients on all measures and significant ones for capital stock per establishment and production labor per establishment. It also suggests that the firms of the industries with large scale tend to import intermediates within firm boundary than through arm’s length.

Despite the data limitation, we conduct a few analyses to check the robustness of the baseline results. To check the potential reverse causality problem, we lag all explanatory variables by one year[58]. Table 4.14 shows the results. The pattern is consistent with the baseline suggesting that reverse causality is not a serious issue. More specifically, productivity dispersion and “headquarter service” intensity variables are positively correlated with the share of intra-firm trade in total intermediate imports when included together with only year fixed-effects. The impact of Dispersion and “headquarter service” intensity cannot be distinguished from other explanatory variables.

We further experiment with different estimation approaches to taking care of the censoring or truncation issue. The approaches include random-effects Tobit (table 4.15), Maximum Likelihood estimation for truncated data with known upper limit (table 4.16), and Between estimation for truncated panel data (table 4.17) where all limits are set at unity. We experiment with other cutoff values and the results do not seem to be affected. Regardless censoring or truncating the sample and the approaches used the main results are consistent with the baseline: productivity dispersion and "headquarter services" are weakly positively associated with the share of intra-firm trade in total intermediate imports.

As final robustness checks, we compute the dependent variables using alternative information and conduct the same Pooled Tobit estimation. First, we calculate the denominator where consumption is defined as (domestic sales + imports). The results are reported in table 4.18. As BEA also provides information on MNCs' imports from all foreign affiliates we use it to compute the variable and present the results in table 4.19. We find the results on main variables of interests, *Dispersion* and "headquarter service" intensity measures, are not affected by the way we calculate the dependent variable.

4.6 Conclusion

Despite the overall spectacular growth of trade in intermediates, there exist considerable differences across industries in terms of the pattern of trade and the relative prevalence of underlining firm organization forms. In order to explain these cross-industry variations, we make an extension to the framework developed by Antras and Helpman (2004) and conduct an empirical analysis on an industry-level panel data of the US manufacturers.

The results show that a higher degree of productivity dispersion is associated with a greater share of imports from developing countries in total intermediate purchases. It is consistent with the model implication and confirms the importance of firm heterogeneity in determining international trade pattern. Our analyses also indicate that various input

[58] We also experiment with lagging two year. The results are similar and available upon request.

intensities also influence an industry’s propensity to import intermediates from developing countries, in particular capital and/or human capital intensive industries are less likely to import intermediates and R&D intensive industries tend to acquire intermediates abroad. Overall, the empirical model can explain the cross-industry variations in the relative importance of trade reasonably well. Our analyses also suggest that productivity dispersion and input intensities may affect industry’s propensity for intra-firm trade relative to arm’s length transactions though the results are weak. These results not only shed some light on the pattern of trade in intermediates but also help us to gain some insights of the underlining firm investment decisions.

4.7 Appendix A

Concordance between Industry Classification Defined in Input-Output Matrix (IO Classification) and SIC Classification (1987 base)

IO Classification	SIC Classification	Industry description
13	3481-- 3489, 3761, 3795	Ordnance and accessories
14	2011-- 2099	Food and kindred products
15	2111-- 2199	Tobacco products
16	2211-- 2249, 2261-- 2269, 2281-- 2289	Broad and narrow fabrics, yarn and thread mills
17	2271-- 2279, 2291-- 2299	Miscellaneous textile goods and floor coverings
18	2251-- 2259, 2311-- 2389	Apparel
19	2391-- 2399	Miscellaneous fabricated textile products
20+21	2411-- 2499	Lumber and wood products
22+23	2511-- 2599	Furniture and fixtures
24	2611-- 2649, 2661-- 2699	Paper and allied products, except containers
25	2651-- 2659	Paperboard containers and boxes
26A	2711-- 2729	Newspapers and periodicals
26B	2731-- 2799	Other printing and publishing
27A	2811-- 2819, 2861-- 2869, 2891-- 2899	Industrial and other chemicals
27B	2871-- 2879	Agricultural fertilizers and chemicals
28	2821-- 2829	Plastics and synthetic materials
29A	2831-- 2839	Drugs
29B	2841-- 2849	Cleaning and toilet preparations
30	2851-- 2859	Paints and allied products
31	2911-- 2999	Petroleum refining and related products
32	3011-- 3099	Rubber and miscellaneous plastics products
33+34	3111-- 3199	Footwear, leather, and leather products
35	3211-- 3239	Glass and glass products
36	3241-- 3299	Stone and clay products
37	3311-- 3329, 3462 ,3391-- 3399	Primary iron and steel manufacturing
38	3331-- 3369, 3463	Primary nonferrous metals manufacturing

Appendix A (cont.)

