Essays on agglomeration economics and trade

by

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Title of paper: Firms and Products in International Trade: Data and Patterns for Hungary

Co-authors: Gábor Békés and Balázs Muraközy

The nature of cooperation & the roles of the individual co-authors and approximate share of each co-author in the joint work: The paper was developed in cooperation with Gábor and Balázs. Their ideas and comments are reflected in the structure and the contents of the paper. All calculations, programming and producing figures were my contributions.

Title of paper: Agglomeration Premium and Trading Activity of Firms

Co-authors: Gábor Békés

The nature of cooperation & the roles of the individual co-authors and approximate share of each co-author in the joint work: The paper was developed in close cooperation with Gábor over a span of several years and was improved and changed significantly over two submission processes. My contribution is in data management, regression analysis, and programming robustness checks.

Abstract

This thesis is about the effect of agglomeration economies on trading firms. It follows in the footsteps of the studies of the last two decades which emphasize the role of firm-level heterogeneity in international trade and examine the local determinants of firm behavior. The thesis is comprised of four chapters.

The first chapter describes the most important patterns of international trade and establishes stylized facts on trading firms in Hungary. Together with its appendix, it serves as a detailed introduction to the data used in the other chapters of the dissertation.

The second chapter investigates the heterogeneous response of traders to agglomeration economies and argues that trading firms benefit more from agglomeration externalities than non-traders. Given that firms' trade participation is endogenous to firm performance, various treatment methods are offered to solve this endogeneity issue. Key results are robust and well above the gap suggested by simple self-selection models.

The third chapter investigates the effect of agglomeration economies on exporting activity. Evidence suggests that firms tend to become exporters in the proximity of other exporting firms, and they are likely to become exporters of the same types of products to the same destination countries as their neighbors. These export spillovers exhibit considerable heterogeneity. Foreign-owned firms benefit from peers generally, domestic firms only from the agglomeration of domestic exporters.

The fourth chapter tracks the adoption of imported machinery over time and space in Hungary. It investigates the effects of peers on firms' decision to import foreign machines and finds that the probability of importing sector-specific machinery is positively affected by the presence of local prior importers of the same machine.

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Contents

i Introduction

International traders are bigger and perform better than other manufacturers. This very robust fact is now one of the cornerstones of international trade. These empirical observations were documented in the seminal papers of Bernard and Jensen (1997, 1999) and were incorporated in a theoretical framework developed by Melitz (2003). This heterogeneous firm model has eventually become the workhorse model of international trade.

The heterogeneity uncovered regarding exporters and importers have several implications. Without the attempt of being comprehensive let me highlight three. First, trade policies can have different effect on firms even in the same sector. For example, in the world with heterogeneous firms, if a country opens up to trade or trade becomes easier for some reason, the least productive firms will be forced out of the domestic market, simultaneously reallocating resources for the more productive. This results in the increase of the average productivity of the sector. Second, trade policies do not necessarily have to pick specific industries to promote trade. A handful of productive firms can become exporters in every sector. The relative abundance of the production factors used in the sector intensively does not play definitive role. Third, the link between exports and other macro aggregates depends on the productivity distribution of firms. For example, when formulating forecasts based on the changes in gross domestic product (GDP) about the evolution of exports one needs to bear in mind that GDP captures the whole of the economy, while export developments reflect the situation and the decisions of only a small fraction of manufacturing firms.

Chapter 1 gives a basic description of the most important patterns of international trade and it establishes stylized facts on heterogeneous trading firms in Hungary. This chapter is a joint work with Balázs Muraközy and Gábor Békés. Our study joins the long list empirical studies describing trade performance and premium of internationalized firm, such as Bernard et al. (2007) for U.S., Eaton et al. (2011) for France, for Castellani et al. (2010) Italy, Muûls and Pisu (2009) for Belgium, Eaton et al. (2007) for Columbia. For comparable results across panel of European countries see Mayer and Ottaviano (2008) and for a comprehensive review of micro-evidence of the premium performance of traders, see Wagner (2007).

The chapter offers the following insights to trade behavior of Hungarian firms. Only a small share of firms participates in international trade; in Hungary less than third of the manufacturing firms export and about third import. Trade volume is concentrated; the largest five percent of traders in are responsible for more than eighty percent of the export and import volume. Hungarian trading firms are different than non trading firms along a number of dimensions. Traders are more productive, employ more than three times as many workers as non-traders, pay higher wager and are more capital intensive. When assessing trade related heterogeneity across firms importing activity is as well as important to take into consideration as exporting. Though, a large number of firms sell only a single product or just to a single country, most of Hungarian trade is carried out by multi-product firms trading with many countries. Hungarian trade is concentrated spatially around the capital Budapest and for the benefit of the western regions.

The fact that trading firms are bigger in employment implies that their spatial distribution within a country cannot be random. While small firms are scattered and mimic the distribution of the population, larger firms, like traders, tend to concentrate in space (Holmes and Stevens, 2012). This might suggest that trading firms are more likely to be in cities, agglomerated areas where they interact with various other firms, competitors, buyers and suppliers alike.

Agglomeration economies were initially modeled as interaction of homogeneous firms facing trade costs. If trade costs are high, firms are likely to locate together for easier access to suppliers and consumers, while enjoying the benefits of scale economies. Though competition is tougher in cities, proximity to other firms, often leads to improved performance of firms located in more agglomerated areas. Evidence of such agglomeration economies was suggested by Ciccone and Hall (1996) showing that labor productivity's elasticity with respect to density is 6 percent on average in the US.

In the presence of firms with heterogeneous productivity, agglomerations still emerge, though firms will sort themselves across space (Baldwin and Okubo, 2006; Behrens et al., 2011). Less productive firms would locate in smaller cities, while more productive firms in would find themselves in larger ones. Additionally, the higher competition in cities would drive less productive firms out of the market thus increasing average productivity.

Chapter 2, a joint work with Gábor Békés, looks at how firm heterogeneity - in terms of participation in international trade - affects the measurement of agglomeration elasticity. While participation in foreign markets is closely related to productivity, we will argue that trade status itself matters. We do not model macro-heterogeneity (just control for it) but focus on how the absorption of local externalities is enhanced by the firms' trade status. In others words, we will take a reduced form equation of firm productivity and agglomeration, and investigate if the agglomeration elasticity for trading firms is greater than for non-traders. International traders might benefit more from agglomeration due to a different set of externalities enjoyed by traders or a better utilization of externalities available for all firms.

We investigate the role of firms' international trade status in explaining heterogeneity in terms of agglomeration elasticity using firm level, location specific data from Hungary for the 1992-2003 period. In a pooled ordinary least squares model, we find a general agglomeration elasticity of 4-5 percent and for firms engaged in international trade having an additional productivity advantage of 2 percent. Moreover, looking at separate samples, while trading firms do indeed benefit from density, it is uncertain if non-trading firms gain at all. To address biases a arising from firms' location selection, we use historical instruments of population density.

Given that we focus on firms' trade participation, which is endogenous to firm performance, an important task of the paper is to offer some treatment of this endogeneity issue. We will apply three methods to treat this problem. First, we will increase the comparability of samples of non-trading and trading firms by a matching process. Second, we offer a placebo treatment exercise to attend to the endogeneity of trading status and find that only 25 percent of the original difference is related to simple productivity differences. Finally, to absorb any time invariant heterogeneity (e.g. related to management capacity leading to superior performance) at the firm level, we use firm fixed effects. Furthermore, to test robustness of results from other angles, we add spatial lags, extend results for the number of firms instead of density, and consider the impact of large or multi-site firms. All these methods confirm our results.

Trading firms can benefit from agglomeration mechanisms in several ways. For example, sharing such indivisibilities as harbors, airports, suppliers of large varieties of inputs or dense economic environment have a better chance of finding matching quality input to their production process. Agglomeration economies are able to create sufficient backward linkages to find more suppliers or ones that can provide materials at a larger scale. In addition, learning and knowledge spillovers can bring about information that can significantly reduce the costs of establishing an international trade relationship. These can be knowledge spillovers on the techniques of trade, administration related, marketing issues, repackaging or distribution channels.

Recent studies have shown that the presence of other exporting firms in the close vicinity increases the probability of a firm's trade participation. Chapter 3 joins the list of empirical studies investigating the benefits of agglomeration on export entry. These studies provide evidence on a wide range of countries. Clerides et al. (1998) investigate Colombian, Mexican and Moroccan firms. Greenaway and Kneller (2008) looks at the UK located, Pupato (2007) at Argentine, Koenig et al. (2010) at French, Dumont et al. (2010) at Belgian and Mayneris and Poncet (2011a,b) look at Chinese exporting firms.