IO Classification	SIC Classification	Industry description
39	3411-- 3419	Metal containers
40	3431-- 3449	Heating, plumbing, and fabricated structural metal products
41	3451-- 3459, 3464-- 3469	Screw machine products and stampings
42	3421-- 3429, 3471-- 3479, 3491-- 3499	Other fabricated metal products
43	3511-- 3519	Engines and turbines
44+45	3521-- 3533	Farm, construction, and mining machinery
46	3534-- 3539	Materials handling machinery and equipment
47	3541-- 3549	Metalworking machinery and equipment
48	3551-- 3559	Special industry machinery and equipment
49	3561-- 3569	General industrial machinery and equipment
50	3591-- 3599	Miscellaneous machinery, except electrical
51	3571-- 3579	Computer and office equipment
52	3581-- 3589	Service industry machinery
53	3611-- 3629	Electrical industrial equipment and apparatus
54	3631-- 3639	Household appliances
55	3641-- 3649	Electric lighting and wiring equipment
56	3651-- 3669	Audio, video, and communication equipment
57	3671-- 3679	Electronic components and accessories
58	3691-- 3699	Miscellaneous electrical machinery and supplies
59A	3711	Motor vehicles (passenger cars and trucks)
59B	3712-- 3719	Truck and bus bodies, trailers, and motor vehicles parts
60	3721-- 3729, 3762-- 3769	Aircraft and parts
61	3731-- 3799 (except 3795)	Other transportation equipment
62	3811-- 3849, 3871-- 3879	Scientific and controlling instruments
63	3851-- 3869	Ophthalmic and photographic equipment
64	3911-- 3999	Miscellaneous manufacturing

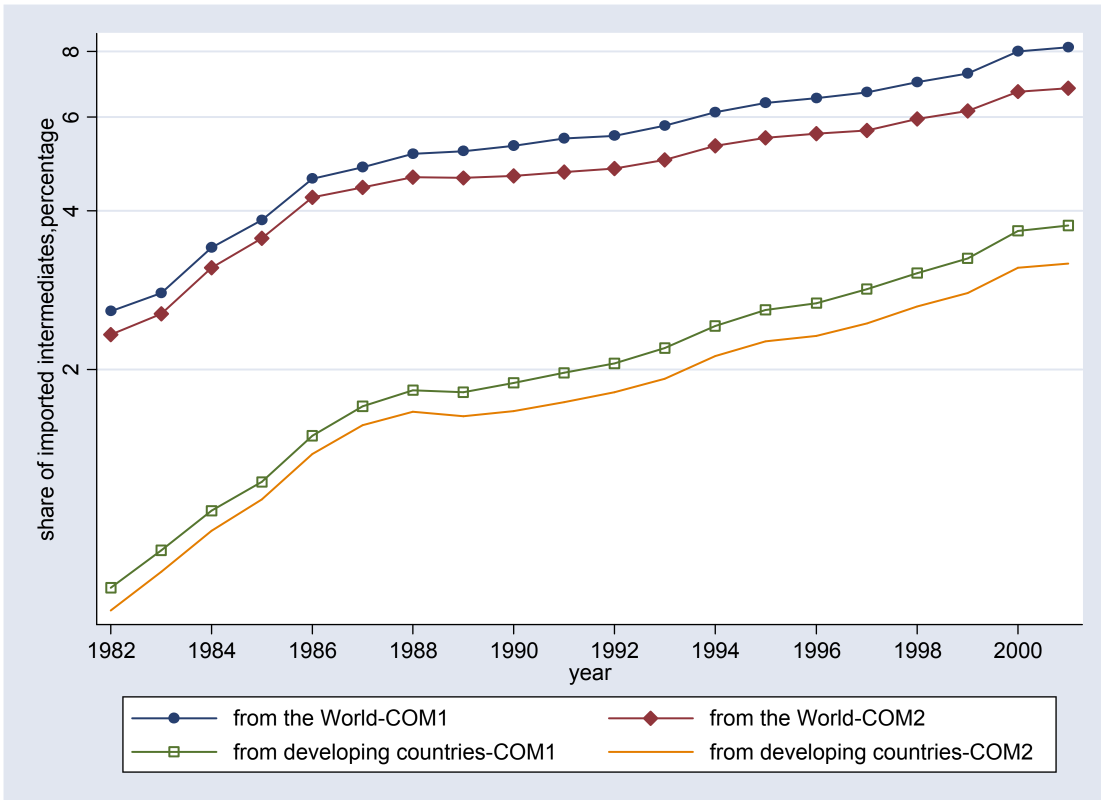
4.8 Appendix B

Concordance between Classification Defined in BEA "*US Direct Investment Abroad*" dataset (MNC Classification), IO Classification, and SIC Classification (1987 base)

MNC Classification	IO Classification	SIC Classification	Industry Description
FOO+BEV	14	20	Food and kindred products
TOB	15	21	Tobacco products
TEX	16, 17, 18, 19	22,23	Textile products and apparel
LUM	20+21, 22+23	24,25	Lumber, wood, fur, & fixtures
PAP	24, 25	26	Paper and allied products
PRI	26A, 26B	27	Printing and publishing
CHE	27A, 28	281,282,286	Industrial chemicals & synthetics
DRU	29A	283	Drugs
CLE	29B	284	Soap, cleaners, & toilet goods
OCH	27B, 30	285,287,289	Other chemicals and allied products
RUB+PLA	32	30	Rubber and Miscellaneous plastics products
STO	35, 36	32	Stone, clay, & glass prods
FME	13, 39, 40,41,42	34	Fabricated metal products
COM	51	357	Office and computing machines
IMA	43, 44+45, 46, 47, 48,49, 50, 52	351-356,358,359	Other industrial machinery and equipment
AUD	56	365,366	Radio, TV, & communication
ELE	57	367	Electronic components & access
OEL	53, 54, 55, 58	361,362,363,364,369	Other electronic and electrical machinery
VEH	59A, 59B	371	Motor vehicles and equipment
TRA	60, 61	372-379	Other transportation equip
INS	62, 63	38	Instruments & related products
OMA	33+34, 64	31,39	Footwear, Leather product & Miscellaneous manufacturing