Chapter 3 investigates the existence and scope of local spillovers generated by exporting firms to facilitate export entry of firms. It asks whether firms are more likely to enter foreign markets when there are more trading firms in their vicinity. To answer these questions, the approach developed by Koenig et al. (2010) is applied to examine the export behavior of Hungarian manufacturers from 1993 to 2003, whose location and trade activity is known at the product and country level.

Results show a positive effect of local peers on export entry and also that these spillovers are rather specific to destination country and product. I find that spillovers are stronger when peers export the same product. An additional peer that exports to the same country increases the entry probability by 0.3 per cents. An additional local per exporting the same product to the same county increased entry probability by 3.2 percents. Examining the heterogeneity of spillovers reveals that spillovers differ significantly with respect to the composition of the peers and the characteristics of the firm who enjoys the benefit.

While the effect of agglomeration economies on export propensity are well researched, we know little about the effect of agglomeration on importing activity at the firm level, especially for capital items, even though importers may face a harder challenge than exporters. First, evidence suggests that the productivity premium needed to start importing is higher than in the case of exporting (Altomonte and Békés, 2010). Second, while exporters often experiment their profitability on foreign markets for a year or two (Eaton et al., 2011), capital importers make long term investment decisions which might result in a higher fixed cost. Firms deciding to invest in an imported technology face the screening cost of potential foreign suppliers, the cost of the technology itself and adapting equipment to foreign conditions and standards. They also require information about the skill requirements for workers and operating difficulties (see Eaton and Kortum, 2001; Bas and Berthou, 2012). While this information may be available via the manufacturer, local industry experience with a given machine may also prove beneficial and encourage adoption.

Chapter 4 looks at the extent to which locally accumulated knowledge of machine imports affect new adoptions. It asks whether the previous machine imports by local firms encourage other firms to also invest in the same specific machinery. I assume that the more firms in the location have imported a machine, the easier it is for another firm to be informed about the advantages and the specifics of certain innovations. It will be able to learn more easily whether a machine fits firms' expectations about adaptability and profitability. In addition, if the machine is available from many countries, firms learn whether it is worth substituting a machine from one country with one from another. If these learning channels are at work, I hypothesize that in the absence of peers a firm would be less inclined to import a given machine or it would import it much later. Also, the firms' country choice for a machine would not differ across regions.

I find that the presence of an additional previous importer of a specific machine in the same location increases the probability of a firm importing the same machine by about eight per cent. In addition to the decision on importing machinery, I investigate which country the machine is chosen to be imported from. The results show that firms tend to import a particular machine from the country which was chosen by the prior importers. At the same time, I find a negative relationship when other firms have imported the same machine from a different country. The positive effect from peers diminishes over distance. All results stay robust after controlling for location-specific and location-sector-specific unobserved heterogeneity and location-specific business cycles.

Chapter 1

Firms and Products in International Trade: Data and Patterns for Hungary

jointly written with Gábor Békés and Balázs Muraközy.[1]

1.1 Introduction

In the past decade, the appearance of firm level datasets allowed micro-level statistical examination of international trade. Datasets from the US (Bernard et al., 2007), France (Eaton et al., 2011), Italy (Castellani et al., 2010), Belgium (Muûls and Pisu, 2009) or Columbia (Eaton et al., 2007) all described the patterns of international trade at the firm level. Empirical trade research based on firm level data point towards the importance of firm heterogeneity and the exceptional performance of the exporting and importing firms, see e.g. Mayer and Ottaviano (2008).

Hungarian data have also been used recently in several cross-country studies to describe firms' export behavior. This paper is aimed at introducing the key features of the data as well as basic description of the most important patterns of international trade and establishing stylized facts on heterogeneous trading firms in Hungary. The descriptions give additional insight on Hungarian trade with respect to previous efforts[2] in three dimensions, (i) it includes import behavior, (ii) our analysis includes the service sector who is the main actor in aggregate imports, (iii) we analyze the changes in the structure of partner countries.

[1]Published in Economic Systems 35(1), 2011.
[2]For example, Mayer and Ottaviano (2008)or the EFIGE project

The CEFiG-BC[3] dataset is compiled with the purpose of investigating international trade at the firm level. Balance sheet and customs information for the period 1992-2003 are merged with a firm-product-country panel of manufacturing trade observations. This note is to provide descriptive statistics on this comprehensive dataset focusing on international trade related phenomena: prevalence of trading activity, concentration of trade volume within and across sectors and over space. Furthermore, we give basic inference about the variety of trading partner countries and product categories.

Two datasets from different sources are merged. The first dataset is from the Hungarian Tax Authority (APEH) containing an almost universal sample of firms with double-entry bookkeeping. Data include common balance sheet and income statement information such as output, labor, capital or ownership. Balance sheet data are available for the whole economy. The customs data cover complete set of *transactions* from 1992-2003 taken until Hungary's EU accession in 2004.The observation is an aggregate of shipments at economic entity-destination-product level of export or import naming the country of destination or origin, the value and its physical quantity and product category. Customs data are available for goods (and not services). Importantly, the customs data allowed creating firm-level descriptive variables of trade volume, diversity of trading partners and that of products. These aggregate firm level variables were than directly merged with the balance sheet data.

Manufacturing plays a dominant role in both import and export activity by volume, therefore this discussion focuses on the manufacturing sector. Throughout the paper, we use the following approach to Tables and Statistics. The year 1999 is picked as reference point to describe cross-sectoral distribution of any phenomena; while these tables for 1999 are displayed in the text, time-series of the descriptive statistics will be available in the Appendix.

The rest of the paper is structured as follows. In Section 1.2, first we describe the two datasets separately as they exist before the merging and also the procedure of merging. Section 1.4 discusses the prevalence of trading activity across sectors. Section 1.5 investigates how trading firms are different from non-trading firms in main characteristics. Section 1.6 describes the concentration of trading volume across and within sectors. Also, we provide basic picture on the spatial distribution on trade volume. Finally, using the customs data section 1.8 presents a broader picture on the Hungarian trade regarding her trading partners.

1.2 Constructing the Dataset

In this section we explain in detail how the CEFIG-BC Hungary dataset was constructed: describing both the source dataset and the procedure of merging.

[3]abbreviation stands for **C**enter for **Fi**rms in the **G**lobal Economy - **B**alance sheet and **C**ustoms

1.2.1 The source datasets

The balance sheet database is based on information collected by the Hungarian Tax authority (APEH). It contains information on double entry book keeping firms from 1992 to 2006. The list of key variables include: annual average employment, net value of sales and export sales, fixed assets, wage bill, financial assets, costs of goods and materials. Also, we have information on ownership, as the equity share of the public sector, domestic private sector and foreign owners are given. Firms' sectoral categorization is identified at four-digit NACE categories (of 1996). The location of the headquarter of the firm is available at municipal level along with its post code, and this allows to describe CEFIG-BC spatially at any level of NUTS classification.

The firm level custom dataset is collected by the Hungarian Statistical Office. The dataset is assembled from the customs declarations that economic agents fill out in case they export or import. These account for all transactions entering or leaving Hungary with the special trade approach which excludes goods stored unaltered in bounded warehouse and duty free zones.[4] In the database yearly trade volumes are reported at destination-firm-product-level. The goods are categorized by the Hungarian Nomenclature of product of 9 digits, which is up-to six digits is equivalent with the Harmonized System categories. As this information is not fully available for us in every year, in this study we will regard each HS6 category as separate product.

The destination or origin of the *transaction* is labeled by two-letter UN country classification, taking the geopolitical changes of the sample period into account. The values of export are calculated as *free on board* and the imports are accounted for on *cost, insurance freight* value in both USD and HUF terms. We are also have information on the physical quantity of an observational unit and its unit of measurement given by the guidelines of Combined Nomenclature. Each observation entails an entity identifier, which is congruent with that of the balance sheet database and which facilitates the merger of the data.

We have no information regarding either the actual APEH id or the name of firms.

1.2.2 Merger

The merger of the datasets took place the following way. First, an entity-year level observation set of the customs statistics was created. Though the data allows to generate many possible descriptive statistics we included the value of trade in millions of HUF, the number of trading partner countries and the number of traded varieties both for importing and exporting for an entity. Given the transformation of the customs data, it can be merged to the balance-sheet panel by year and the identifier.

[4] Further exclusions are: currency, monetary gold, temporarily used machinery, goods shipped for repairs, international aids, military shipments. From 1997 on only the shipments from duty free zones to abroad were accounted for, those to within Hungary not.