4.9 Figures of Chapter 4

Figure 4.1 Share of Imports in Total Intermediate Purchases
US Manufacturing Industries (log-scale)



Data Source: Author calculation, based on BEA 1992 "Input-output Account" dataset, NBER trade data and NBER "Manufacturing Industry Productivity" dataset.

4.10 Tables of Chapter 4

Table 4.1 IMP_IN/Intermediates

Industry Code	Industry Description, based on 1992 Input-Output Matrix	1987	1992	1997	1997-1987
33+34	Footwear, leather, and leather products	10.57%	11.68%	13.86%	3.29%
18	Apparel	6.70%	8.80%	10.75%	4.05%
51	Computer and office equipment	4.85%	7.06%	10.57%	5.72%
56	Audio, video, and communication equipment	4.11%	4.93%	6.76%	2.65%
19	Miscellaneous fabricated textile products	3.93%	4.73%	5.44%	1.52%
57	Electronic components and accessories	3.11%	3.59%	5.14%	2.02%
59A	Motor vehicles (passenger cars and trucks)	2.44%	3.47%	4.51%	2.07%
58	Miscellaneous electrical machinery and supplies	2.43%	3.10%	4.30%	1.87%
37	Primary iron and steel manufacturing	2.34%	2.22%	3.83%	1.49%
64	Miscellaneous manufacturing	2.00%	2.74%	3.38%	1.38%
62	Scientific and controlling instruments	1.92%	2.41%	3.40%	1.48%
59B	Truck and bus bodies, trailers, and motor vehicles parts	1.81%	2.15%	3.20%	1.39%
16	Broad and narrow fabrics, yarn and thread mills	1.69%	2.03%	2.44%	0.75%
17	Miscellaneous textile goods and floor coverings	1.54%	1.88%	2.35%	0.81%
54	Household appliances	1.47%	2.12%	3.00%	1.53%
43	Engines and turbines	1.42%	1.67%	2.57%	1.15%
53	Electrical industrial equipment and apparatus	1.39%	1.79%	2.69%	1.30%
22+23	Furniture and fixtures	1.38%	1.64%	1.99%	0.61%
40	Heating, plumbing, and fabricated structural metal products	1.31%	1.35%	2.30%	1.00%
52	Service industry machinery	1.30%	1.72%	2.62%	1.32%
28	Plastics and synthetic materials	1.30%	1.28%	2.09%	0.79%
55	Electric lighting and wiring equipment	1.25%	1.72%	2.42%	1.17%

Table 4.1 IMP_IN/Intermediates (Cont.)

Industry Code	Industry, based on Input-Output Matrix	1987	1992	1997	1997-1987
46	Materials handling machinery and equipment	1.25%	1.46%	2.18%	0.93%
20+21	Lumber and wood products	1.22%	1.27%	1.41%	0.19%
42	Other fabricated metal products	1.20%	1.34%	2.06%	0.87%
61	Other transportation equipment	1.19%	1.45%	2.11%	0.92%
49	General industrial machinery and equipment	1.18%	1.29%	2.00%	0.83%
41	Screw machine products and stampings	1.11%	1.12%	2.03%	0.93%
44+45	Farm, construction, and mining machinery	1.08%	1.26%	1.86%	0.78%
48	Special industry machinery and equipment	1.07%	1.28%	1.94%	0.87%
27A	Industrial and other chemicals	0.97%	0.88%	1.52%	0.55%
63	Ophthalmic and photographic equipment	0.91%	1.15%	1.83%	0.91%
60	Aircraft and parts	0.90%	1.22%	1.86%	0.95%
30	Paints and allied products	0.87%	0.83%	1.49%	0.61%
50	Miscellaneous machinery, except electrical	0.85%	0.86%	1.42%	0.57%
47	Metalworking machinery and equipment	0.77%	0.91%	1.48%	0.70%
27B	Agricultural fertilizers and chemicals	0.74%	0.64%	1.02%	0.28%
24	Paper and allied products, except containers	0.70%	0.81%	1.04%	0.34%
32	Rubber and miscellaneous plastics products	0.66%	0.93%	1.28%	0.63%
29B	Cleaning and toilet preparations	0.64%	0.80%	1.07%	0.44%
35	Glass and glass products	0.63%	0.73%	1.04%	0.41%
36	Stone and clay products	0.58%	0.67%	0.93%	0.36%
25	Paperboard containers and boxes	0.53%	0.57%	0.86%	0.33%
14	Food and kindred products	0.44%	0.52%	0.60%	0.17%
29A	Drugs	0.32%	0.42%	0.47%	0.15%
26B	Other printing and publishing	0.32%	0.44%	0.63%	0.31%
15	Tobacco products	0.07%	0.10%	0.21%	0.14%

Data Source: Author calculation, based on BEA 1992 “Input-output Account” dataset, NBER trade data and NBER “Manufacturing Industry Productivity” dataset.

Table 4.2 Summary Statistics, Model 1

Variable		Mean	Std. Dev.	Min	Max	Observations	
IMP_IN/Intermediates (imports from developing countries) (Consumption 1*)	overall	0.022	0.023	0.001	0.139	N =	141
	between		0.022	0.001	0.120	n =	47
	within		0.006	-0.004	0.053	T =	3
IMP_IN/Intermediates (imports from developing countries) (Consumption 2)	overall	0.019	0.021	0.001	0.129	N =	141
	between		0.020	0.001	0.113	n =	47
	within		0.005	0.000	0.043	T =	3
IMP_IN/Intermediates (imports from developed countries) (Consumption 1)	overall	0.035	0.015	0.002	0.084	N =	141
	between		0.014	0.002	0.080	n =	47
	within		0.004	0.012	0.055	T =	3
Dispersion (use sales data)	overall	1.120	0.395	0.321	2.563	N =	141
	between		0.375	0.450	2.382	n =	47
	within		0.133	0.391	1.531	T =	3
Dispersion (use employment data)	overall	1.673	0.211	1.278	2.400	N =	141
	between		0.210	1.288	2.350	n =	47
	within		0.034	1.495	1.822	T =	3
Hintensity	overall	0.305	0.110	0.123	0.602	N =	141
	between		0.110	0.128	0.581	n =	47
	within		0.013	0.256	0.333	T =	3
Kintensity	overall	4.223	0.633	2.667	5.743	N =	141
	between		0.624	2.796	5.616	n =	47
	within		0.132	3.745	4.881	T =	3
RDIntensity	overall	2.929	2.469	0.400	13.700	N =	141
	between		2.448	0.533	11.733	n =	47
	within		0.435	0.396	4.896	T =	3
LScale	overall	0.061	0.066	0.009	0.454	N =	141
	between		0.065	0.010	0.393	n =	47
	within		0.011	0.018	0.122	T =	3
HScale	overall	0.028	0.029	0.003	0.168	N =	141
	between		0.028	0.003	0.139	n =	47
	within		0.006	-0.003	0.057	T =	3
KScale	overall	1.798	0.969	0.327	4.518	N =	141
	between		0.973	0.342	4.479	n =	47
	within		0.074	1.571	2.080	T =	3

*Note:Consumption 1 is when consumption = domestic sales + imports - exports; and Consumption 2 is when consumption = domestic sales + imports

Table 4.2 Summary Statistics, Model 2

Variable		Mean	Std. Dev.	Min	Max	Observations	
MNC/IMP_IN (majority owned foreign affiliates) (Consumption 1*)	overall	0.492	0.647	0.006	4.026	N =	66
	between		0.605	0.014	2.706	n =	22
	within		0.254	-0.918	1.812	T =	3
MNC/IMP_IN (majority owned foreign affiliates) (Consumption 2)	overall	0.569	0.744	0.007	4.530	N =	66
	between		0.694	0.015	3.046	n =	22
	within		0.295	-1.080	2.052	T =	3
MNC/IMP_IN (all foreign affiliates) (Consumption 1)	overall	0.517	0.709	0.011	4.683	N =	66
	between		0.632	0.013	2.833	n =	22
	within		0.339	-1.296	2.367	T =	3
Dispersion (use sales data)	overall	1.147	0.381	0.556	2.563	N =	66
	between		0.378	0.624	2.461	n =	22
	within		0.081	0.990	1.431	T =	3
Hintensity	overall	0.331	0.118	0.152	0.602	N =	66
	between		0.120	0.158	0.581	n =	22
	within		0.012	0.292	0.355	T =	3
Kintensity	overall	4.342	0.607	3.268	5.797	N =	66
	between		0.602	3.381	5.628	n =	22
	within		0.129	4.025	4.662	T =	3
RDIntensity	overall	3.489	3.157	0.400	13.700	N =	66
	between		3.152	0.533	11.733	n =	22
	within		0.582	0.956	5.456	T =	3
LScale	overall	0.051	0.038	0.009	0.208	N =	66
	between		0.038	0.009	0.190	n =	22
	within		0.007	0.022	0.071	T =	3
HScale	overall	0.029	0.024	0.003	0.101	N =	66
	between		0.024	0.003	0.084	n =	22
	within		0.005	0.010	0.045	T =	3
KScale	overall	1.872	0.923	0.327	4.138	N =	66
	between		0.934	0.371	4.040	n =	22
	within		0.082	1.644	2.154	T =	3

*Note:Consumption 1 is when consumption = domestic sales + imports - exports; and Consumption 2 is when consumption = domestic sales + imports

Table 4.3 Correlation Coefficients of Explanatory Variables, Model 1

	Dispersion (Sales)	Kintensity	HIntensity	RDIntensity	Kscale	Hscale	Lscale
Dispersion (Sales)	1.00						
Kintensity	0.47	1.00					
HIntensity	0.08	0.26	1.00				
RDIntensity	0.07	0.26	0.78	1.00			
Kscale	0.75	0.80	0.21	0.33	1.00		
Hscale	0.56	0.32	0.46	0.47	0.72	1.00	
Lscale	0.56	0.32	-0.14	0.04	0.74	0.70	1.00
Dispersion (Employment)	0.70	0.31	0.08	0.24	0.75	0.71	0.80