After the merger entity-year observations that were not originally available in the APEH dataset were dropped. In case of exports this implied on average yearly 5000 observations, showing stability over time. The share of export value dropped in 1992 and 1993 constitute 19% and 14% of the customs export, while in the later years this share is only 3-5%. In case of imports on average 10000 observations are dropped yearly. Similarly to imports in 1992 and 1993 the share of unmatched volume was higher than in later years, being 23 and 19 percent respectively, but only 3 to 5 percents afterwards.

All in all, 26 percent of the export observations (entity-year) and 32 percent of the import observations were not matched. The discrepancy stems form exporter and importer entities that were not obliged to have double book-keeping by the *Act on Accounting* in effect of the period. This also implies, that by keeping observations present in the APEH data only, we can be more certain, that observations about export and import remaining in CEFIG-BC refer to proper firms.

In this study we use trade information obtained from the customs statistics. Therefore we implicitly assume, that firm that show positive exports in the APEH dataset, but do not appear in the customs data do not trade. That is, we will evaluate exporter status and export volume as suggested by the customs data. This way exporting and importing is handled with the same methodology.

1.2.3 The scope of the CEFIG-BC dataset

Having merged the datasets, a panel ranging from 1992 to 2006 containing 1,246,925 firm-year observations with trade related information until 2003 was obtained. The number of observations ranges from 54 to 136 thousand yearly, as represented by Figure 1.1. The sharp drop observed after 1999 is due to the change in the sampling rules used by the data collector. The change affects the sampling of the firms with less than 5 employee, who thus become underrepresented.[5] The effect of the gap on the trade related inference is minuscule, given the large average size of international traders. However, it might affect the time-series nature of the data.

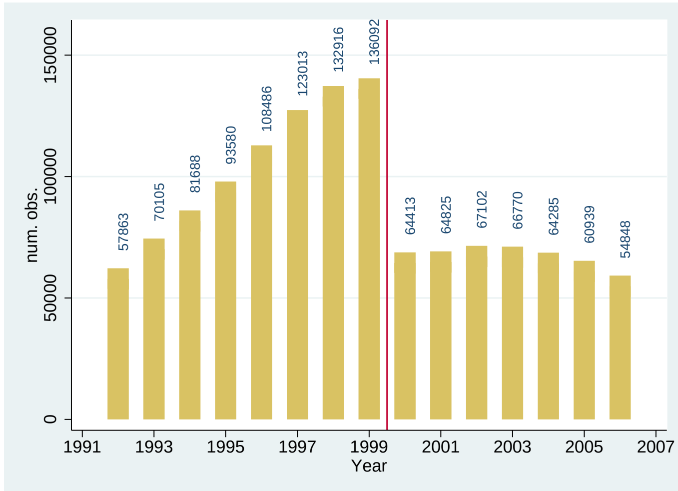
The cross sectoral distribution of observations shows that more than 70% of firms are in NACE chapters of *Manufacturing*, *Wholesale and retail trade* and in *Real estate & renting and business activities*. These sectors represent on average 63% of total employment. The relative shares of chapters are stable over time.[6] summarizing the employment shares of the NACE chapters over the years confirms. However, one can witness the decline in the relative importance of *Agriculture*, *Mining and quarrying* and the increase in the *Health and Social work*, *Wholesale and retail trade* and *Education*.

The customs data allow to evaluate the distribution of trade activity over the chapters. Not surprisingly, the largest share of product exports are performed by the manufac-

[5]The average firm size in terms of employment doubles from 1999 to 2000, from 15 to 30, also total employment in the sample drops only with 7 percent from 1999 to 2000 in the data.

[6]For details, see the appendix

Figure 1.1: Number of firms by years



The graph shows the yearly number of observations in the CEFIG-BC dataset. The red line represents the change in the sampling procedure from 1999 to 2000.

turing firms. Over time their share of export volume increases from 73 percent to 90 percent.[7] The largest part of the remaining trade activity is performed by the *Wholesale and retail sector*, though its share is decreasing over time from 17 to 5 percent. Contrary to export volume distribution imports show a bit different picture. While, *Manufacturing* sector is responsible for the majority share of import volume (50-60 percent) a considerable share of product import (30-40 percent) is carried out through the *Wholesale and retail sector*. While most of this latter import volume consists of products that are sold to consumers directly, some will become inputs to manufacturing firms. The distinction between *Manufacturing* and *Wholesale and Retail* trade is important for example when assessing role of imported inputs of performance of firm or on income distribution of workers, see e.g. Halpern et al. (2005) and Csillag and Koren (2011).

Given the relative high intensity of trade in the manufacturing sector, the rest of this paper (from Section 1.4 on) will concentrate on manufacturing firms.

1.3 Source discrepancies and representative power of data

This section discusses the representative power of CEFIG-BC dataset regarding the volume of trade. First, we compare the firm level export information from the customs and APEH sources in the merged dataset. Second we compare the customs trade data to the official trade volume aggregate figures published by the Hungarian Statistical

[7]For details, see the appendix

Table 1.1: Number of observations by NACE chapters

NACE		Observa-tions	share (%)
A	Agriculture, Hunting and Forestry	74300	5.96
B	Fishing	2400	0.19
C	Mining and quarrying	2956	0.24
D	Manufacturing	225316	18.07
E	Electricity, gas and water supply	5335	0.43
F	Construction	100096	8.03
G	Wholesale and retail trade	422198	33.86
H	Hotels and restaurants	39075	3.13
I	Transport, storage and communication	49220	3.95
J	Financial intermediation	11407	0.91
K	Real estate, renting and business activities	241213	19.34
L	Public administration and defence	12	0.00
M	Education	7553	0.61
N	Health and social work	12938	1.04
O	Other community service activities	40657	3.26
Q	Extra-territorial organisations and bodies	22	0.00
	No info	12227	0.98
	TOTAL	1246925	100

Office (KSH).

1.3.1 Two sources of export

The CEFIG-BC dataset has two sources of exports. One is the balance sheet information from APEH, which contains the volume of export activity that is accounted in the books for a given year. The other source is the merged customs data, which captures all actual transactions. The actual figures from the two sources may be different, because APEH documents only those transactions where change in the ownership occurs, while customs data records transactions irrespective of the ownership status.[8]

A comparison of the two dataset finds a correlation of 0.95 between the export volumes, implying an acceptable difference. However, the discrepancy varies considerably across sectors and over time.[9] Manufacturing sectors show the highest and most stable correlation with an average of 0.93. The other sectors, with the exception of *Agriculture and Forestry* demonstrate low correlation. If sectors of manufacturing are examined separately, the correlations of the two sources of export data appear strong on average. However sectors, such as *Textiles*, *Printing and Publishing* and *Radio, television and communication equipment* show average correlation lower than 0.8.

While correlation describes strength of the relationship of the variables it does not assess scale issues. Therefore, in Table A.8 the differences in the sums of volumes for a given sector in the given year are examined. The figures express the share volume by which

[8]The discrepancy is also influenced by accounting techniques: the accounting and actual exports appear in different years.

[9]For details, see the appendix.

customs data exceeds the book report.[10] While on average, differences are acceptable, in several sectors, especially in *Tobacco products*, *Wearing apparel* and *Tanning and dressing of leather* larger discrepancies are present.

1.3.2 Representativeness of volume data

To show the representative power of CEFIG-BC in Table 1.2 the sums of all export and import values in the data are compared to the official annual product trade volumes published by Hungarian Statistical Office (KSH) . We find that data sums up to 95 - 97 percent of the trade volume thus published. The discrepancy stems from methodological differences. The official figure incorporates some financial services[11] as product trade, while we do not find that in CEFIG-BC.

Table 1.2: Comparison of KSH and CEFIG-BC trade volume data in hundred Bn. HUFs.

	KSH		CEFIG-BC	
	import	export	import	export
1992	8.8	8.4	6.7	6.8
1993	11.6	8.2	9.4	7.0
1994	15.4	11.3	14.0	10.3
1995	19.4	16.2	18.2	15.4
1996	24.7	20.0	26.3	22.8
1996	*27.6*	*23.9*		
1997	39.6	35.7	37.9	34.6
1998	55.1	49.3	53.7	48.4
1999	66.5	59.4	64.7	58.5
2000	90.6	79.4	86.2	73.0
2001	96.7	87.5	95.1	86.2
2002	97.0	88.7	94.3	87.1
2003	107.0	96.4	104.1	93.5

The trade volumes are in current prices. The second official KSH figures for 1996 (*in italics*) are calculated retrospectively by new method introduced from 1997 on.

Also, as indicated by the hollow row in Table 1.2 a methodological change occurs in the KSH in 1997, which broadens 'special trade' category of custom-free areas. Furthermore, the difference also comes from the fact that customs data and KSH treats arm's length and non-arm's length transaction differently. Despite the aforementioned differences, CEFIG-BC created from raw customs transaction level data seems to be able to grasp the majority of Hungarian product trade.