Table 4.3 Correlation Coefficients of Explanatory Variables, Model 2

	Dispersion (Sales)	Kintensity	HIntensity	RDIntensity	Kscale	Hscale	Lscale
Dispersion (Sales)	1.00						
Kintensity	0.55	1.00					
HIntensity	0.20	0.31	1.00				
RDIntensity	0.07	0.18	0.84	1.00			
Kscale	0.80	0.85	0.41	0.35	1.00		
Hscale	0.66	0.42	0.70	0.63	0.76	1.00	
Lscale	0.79	0.46	0.02	0.03	0.79	0.67	1.00

Table 4.4 IMP_IN/Intermediates (Model 1)
Pooled OLS

	1	2	3	4
$Dispersion_t$	0.022**	0.028*	0.030**	0.022*
	(0.010)	(0.015)	(0.012)	(0.012)
$KIntensity_t$	-0.024***		-0.026***	-0.026***
	(0.008)		(0.009)	(0.009)
$HIntensity_t$	-0.073**	-0.114**		
	(0.029)	(0.045)		
$RDIntensity_t$	0.005***	0.007***	0.004**	0.003**
	(0.002)	(0.002)	(0.002)	(0.001)
$KScale_t$		-0.014*		
		(0.007)		
$HScale_t$			-0.141	
			(0.100)	
$LScale_t$				0.017
				(0.044)
No. of obs.	141	141	141	141
F-test	4.599	5.059	4.496	5.286
R-Square	0.419	0.276	0.387	0.374

All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Table 4.5 IMP_IN/Intermediates (Model 1)
One-year Lag, Pooled OLS

	1	2	3	4
$Dispersion_{t-1}$	0.023**	0.028*	0.030**	0.023*
	(0.010)	(0.016)	(0.013)	(0.012)
$KIntensity_{t-1}$	-0.025***		-0.027***	-0.027***
	(0.009)		(0.009)	(0.009)
$HIntensity_{t-1}$	-0.077**	-0.119**		
	(0.030)	(0.047)		
$RDIntensity_{t-1}$	0.006***	0.007***	0.004**	0.003**
	(0.002)	(0.002)	(0.002)	(0.001)
$KScale_{t-1}$		-0.015*		
		(0.008)		
$HScale_{t-1}$			-0.136	
			(0.106)	
$LScale_{t-1}$				0.021
				(0.044)
No. of obs.	141	141	141	141
F-test	5.124	5.517	4.961	6.245
R-Square	0.422	0.278	0.388	0.377

All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Table 4.6 IMP_IN/Intermediates (Model 1)
Two-year Lag, Pooled OLS

	1	2	3	4
$Dispersion_{t-2}$	0.023**	0.029*	0.031**	0.023*
	(0.010)	(0.016)	(0.013)	(0.012)
$KIntensity_{t-2}$	-0.026***		-0.028***	-0.028***
	(0.009)		(0.009)	(0.009)
$HIntensity_{t-2}$	-0.079**	-0.122**		
	(0.031)	(0.047)		
$RDIntensity_{t-2}$	0.006***	0.008***	0.004**	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
$KScale_{t-2}$		-0.015*		
		(0.008)		
$HScale_{t-2}$			-0.132	
			(0.107)	
$LScale_{t-2}$				0.024
				(0.045)
No. of obs.	141	141	141	141
F-test	6.192	7.969	6.681	6.881
R-Square	0.431	0.286	0.397	0.389

All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Table 4.7 IMP_IN/Intermediates (Model 1)
Between Estimation

	1	2	3	4
$Dispersion_t$	0.028***	0.043***	0.042***	0.031**
	(0.009)	(0.016)	(0.012)	(0.011)
$KIntensity_t$	-0.027***		-0.031***	-0.029***
	(0.005)		(0.005)	(0.006)
$HIntensity_t$	-0.075*	-0.125***		
	(0.038)	(0.042)		
$RDIntensity_t$	0.006***	0.008***	0.004***	0.003***
	(0.002)	(0.002)	(0.001)	(0.001)
$KScale_t$		-0.020***		
		(0.006)		
$HScale_t$			-0.214	
			(0.137)	
$LScale_t$				0.003
				(0.051)
No. of obs.	141	141	141	141
No. of groups	47	47	47	47
F-test	9.015	4.853	8.381	7.348
R-Square	0.462	0.316	0.444	0.412

*significant at 10%, ** at 5%, *** at 1%

Table 4.8 IMP_IN/Intermediates (Model 1)
Cross-section, Individual Year

	1987		1992			1997		
$Dispersion_t$	0.017*	0.031*	0.021**	0.033*	0.032**	0.037**	0.018	0.032
	(0.010)	(0.018)	(0.010)	(0.018)	(0.013)	(0.018)	(0.016)	(0.019)
$KIntensity_t$	-0.019**		-0.026***		-0.029***	-0.031**		-0.032**
	(0.007)		(0.009)		(0.009)	(0.012)		(0.012)
$HIntensity_t$	-0.069**	-0.101**	-0.075**	-0.118**		-0.074*	-0.114**	
	(0.027)	(0.042)	(0.030)	(0.046)		(0.042)	(0.051)	
$RDIntensity_t$	0.004***	0.006***	0.006***	0.008***	0.004**	0.006**	0.007**	0.004**
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
$KScale_t$		-0.015*		-0.019**			-0.01	
		(0.008)		(0.009)			(0.006)	
$HScale_t$					-0.223*			
					(0.124)			
$LScale_t$								0.063**
								(0.031)
No. of obs.	47	47	47	47	47	47	47	47
F-test	3.64	2.566	4.154	3.186	3.828	2.622	1.867	3.471
R-Square	0.442	0.322	0.493	0.351	0.477	0.344	0.163	0.323

Robust standard errors.
*significant at 10%, ** at 5%, *** at 1%

Table 4.9 IMP_IN/Intermediates (Model 1)
Dispersion measured in Employment Size, Pooled OLS

	1	2	3	4
$Dispersion_t$	0.027**	0.063**	0.052***	0.046**
	(0.011)	(0.024)	(0.017)	(0.019)
$KIntensity_t$	-0.019**		-0.020***	-0.020**
	(0.007)		(0.007)	(0.007)
$HIntensity_t$	-0.064**	-0.076**		
	(0.030)	(0.032)		
$RDIntensity_t$	0.004***	0.005***	0.003**	0.002
	(0.001)	(0.002)	(0.001)	(0.001)
$KScale_t$		-0.015**		
		(0.006)		
$HScale_t$			-0.222**	
			(0.096)	
$LScale_t$				-0.046
				(0.053)
No. of obs.	141	141	141	141
F-test	7.042	6.999	7.304	8.781
R-Square	0.38	0.328	0.375	0.352

All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at5%, *** at 1%

Table 4.10 IMP_IN/Intermediates (Model 1)
(Consumption 2)*, Pooled OLS

	1	2	3	4
$Dispersion_t$	0.020**	0.026*	0.028**	0.021*
	(0.009)	(0.014)	(0.012)	(0.011)
$KIntensity_t$	-0.022***		-0.025***	-0.024***
	(0.008)		(0.008)	(0.009)
$HIntensity_t$	-0.068**	-0.106**		
	(0.027)	(0.042)		
$RDIntensity_t$	0.005***	0.006***	0.003**	0.002**
	(0.001)	(0.002)	(0.001)	(0.001)
$KScale_t$		-0.014*		
		(0.007)		
$HScale_t$			-0.135	
			(0.091)	
$LScale_t$				0.013
				(0.040)
No. of obs.	141	141	141	141
F-test	4.138	4.29	3.965	4.735
R-Square	0.416	0.268	0.384	0.368

*note: Consumption 2 = domestic sales + imports
when calculating (IMP_IN/Intermediates)
All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Table 4.11 IMP_IN/Intermediates (Model 1)
Imports from Developed Countries, Pooled OLS

	1	2	3	4
$Dispersion_t$	0.000	-0.016	-0.008	-0.012
	(0.007)	(0.010)	(0.009)	(0.009)
$KIntensity_t$	0.001		0.001	0.000
	(0.003)		(0.003)	(0.003)
$HIntensity_t$	-0.055	-0.046		
	(0.042)	(0.030)		
$RDIntensity_t$	0.003*	0.002	0.000	0.002
	(0.002)	(0.002)	(0.001)	(0.001)
$KScale_t$		0.009**		
		(0.003)		
$HScale_t$			0.218**	
			(0.107)	
$LScale_t$				0.127***
				(0.026)
No. of obs.	141	141	141	141
F-test	12.35	9.204	8.986	9.952
R-Square	0.162	0.262	0.188	0.313

All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Table 4.12 MNC_IN/IMP_IN (Model 2)
Pooled Tobit, <= 1

	1	2	3	4	5	6	7	8
$Dispersion_t$	0.567***				0.356*	0.075	0.093	-0.254
	(0.170)				(0.201)	(0.271)	(0.283)	(0.219)
$KIntensity_t$		0.334**			0.173		0.168	0.159*
		(0.130)			(0.129)		(0.107)	(0.081)
$HIntensity_t$			1.323**		-1.49	-1.17		
			(0.632)		(1.079)	(0.863)		
$RDIntensity_t$				0.065***	0.101***	0.077***	0.031	0.054***
				(0.016)	(0.033)	(0.026)	(0.030)	(0.010)
$KScale_t$						0.221*		
						(0.122)		
$HScale_t$							4.975	
							(5.729)	
$LScale_t$								6.847***
								(2.472)
No. of obs.	66	66	66	66	66	66	66	66
No. of censored obs.	9	9	9	9	9	9	9	9
Log-likelihood	-24.252	-23.452	-28.733	-23.096	-2.697	-0.037	-6.397	7.882
Pseudo-R-Square	0.31	0.333	0.183	0.343	0.923	0.999	0.818	1.224

All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Table 4.13 MNC_IN/IMP_IN (Model 2)
Pooled Tobit, <= 0.8