1.4 The Prevalence of Trading Activity

The key interest in examining firm level datasets on trade activity is that it gives a more detailed picture about what is behind aggregate trade flows and allows to see

[10] If e.g. the figure is 85.7, it suggest that 85 percent of the customs data should be added to the APEH data to make the two sources of data equal.

[11] e.g. such as leasing

whether findings are consistent with trade theories. One of the recent stylized facts is the relative scarcity and concentrated-ness of exporting and importing activity, see e. g. Bernard et al. (2007), Bernard and Jensen (1999).

To illustrate the propensity to trade in Hungarian manufacturing firms and compare it with results from other countries a summary taken from Castellani et al. (2010) is replicated in Table 1.3 and have been supplemented with our results.

Table 1.3: Participation Rate and Concentration: International comparison

	Hungary	Italy	U.S.	Sweden	Belgium
% Exporters	27.7	70.6	27	71	41.2
% Importers	33.2	69.3	14	60	43.2
Gini Exports	0.936	0.825	0.972	.	0.959
Gini Imports	0.945	0.965	0.965	.	0.956
Gini Sales	0.922	0.807	0.916	.	0.873 (VA)
	our paper	Castellani et al. (2010)	Bernard et al. (2007)	Andersson et al. (2008)	Muûls and Pisu (2009)
	Firms, 1999	Firms, 1997	Plants, 2002	Firms, 2004	Firms, 1996
	all manufacturing	*empl.* > 20 manufacturing	all manufacturing	*empl.* > 10 manufacturing	all manufacturing

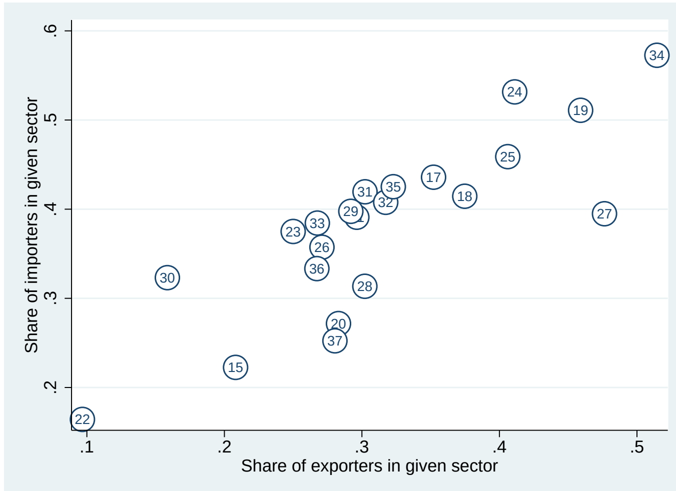
In Hungary, less than third of the firms were exporters and about third were importers in 1999, and the distribution of export and import volumes were both more concentrated than that of sales.

Compared to results computed for other countries, Hungary is slightly less open than Belgium, but more open than the U.S. At first glance, Hungarian data may look different to other EU countries such as Italy or Sweden. However, this is due to different sampling restrictions used. Knowing from Mayer and Ottaviano (2008) that traders are on average larger in size in Europe, exclusion of small firms results in the overestimation of openness. To be able to compare to Sweden and Italy size adjustment has to be made on our data. For Hungary, the result are as follows. When excluding less than 10 employee firms 55% of the firms export and 59% import. When excluding the less than 20 employee firms results change to 66 and 70 percent respectively. Given these estimates, Hungary seems less open then Sweden, but seems comparable to Italy. [12]

Next, the underlying sectoral distribution of the average 27% export and 33% import participation rate of the manufacturing sector is investigated. Figure (1.2) shows the share of firms that export in each manufacturing sector plotted against the share that import in 1999. Most open sectors in terms of exports are *34 - Motor vehicles* (51%), *28 - Basic and Fabricated metals* (48-30%) and *25 - Rubber and Plastic products* sector and *24 - Chemicals* sector both with (41%). The least open sectors in terms of export are the *22 - Printing and publishing* sector (10%) and *30 - Office Machinery* sector (16%).

[12]For more on the effects of sampling size differences on the inference about exporters see Békés and Harasztosi (2008), available from authors upon request

Figure 1.2: Share of exporters and importers by sector in 1999



The graph plots the share of exporting firms against the share of importing firms in manufacturing sectors. Each ball represents an industry with the corresponding NACE code indicated on it. Sector 16 of *Tobacco products* is excluded due to the small number of firms, who are all traders.

The export and import participation rate within sectors shows stability over time. Remember, that there is a break in the data from 1999 to 2000, the share of traders are systematically higher in the late periods across all sectors due to the lack of small firms.[13]

Sectors with high share of exporters tend to have high share of importers. The high correlation of the within sector participation rates is also apparent in Figure 1.2. This is due to the fact, that most firms perform both exporting and importing activity. Thus for more precise examination of trading activity, four trade status categories have been created. These are the non-trading firms, the firms that import only, firms that export only, and firms that import as well as export (two-way traders). Table 1.4 shows the share of firms in each status for 1999. It shows, that 38.5% of the firms engage in trading activity, either exporting, importing or both. Five and half percent of the firms on average engage in exporting activity only, on average 11 percent of the firms import only and on average 22.2 percent of the firms engage in both activities. This suggest, that most of the trading manufacturers in the Hungarian economy are two-way traders. There are only some sectors, where share of exporters-only is relatively high e.g. *Wood* and *Basic Metals*.

[13]For details, see the appendix.

Table 1.4: Share of firms in different trade status in sectors of manufacturing 1999, (%)

	industry	Num. Obs.	share of non-trader	exp. only	imp. only	two-way trader
15	Food products and beverages	2705	71.2	6.5	8.0	14.3
16	Tobacco products	7	0.0	0.0	14.3	85.7
17	Textiles	764	51.3	5.1	13.5	30.1
18	Wearing apparel	1158	55.0	3.5	7.5	33.9
19	Tanning and dressing of leather	366	45.4	3.6	8.7	42.3
20	Wood	1244	61.9	10.9	9.8	17.4
21	Pulp, paper	243	57.2	3.7	13.2	25.9
22	Publishing, printing	2625	80.1	3.5	10.2	6.2
23	Coke, refined petroleum	8	62.5	0.0	12.5	25.0
24	Chemicals, and chemical products	523	41.7	5.2	17.2	35.9
25	Rubber and plastic products	1059	47.1	7.0	12.3	33.6
26	Other non-metallic mineral products	764	59.0	5.2	13.9	21.9
27	Basic metals	233	45.9	14.6	6.4	33.0
28	Fabricated metal products	2724	61.1	7.5	8.7	22.7
29	Machinery	1997	56.1	4.1	14.7	25.1
30	Office machinery and computers	164	67.1	0.6	17.1	15.2
31	Electrical machinery	708	55.6	2.4	14.1	27.8
32	Radio, television and comm. equip.	520	55.6	3.7	12.7	28.1
33	Medical, precision and optical instr.	796	58.0	3.5	15.2	23.2
34	Motor vehicles	241	38.6	4.1	10.0	47.3
35	Other transport equipment	127	55.9	1.6	11.8	30.7
36	Furniture	1059	61.9	4.8	11.4	21.9
37	Recycling	107	65.4	9.3	6.5	18.7
	All manufacturing	20142	61.3	5.5	11.0	22.2

1.5 How are traders different?

Firms engaged in international trade look different along a number of dimension. Since Bernard and Jensen (1999)'s seminal empirical paper on U.S. exporters, many have documented that firms involved in international trade, besides the fact that their products cross national borders are different from non-trading firms in many aspects. These firms employ more and better skilled workers, pay higher wages and are more productive than firms selling within borders only. Many of these differences related to the operation of the firms were found and documented both for the U.S. and European countries for example in Bernard et al. (2007) or in Mayer and Ottaviano (2008). These phenomena is also documented for Hungary by Altomonte and Békés (2010) and Békés and Muraközy (2008).

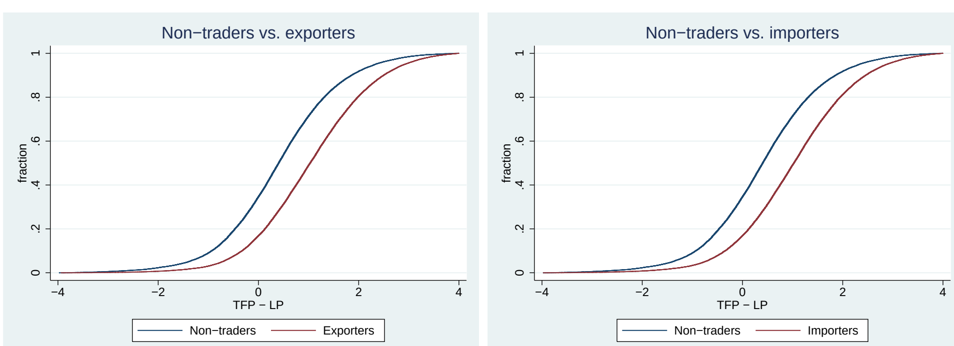
These differences calculated for the CEFIG-BC dataset are summarized in Table 2.1. Each row displays the average difference between exporter and non-exporters and importers and non-importers in a firm characteristic. The first and the third columns represent ordinary least squares regressions with log of employment, value added per worker, average wage and capital per worker as dependent variables on exporter and importer dummies respectively. The second and fourth columns include employment and sectoral dummies as controls. When employment is the dependent variable employment control is omitted.

Table 1.5: Exporting and importing premia across manufacturers

	exporter premia		importer premia	
	(1)	(2)	(3)	(4)
log of employment	1.525	1.467	1.313	1.276
log of value added per worker	0.388	0.398	0.533	0.524
log of TFP[14]	0.850	0.374	0.947	0.478
log of average wage	0.395	0.255	0.456	0.312
log of capital per worker	0.346	0.477	0.357	0.5
additional covariates	none	sector empl.	none	sector empl.

As dependent variables are in logs the coefficients can be interpreted as percentage differences. That is, coefficient 1.46 with the log of employment implies: exp(1.46)-1 = 330% higher employment on average in exporter firms. Analogously, other coefficients imply that exporters produce 39 percent more value added per worker, are on average 44 percent more productive, pay 28 percent higher wages and own 47 percent more capital per worker than non-exporting firms. The differences are similar when comparing importers to non-importers, with minor differences: importers have 120% more employment, produce 52% more value added per worker and 47% higher TFP, pay 31% more average wage, are 50% more capital intensive. The performance premium of the traders, either exporters or importers is general, is not caused by outliers. In Figure 1.3 the cumulative density of log of TFP of non-trading firms is compared to that of exporters and importers. The picture shows that in both cases traders on average outperform non-traders in all deciles of the productivity distribution.

Figure 1.3: Cumulative distribution of FTP comparing traders and non-traders

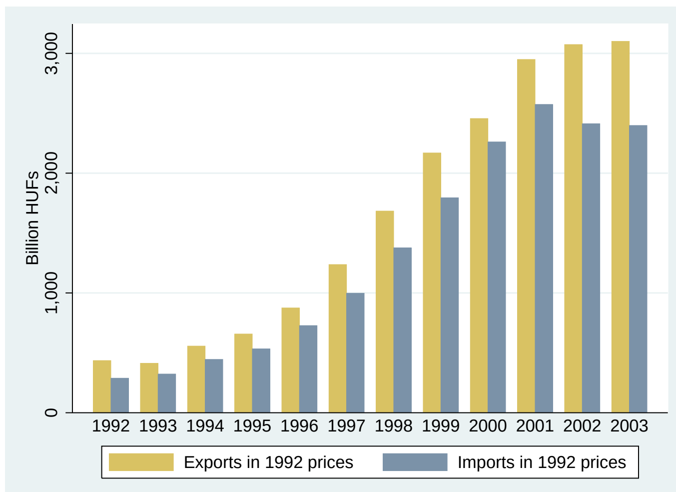


(a) Exporters premia (b) Importers premia

1.6 Distribution of trade volume

International research on traders reveals that only a few firms are responsible for most of the trade volume, see e.g. Bernard et al. (2007) or Mayer and Ottaviano (2008). That is, trade volume is highly concentrated. This section describes the distribution of the volume of trade in the Hungarian manufacturing sectors. To provide a general picture, first the evolution of the real trade volume over time is displayed in Figure 1.4. Both volumes show steady increase in real terms: the average yearly growth of export volume is 19.1 percent, while the corresponding import figure is 23 percent.

Figure 1.4: Manufacturing firms direct export and import volume 1992-2003



The graph shows the yearly volume of exports and imports. Both are deflated to 1992 prices and are expressed in billions of HUFs.

1.6.1 Across Sector distribution of trade

The cross sector distribution of manufacturing trade volume is rather unequal. Table 1.6 summarizes the share of each NACE-2 sectors from the volume of export and import in 1999. The major contributor to both import and export volume is the sector 34 of *Motor vehicles*, which is responsible for 23 and 21 percent of the export and import volume respectively. Other main contributing sectors are the *Radio, television and communication* sector with 15 and 18, the *Office machinery and computers* sector with 11 and 11, and the *Electrical machinery* sector with 9 and 8 and percentages shares from the export and import volumes of manufacturing. While other sectors hold only a small share from the volumes, we find that export and import volume shares across sectors are highly correlated. In Figure 1.5 we plot the share of export volume in a given sector against the share of import volume in the same sector.

Table 1.6: Volume shares of manufacturing sectors of exporting and importing in 1999, in (%)

	industry	obs.	share of export volume	share of import volume
15	Food products and beverages	2705	5.8	3.5
16	Tobacco products	7	0.2	0.6
17	Textiles	764	2.7	3.3
18	Wearing apparel	1158	5.0	4.7
19	Tanning and dressing of leather	366	1.8	1.7
20	Wood	1244	1.1	0.7
21	Pulp, paper	243	1.3	1.8
22	Publishing, printing	2625	0.1	0.9
23	Coke, refined petroleum	8	1.6	5.3
24	Chemicals, and chemical products	523	5.4	4.8
25	Rubber and plastic products	1059	2.9	3.4
26	Other non-metallic mineral products	764	1.5	1.0
27	Basic metals	233	2.9	2.5
28	Fabricated metal products	2724	2.7	1.8
29	Machinery	1997	4.2	3.6
30	Office machinery and computers	164	11.0	10.6
31	Electrical machinery	708	9.3	8.3
32	Radio, TV and communication equip.	520	15.3	18.3
33	Medical, precision and optical instruments	796	0.8	0.8
34	Motor vehicles	241	22.9	21.2
35	Other transport equipment	127	0.3	0.3
36	Furniture	1059	1.0	0.8
37	Recycling	107	0.1	0.0
	TOTALS	20142	100.0	100.0

Figure 1.5: Export and import share of volume by sector in 1999

The graph plots the share of sectors of total manufacturing export volume of 1999 against the share of corresponding import volume. Each ball represents an industry with the corresponding NACE code indicated on them. For better visibility sectors below and above 5 percent of share of total export volume are graphed separately.

1.6.2 Within Sector distribution of trade

In most sectors the bulk of the trading in volume is carried out by a few firms only, and thus trading activity is very concentrated. In 1999 the largest 5 percent of exporters were responsible for 81.5 percent of the total trade, while in case of imports the figure is 84.4%. To further illustrate the extent of this concentration Table 1.7 presents the share of the largest exporters and importers. Both the export and import block consists of two columns. The first shows the share of the largest 5 percent traders in sectoral trade volume, while the second shows the corresponding figure for the largest 10 percent.

The sectors, where trading volume is most concentrated across exporters are the *Motor vehicles*, *Basic Metals*, and *Pulp and Paper* and *Radio and television* sectors where the top 5 percent are responsible for more than 70 percent of the sectoral trade volume. In case of imports the picture is similar, though *Wood* and *Office Machinery* sectors also appear rather concentrated.