	1	2	3	4	5	6	7	8
$Dispersion_t$	0.476***				0.258	0.023	0.01	-0.214
	(0.152)				(0.165)	(0.216)	(0.256)	(0.162)
$KIntensity_t$		0.293***			0.156		0.157*	0.148**
		(0.110)			(0.105)		(0.083)	(0.068)
$HIntensity_t$			1.388**		-1.088	-0.799		
			(0.532)		(0.823)	(0.689)		
$RDIntensity_t$				0.068***	0.092***	0.070***	0.035	0.055***
				(0.015)	(0.027)	(0.023)	(0.027)	(0.010)
$KScale_t$						0.189**		
						(0.095)		
$HScale_t$							4.855	
							(5.622)	
$LScale_t$								5.284***
								(1.873)
No. of obs.	66	66	66	66	66	66	66	66
No. of censored obs.	12	12	12	12	12	12	12	12
Log-likelihood	-19.824	-17.369	-19.748	-12.426	6.301	8.516	4.274	15.601
Pseudo-R-Square	0.322	0.406	0.325	0.575	1.215	1.291	1.146	1.533

All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Table 4.14 MNC_IN/IMP_IN (Model 2)
One-year Lag, Pooled Tobit, <= 1

	1	2	3	4	5	6	7	8
$Dispersion_{t-1}$	0.589***				0.357*	0.079	0.11	-0.23
	(0.170)				(0.200)	(0.271)	(0.272)	(0.230)
$KIntensity_{t-1}$		0.350***			0.19		0.182	0.173*
		(0.132)			(0.134)		(0.110)	(0.088)
$HIntensity_{t-1}$			1.373**		-1.468	-1.118		
			(0.629)		(1.102)	(0.907)		
$RDIntensity_{t-1}$				0.067***	0.102***	0.077***	0.034	0.055***
				(0.016)	(0.035)	(0.029)	(0.028)	(0.010)
$KScale_{t-1}$						0.228*		
						(0.125)		
$HScale_{t-1}$							4.591	
							(5.400)	
$LScale_{t-1}$								6.596**
								(2.565)
No. of obs.	65	65	65	65	65	65	65	65
No. of censored obs.	9	9	9	9	9	9	9	9
Log-likelihood	-24.666	-23.337	-29.084	-23.585	-2.485	-0.25	-6.18	6.962
Pseudo-R-Square	0.313	0.35	0.19	0.343	0.931	0.993	0.828	1.194

All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Table 4.15 MNC_IN/IMP_IN (Model 2)
Random-effects Tobit, <= 1

	1	2	3	4	5	6	7	8
$Dispersion_t$	0.358**				0.319**	0.039	0.113	-0.068
	(0.160)				(0.146)	(0.169)	(0.177)	(0.164)
$KIntensity_t$		0.213**			0.12		0.165*	0.137*
		(0.083)			(0.089)		(0.087)	(0.073)
$HIntensity_t$			1.144**		0.019	0.061		
			(0.482)		(0.764)	(0.685)		
$RDIntensity_t$				0.013	0.031	0.017	0.012	0.037***
				(0.018)	(0.027)	(0.025)	(0.018)	(0.013)
$KScale_t$						0.236***		
						(0.077)		
$HScale_t$							4.757*	
							(2.680)	
$LScale_t$								5.833***
								(1.636)
No. of obs.	66	66	66	66	66	66	66	66
No. of censored obs.	9	9	9	9	9	9	9	9
No. of groups	22	22	22	22	22	22	22	22
Log-likelihood	13.589	12.711	12.169	11.334	16.205	19.697	17.724	21.97
Pseudo-R-Square	5.279	6.894	5.952	0.825	16.751	29.913	22.922	45.883

All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Table 4.16 MNC_IN/IMP_IN (Model 2)
MLE Truncated Model, <= 1

	1	2	3	4	5	6	7	8
$Dispersion_t$	0.262				-0.12	-0.224*	-0.14	-0.122
	(0.166)				(0.094)	(0.126)	(0.131)	(0.134)
$KIntensity_t$		0.187**			0.126***		0.136***	0.133***
		(0.074)			(0.049)		(0.039)	(0.039)
$HIntensity_t$			1.594***		0.169	0.299		
			(0.290)		(0.403)	(0.448)		
$RDIntensity_t$				0.066***	0.055***	0.044***	0.057***	0.060***
				(0.010)	(0.013)	(0.016)	(0.016)	(0.009)
$KScale_t$						0.119**		
						(0.049)		
$HScale_t$							0.593	
							(2.297)	
$LScale_t$								0.094
								(1.246)
No. of obs.	57	57	57	57	57	57	57	57
No. of censored obs.	66	66	66	66	66	66	66	66
Log-likelihood	6.283	11.306	29.06	34.259	41.406	39.62	41.318	41.261

All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Table 4.17 MNC_IN/IMP_IN (Model 2)
Between Regressions, <= 1