Table 1.7: Share of top traders in sectoral trade volume in 1999, (%)

		top exporters		top importers	
	industry	5%	10%	5%	10%
15	Food products and beverages	56.6	74.3	67.2	81.0
17	Textiles	58.2	70.6	63.9	75.9
18	Wearing apparel	49.4	65.3	50.7	66.0
19	Tanning and dressing of leather	44.8	60.7	48.4	63.5
20	Wood	65.3	80.2	75.4	87.3
21	Pulp, paper	73.7	89.3	60.7	82.4
22	Publishing, printing	58.3	78.0	69.2	83.3
24	Chemicals, and chemical products	75.3	88.6	70.4	84.6
25	Rubber and plastic products	65.0	80.7	61.0	78.4
26	Other non-metallic mineral products	63.4	79.8	50.0	70.3
27	Basic metals	74.9	88.8	79.0	90.3
28	Fabricated metal products	57.4	71.7	60.5	76.8
29	Machinery	66.5	80.5	68.2	80.6
30	Office machinery and computers	54.8	76.8	76.1	98.5
31	Electrical machinery	60.2	76.2	60.1	77.8
32	Radio, TV and communication equip.	81.6	92.4	77.3	91.6
33	Medical, precision and optical instruments	60.8	81.0	62.3	77.5
34	Motor vehicles	83.2	89.9	87.5	92.8
35	Other transport equipment	55.9	72.7	49.7	72.2
36	Furniture	52.6	70.3	60.2	75.2

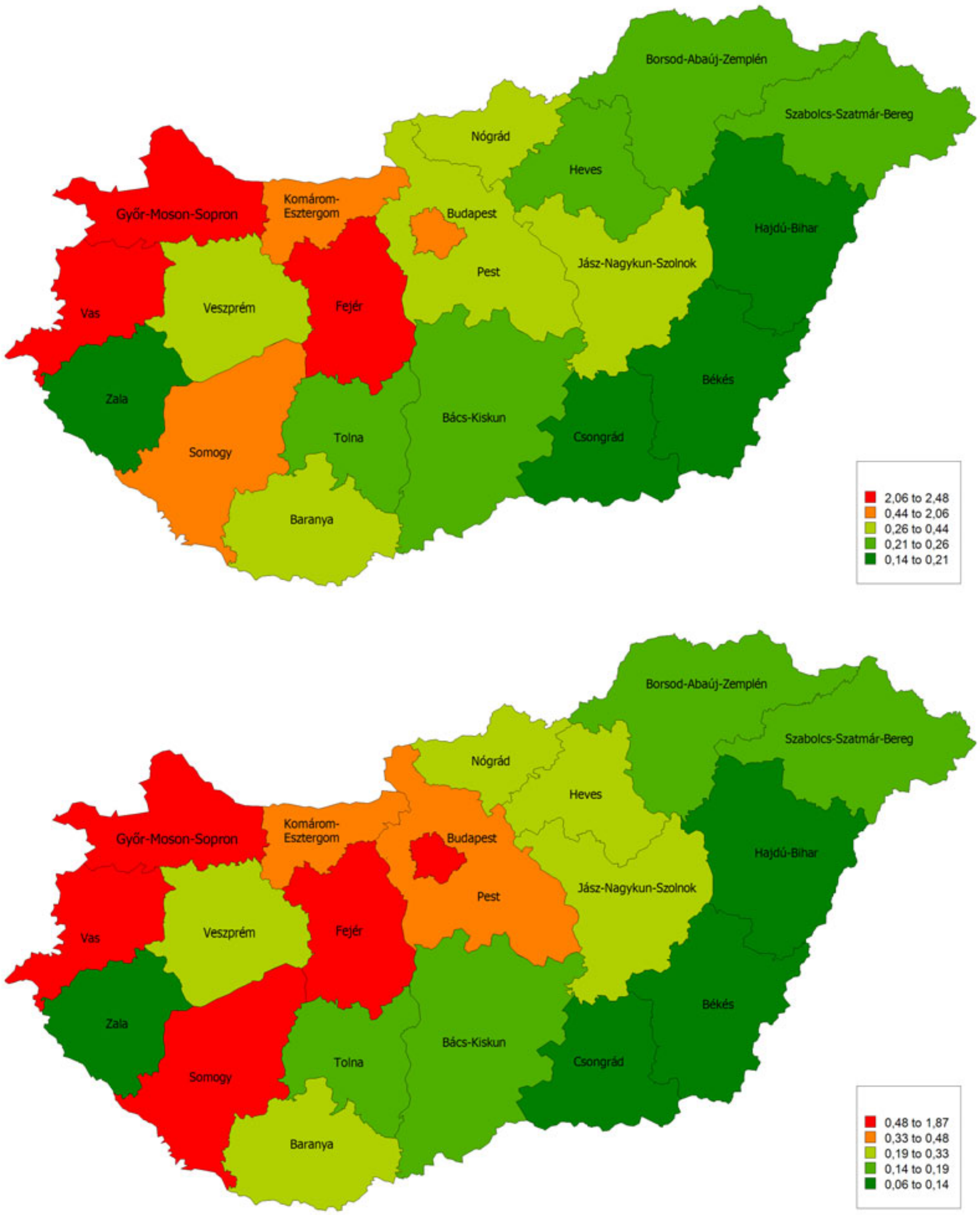
The table shows the percentage share of sectoral export/import volume of the 5 and 10 percent of the biggest exporters/importers. Sectors with less than 50 firms are not considered in this listing

While examining the share of the top exporters and importers in each sector is very illustrative, also Herfindahl indices of concentration were calculated for the better cross section comparison. The over time patterns of concentration are rather stable across low concentration sectors, while across the more concentrated sectors a considerable noise is detectable. Over time, *Motor and vehicle* and *Office machinery* shows increasing within sector concentration of both export and import volume. The only sector, that shows considerable decrease is *Electrical machinery*, where the within sector export Herfindahl index drops from 0.2 to 0.08, suggesting a more equal trade distribution.[15]

[15] For details, see the appendix.

1.6.3 Spatial distribution of trade

Figure 1.6: Export and Import per capita by counties in mill. HUFs in 1999



The graphs show the distribution of export (above) and import (below) value per capita in each county in million HUFs for year 1999. The colors deepen towards red with the higher place a region takes in the quintile of the distribution

Though Hungary is small country both population and economic activity are rather concentrated is space. The vast majority of economic activity takes place in the capital, Budapest, which holds about twenty percent of the population and twenty-four of the manufacturing employment. The most productive and economically prospering regions are those close to the capital and those in north-west Hungary.

The distribution of economic activity and trade is jointly shaped by that of population, the heritage of communist economic spatial planning and location choice of the incoming FDI in the early-mid 1990's. As Brülhart and Koenig (2006) find in their examination of post-communist European countries, transition favors regions that are proximate to the large incumbent EU market, both in terms of wages and employment.

In Figures (1.6) spatial distribution of trade volumes per capita are summarized over NUTS-3 level spatial entities of Hungary, which contain the 19 counties (*megye*) and the capital Budapest.

Figure 1.7: Firms' average export per sales by counties in 1999

The graph shows the distribution of average share of export in firms' sales in each county in million HUFs for year 1999. The colours deepen towards red with the higher place a region takes in the quintile of the distribution

Vas, Győr-Moson-Sopron, Fejér are found to be the leading export and import regions with per capita exports more than 2 million HUFs and per capita imports one and half million. The figures clearly illustrate the west and north bound nature of trading locations. The export volume distribution and also that most importing activity is concentrated towards the western, Austrian border.

While aforementioned geography is driven by volume considerations, another picture can be drawn by looking at the average trade involvement of firms. In Figure 1.7

the average shares of exports in sales are plotted. Though, the east-west division still dominates, some eastern and southern regions appear rather active in trade such as Baranya and Szolnok counties.

1.7 Distribution of Products and Countries

Along with the relative rarity and concentration of trading volume, recent empirical works on international trade see e.g. Bernard et al. (2007), find that there is also a considerable heterogeneity across firms in terms of traded number of products and trading partner countries. Many firms trade only one product and with one country, however the larger share of trade in volume is carried out by firms trading many products with many countries. The importance of this observation is at least twofold. Once, it sheds more light on the nature of firm-level concentration of aggregate trade flows. Second, as e.g. Chaney (2008) argues, introducing firm heterogeneity and destination specific fixed-costs to gravity modeling, shows that contrary to the prediction of Krugman-type new trade models adjustments in reaction to increase in trade cost or distance does not all occur on the intensive margin but on the extensive one.

To portrait the characteristics of firms regarding the extensive margin, the number of traded varieties will be defined as the number of HS 6-digit level categories the firm is engaged in foreign trade with. Number of export destinations are the markets served by the firm, while the variety of source countries is used for imports.

On average firms export 7 types of products, while import 17 product categories, while they export on average to 3 countries and import from 4. However, looking at the distribution of these varieties reveals that only a few international traders can afford complex trade patterns. The most complex traders in Hungarian manufacturing, export over 60 different products, to over 50 countries, while the most complex importers buy over 200 products types, from over 50 countries.[16]

In Table 1.8 the distribution of firms, export volume and employment over categories of number of products traded and number of countries served is displayed.[17] The first block shows, that most firms export only to a single country (44%), furthermore only a single product. The number of firms gradually decrease with an increase in the number of countries or products. Though the single country, single product firms are numerous, their share of export volume and employment is negligible. Multi-product and multi county exporters employ the majority of the exporting workforce and carry out the bulk of the exporting in volume.

Similar exercise is conducted for the analysis of importing activity in Table 1.9. Firms are more likely to trade with many countries and many product when they import than

[16] At least 100 firms satisfy each criteria

[17] The table is constructed in the manner if Table 4 in Bernard et al. (2007), however we use wider categories for better description of the underlying distribution

Table 1.8: Distribution of exporters and Export value by Number of Products and Export Destination 1999

Share of Exporting firms (%)

			Number of products				
Number of countries	1	2-5	6-10	11-20	21-50	50+	All
1	20.3	15.0	4.3	2.8	1.6	0.2	**44.3**
2-5	4.0	18.1	7.5	4.4	3.2	0.8	**38.1**
6-10	0.3	2.2	1.8	2.5	1.4	0.6	**8.7**
11-20	0.0	0.6	1.3	1.8	1.3	0.5	**5.5**
21-50	0.0	0.1	0.4	0.9	1.0	0.7	**3.2**
50+		0.0		0.1	0.1	0.1	**0.2**
All	**24.7**	**36.1**	**15.3**	**12.5**	**8.6**	**2.8**	**100.0**

Share of Export value (%)

			Number of products				
Number of countries	1	2-5	6-10	11-20	21-50	50+	All
1	0.3	1.1	0.8	1.3	1.2	0.1	**4.9**
2-5	0.2	1.4	1.6	2.7	3.6	1.2	**10.8**
6-10	0.0	0.7	0.9	2.0	2.2	3.3	**9.1**
11-20	0.0	0.6	1.4	2.7	4.5	6.6	**15.9**
21-50	0.0	0.2	0.7	3.5	7.3	40.4	**52.0**
50+		0.0		0.1	1.9	5.3	**7.3**
All	**0.6**	**4.1**	**5.3**	**12.4**	**20.8**	**56.8**	**100.0**

Share of Exporting employment (%)

			Number of products				
Number of countries	1	2-5	6-10	11-20	21-50	50+	All
1	4.4	4.3	1.5	1.8	1.4	0.2	**13.5**
2-5	1.2	8.3	5.5	4.6	5.3	1.5	**26.4**
6-10	0.1	2.0	2.5	4.0	3.0	2.9	**14.4**
11-20	0.0	0.9	2.4	4.1	4.7	3.6	**15.9**
21-50	0.0	0.2	1.4	4.9	7.0	9.0	**22.6**
50+		0.0		0.5	1.5	5.3	**7.3**
All	**5.7**	**15.7**	**13.3**	**19.9**	**22.9**	**22.5**	**100.0**

when they export. Multi county and product importers are responsible for the overwhelming majority of import value (94%) and about three quarters of the employment of all importing firms. These statistics shed light on the importance of export and import platforms of multinational firms that shape Hungarian foreign trade.

When Hungarian result are compared to those obtained for the US in Bernard et al. (2007), one finds that though the share of single-product exporters is similar, share of Hungarian single-country exporters is less. This result may be the consequence of different country sizes. The distribution of employment and export value shows less concentration in Hungary, though the pattern is rather similar.

However examining the extensive margin of trade might not tell us that much about economic decision-making as e.g. Bernard et al. (2007) and many others suggest. Armenter and Koren (2008) argue that trade patterns as they appear through the collection of trade forms are observationally equivalent to a completely random trade pattern

Table 1.9: Distribution of importers and Import value by Number of Products and Import Origin 1999

Share of Importing firms (%)							
			Number of products				
Number of countries	1	2-5	6-10	11-20	21-50	50+	All
1	16.2	10.2	2.6	2.6	2.3	0.7	**34.6**
2-5	1.0	13.5	7.9	6.5	6.3	2.2	**37.4**
6-10	0.0	0.4	1.5	3.0	5.6	3.2	**13.8**
11-20			0.1	0.5	3.7	6.3	**10.7**
21-50				0.0	0.2	3.2	**3.4**
50+						0.0	**0.0**
All	**17.2**	**24.1**	**12.2**	**12.6**	**18.1**	**15.8**	**100.0**

Share of Import value (%)							
			Number of products				
Number of countries	1	2-5	6-10	11-20	21-50	50+	All
1	0.1	0.2	0.1	0.2	0.5	0.2	**1.4**
2-5	0.0	0.4	0.5	0.6	1.9	2.0	**5.4**
6-10	0.0	0.1	0.2	0.8	2.3	4.2	**7.6**
11-20			0.0	0.2	2.7	13.1	**16.0**
21-50				0.0	0.1	68.6	**68.8**
50+						0.9	**0.9**
All	**0.1**	**0.7**	**0.9**	**1.9**	**7.4**	**89.0**	**100.0**

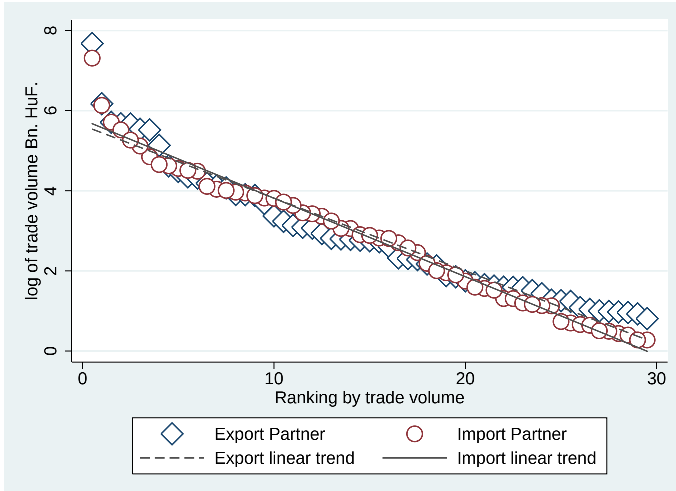
Share of Importing employment (%)							
			Number of products				
Number of countries	1	2-5	6-10	11-20	21-50	50+	All
1	3.8	2.4	0.6	0.6	0.8	0.6	**8.8**
2-5	0.2	5.5	3.6	3.1	3.9	2.4	**18.6**
6-10	0.0	0.3	1.0	2.9	6.2	5.1	**15.4**
11-20			0.1	0.5	6.8	19.1	**26.4**
21-50				0.0	0.3	28.8	**29.1**
50+					0.0	1.7	**1.7**
All	**3.9**	**8.1**	**5.2**	**7.1**	**18.0**	**57.6**	**100.0**

1.8 Hungarian Trade by partner countries

The CEFIG-BC Hungary dataset ranges over a relatively long period of time including periods when fundamental changes took place in the economy. Between 1992 and 2003, Hungarian firms entered a great number of new export markets and a large shift also took place in the direction of exporting from former socialist economies to competitive EU-markets. As for the import origins the top supplier have undergone only a minor change in their order of importance. However, the share of East-Asian countries is steadily increasing towards the end of the period. Thanks to liberalization, increased foreign competition and the collapse of former communist markets, important changes took place in the destination of Hungarian exports and origin of imports.

Hungarian foreign trade involves over hundred countries. If we take a look at the Figure 1.8 we not only see the largest trading partners, but on the x-axis also a fairly full range export and import partner countries and their corresponding trade volumes.

Figure 1.8: **Partner countries sorted according trade volume in 1999**



The figure plots the export and import value traded with partner countries on a log scale. The countries are sorted in a decreasing order with respect to volume from left to right.

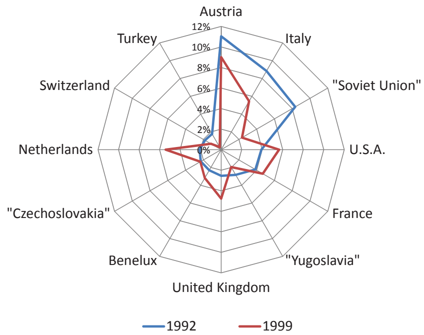
Interestingly, sorted the partners according to trade volume of both export and imports resembles a linear decay on an exponential scale. Focusing currently on the left side of this distribution, we collect statistics on the top 15 trading partners in the Appendix.

The top export partners are quite stable over time: Germany is in the lead with over 30% of manufacturing export share, followed by Austria and Italy. The collapse of Soviet Union diminishes the importance of the eastward trade. However, the neighboring former planned economies remain important: these countries play an important role in case of first-time exporters, which may be explained by the lower fixed costs of these markets. To see a more clear picture on the foreign trade with former socialist and communist countries, in Table A.22 we display the top exporting partners keeping the pre-transition geopolitical entities. Tables include Soviet Union, Yugoslavia and Czechoslovakia in quotation marks, implying that they were artificially created as collection of former members.