	1	2	3	4	5	6	7	8
$Dispersion_t$	0.357				-0.144	-0.231	-0.094	-0.107
	(0.217)				(0.123)	(0.192)	(0.152)	(0.163)
$KIntensity_t$		0.204**			0.148**		0.138**	0.143**
		(0.085)			(0.054)		(0.053)	(0.052)
$HIntensity_t$			1.700***		-0.009	0.174		
			(0.257)		(0.463)	(0.503)		
$RDIntensity_t$				0.065***	0.062***	0.048**	0.069***	0.062***
				(0.008)	(0.016)	(0.017)	(0.016)	(0.008)
$KScale_t$						0.125*		
						(0.071)		
$HScale_t$							-1.324	
							(2.392)	
$LScale_t$								-0.619
								(1.794)
No. of obs.	57	57	57	57	57	57	57	57
No. of groups	20	20	20	20	20	20	20	20
F-test	2.705	5.727	43.761	68.094	24.849	19.405	25.433	25.076
R-Square	0.131	0.241	0.709	0.791	0.869	0.838	0.872	0.87

*significant at 10%, ** at 5%, *** at 1%

Table 4.18 MNC_IN/IMP_IN (Model 2) (Consumption 2)*
Pooled Tobit, <= 1

	1	2	3	4	5	6	7	8
$Dispersion_t$	0.585***				0.324	0.019	0.049	-0.29
	(0.184)				(0.208)	(0.272)	(0.287)	(0.201)
$KIntensity_t$		0.360**			0.196		0.193*	0.183**
		(0.136)			(0.131)		(0.107)	(0.083)
$HIntensity_t$			1.615**		-1.415	-1.05		
			(0.633)		(1.046)	(0.844)		
$RDIntensity_t$				0.078***	0.111***	0.084***	0.041	0.064***
				(0.016)	(0.033)	(0.027)	(0.031)	(0.010)
$KScale_t$						0.243**		
						(0.120)		
$HScale_t$							5.238	
							(5.860)	
$LScale_t$								6.875***
								(2.306)
No. of obs.	66	66	66	66	66	66	66	66
No. of censored obs.	11	11	11	11	11	11	11	11
Log-likelihood	-30.48	-28.258	-31.503	-24.748	-5.639	-2.961	-8.414	4.928
Pseudo-R-Square	0.24	0.295	0.214	0.383	0.859	0.926	0.79	1.123

*note: Consumption 2 = domestic sales + imports when calculating Intermediates
All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Table 4.19 MNC_IN/IMP_IN (Model 2) (All Affiliates)
Pooled Tobit, <= 1

	1	2	3	4	5	6	7	8
$Dispersion_t$	0.562***				0.318	0.034	0.063	-0.258
	(0.169)				(0.209)	(0.284)	(0.291)	(0.242)
$KIntensity_t$		0.349***			0.21		0.206*	0.198**
		(0.129)			(0.137)		(0.112)	(0.092)
$HIntensity_t$			1.256*		-1.389	-1.022		
			(0.650)		(1.110)	(0.943)		
$RDIntensity_t$				0.061***	0.092***	0.065**	0.025	0.047***
				(0.017)	(0.034)	(0.030)	(0.031)	(0.012)
$KScale_t$						0.240*		
						(0.130)		
$HScale_t$							4.839	
							(5.955)	
$LScale_t$								6.534**
								(2.704)
No. of obs.	66	66	66	66	66	66	66	66
No. of censored obs.	9	9	9	9	9	9	9	9
Log-likelihood	-25.581	-23.244	-30.286	-26.234	-8.214	-6.715	-10.761	-0.847
Pseudo-R-Square	0.287	0.352	0.156	0.269	0.771	0.813	0.7	0.976

All models include year fixed effects.
Standard errors are cluster at industry level.
*significant at 10%, ** at 5%, *** at 1%

Chapter 5

Contributions and Future Lines of Research

This dissertation makes several contributions to the existing literature of FDI and suggests a couple of directions for future studies.

First, it extends the scope of current studies to the retail sector. Sixty percent of FDI flows are in services sectors compared with a little over thirty-four percent in manufacturing sectors (UN 2004). Extant studies, however, are largely concentrating on manufacturing sectors partly due to the belief that technologies are most likely to be transmitted there. By showing that the expansion of global retail chains may stimulate productivity growth in supplying industries, this dissertation suggests that large global retailers can be another important catalyst to growth and another media to spread knowledge. However, it still remains to be addressed about what are the exact channels through which such spillovers take place. Carefully designed surveys and case studies may complement the current findings and help to answer the question.

Second, it illustrates the heterogeneity and the complexity of the impact of FDI. Recent literature has pointed out that it is unrealistic and naïve to generalize FDI inflows as having a positive or negative effect on the performance of firms in host economies (Görg and Strobl 2001, Görg and Greenaway 2004, and Javorcik 2007). By identifying spillovers from global retail chains based on sectoral and regional differences and finding a nonlinear relationship between FDI and firm markups, this dissertation confirms the argument. It implies that more efforts should be directed at investigating what are the potential factors conditioning the impact of FDI. For instance, in addition to limiting the spillovers from global retail chains, does sectoral heterogeneity affect FDI spillovers from foreign investors in general, and along what lines of differences? The findings also raise policy related questions. For example, what are the causes of regional differences in the inflows of FDI, in particular, investment by foreign retailers, and do policies have a role here? What are the reasons that this dissertation finds diminishing spillovers confirming one prior study but contradicting the other? Could it because the countries have different FDI promotion policies and regulations which influencing the type of FDI inflows? All of these questions will be worth pursuing in a future research agenda.

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