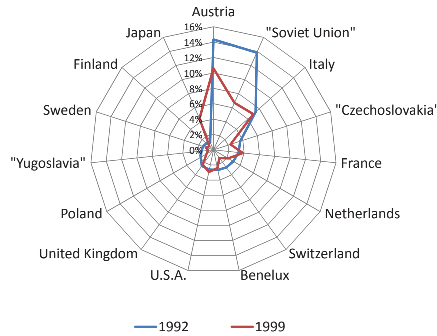
Using these artificial countries on panel (a) of Figure (1.9) shows, how the relative importance of important export partners changed from 1992 to 1999. The blue line corresponds to the countries share in trade volume in 1992, the red shows the corresponding 1996 value. The graphs contains countries by their 1992 importance. Due to illustration purposes, Germany is excluded from the graphs. The picture indicates, that Austria, Italy and "Soviet Union" has lost from their former relative importance by 1999, while Netherlands, UK and USA show an increased share of exports. On panel (c) the export changes occurred from 1999 to 2003 are plotted.[18] The relative importance of USA and Austria is shown to have been decreasing, while the graphs shows

[18]in the later years we do not use the artificial countries

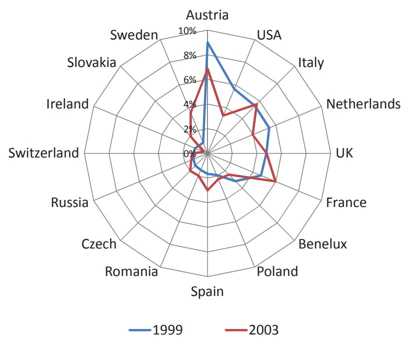
Figure 1.9: Changes in manufacturing trade partner countries 1992 - 1999 and 1999-2003



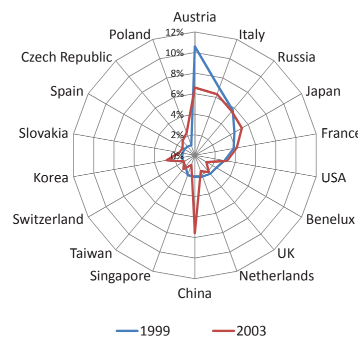
(a) Early Export changes



(b) Early Import changes



(c) Late Export changes



(d) Late Import changes

an increase in that of Sweden, Slovakia and France. Changes in the relative position of top export partners are more moderate in the 1999-2003 period.

On the import side Germany is the leading partner also, with around 30% of the manufacturing imports. It is followed by Austria, Russia and Italy with half, third and less of the German share in 1992 and 1999. By 2003 East-Asian import becomes dominant, China becomes one of the most prominent suppliers as Table A.19 shows.

Just as in the case of exports, the examination of early period import changes also need to take geopolitical changes into account. On panel (b) of Figure 1.9 import changes from 1992 to 1999 are plotted. The relative position loss of Austria and "Soviet Union" is visible. Changes in the position of "Soviet Union" and its successor countries means share drop from 13 to 7 percent. Despite the sharp drop, Russia remains still an important import partner, through oil and gas mainly.

Concerning smaller partners the figure shows a decrease in the relative importance of Switzerland and the Netherlands, and shows a considerable increase in the position of far-eastern countries. Japan has become more important supplier. In the later years of our sample the increasing importance of China as global supplier is quite clearly visible in the Hungarian data as well along with Singapore, Taiwan and Korea.

By the end of our sample period former communist countries become important suppliers once again, e.g. an increase in the relative importance of Slovakia, Czech Republic and Poland is indicated by panel (d) of Figure 1.9.

1.9 Summary

This note gave a basic overview of Hungarian international trade from the point of view of the firms through basic descriptive statistics from a specially compiled database: CEFIG-BC Hungary. Focusing on the manufacturing sector a number of stylized facts has been pointed out about the Hungarian trading firms. These findings are in line with the recent international evidence.

1. Only a small share of firm participate in international trade. In Hungary less than third of the manufacturing firms export and about third import.

2. Trade volume is concentrated. The largest five percent of traders in are responsible for more than eighty percent of the export and import volume.

3. Hungarian trading firms are different than non trading firms along a number of dimensions. Traders are more productive, employ more than three times as many workers as non-traders, pay higher wager and are more capital intensive.

4. When assessing trade related heterogeneity across firms importing activity is as well as important to take into consideration as exporting.

5. Though, a large number of firms sell only a single product or just to a single country, most of Hungarian trade is carried out by multi-product firms trading with many countries.

6. Hungarian trade is concentrated spatially around the capital Budapest and for the benefit of the western regions.

Chapter 2

Agglomeration Premium and Trading Activity of Firms

jointly written with Gábor Békés.[1]

2.1 Introduction

The location of manufacturing firms is far from random even within a country. Firms cluster to benefit from knowledge and labor market externalities and to economize on transaction costs when working together in a supplier or innovation network. At the same time, competition and advantages of proximity to resources will act against agglomeration, and hence the impact of density is a combination of many individual externalities reinforcing or offsetting each other. While most empirical studies in economic geography document positive correlation between regional density and firm productivity, the impact may not be homogeneous across firms. Importantly, recent international trade literature showed that trading firms are different in terms of workforce, size and productivity. This paper will argue that this heterogeneity will influence the productivity premium of density. Furthermore, firms active in international trade may employ a different bundle of resources and be organized differently and hence, be affected differently by spillovers.

Proximity to other firms, often leads to improved performance of firms located in more agglomerated areas. Evidence of such agglomeration economies was suggested by Cic-

[1] This paper was developed in the framework of MICRO-DYN, an international research project funded by the EU Sixth Framework Programme with socio-economic sciences and humanities. It reflects only the author's views, the European Community is not liable for any use that may be made of the information contained therein. It was published in Regional Science and Urban Economics, 43(1), 2013.

cone and Hall (1996) showing that labor productivity's elasticity with respect to density is 6 percent on average in the US. In the light of the recent emergence of evidence from several countries, it is no wonder that policymakers often try encourage agglomeration and clustering so as to boost regional productivity.[2]

Most recent studies assumed that locations differ from each other in several aspects, such as first geography features, market access or human capital. At the same time, firms are assumed to be similar. This is at odds with a great deal of recent theoretical (following Melitz (2003)) and empirical evidence on firm heterogeneity. Firm heterogeneity in terms of productivity will lead to differences in trade activity as shown by Bernard et al. (2007) for the US and Mayer and Ottaviano (2008) for Europe. This evidence shows that exporters' value added is several times higher than that of non-exporters, and these firms employ more and better skilled workers, pay higher wages and are more productive than firms operating in domestic markets only. Hence, our focus will be on firm heterogeneity by involvement in international trade.

While these ideas of agglomeration benefits and firm heterogeneity have been developed as interrelated concepts, research into the impact of firm heterogeneity on spatial interactions has been rather limited and mostly focused on considering the general equilibrium impact of mixing firm heterogeneity and new economic geography (NEG).[3] This is why Ottaviano (2011) argues that such research would be useful as it could look into the intensity of agglomeration economies in the presence of heterogeneity both across firms and space. In addition to the study of differences across regions (macro-heterogeneity), the analysis of the role of differences across firms (micro-heterogeneity) is needed. This paper aims at offering evidence on the importance of this interaction by asking whether agglomeration benefit differs by firm activity in international trade.

As regards to bringing micro-heterogeneity into the analysis of agglomeration elasticity, a paper close to our approach is that of Graham and Maré (2010). They estimate agglomeration elasticity in New Zealand and argue that firm level heterogeneity is captured by either firm fixed effects or industry-region dummies. The paper argues that agglomeration elasticity in general has been overestimated and the point estimate will fall to a fraction if firm heterogeneity is properly treated. The key difference with respect to this paper is that instead of controlling for the difference, we will actually emphasize it - in terms of trade status - and use heterogeneity to better understand the nature of externalities that propel better firm performance - for some firms - in denser areas.

[2]For more on theory see e.g. Henderson (2003), Rosenthal and Strange (2004), Duranton and Puga (2004). On evidence see e.g. Ciccone (2002), Brülhart and Mathys (2008), Combes et al. (2010), Melo et al. (2009). For policy, see Gibbons and Overman (2011) on rural policy in the UK or Duranton et al. (2010) on cluster policies in France.

[3]Baldwin and Okubo (2006) integrated a Melitz (2003) style model into a simple NEG setting and showed that relaxing the homogeneous firm assumption has implications. In Behrens et al. (2011), a traditional NEG model is extended with the introduction of efficiency differences among firms, thus shedding light on interaction with the differences in market conditions and market size. Ottaviano (2012) models how firm heterogeneity affects the relative advantage of agglomerated areas for different firms. These endeavors indeed find a role for the interplay between agglomeration and trade.

This paper looks at how firm heterogeneity - in terms of participation in international trade - affects the measurement of agglomeration elasticity. While participation in foreign markets is closely related to productivity, we will argue that trade status itself matters. We do not model macro-heterogeneity (just control for it) but focus on how the absorption of local externalities is enhanced by the firms' trade status. In others words, we will take a reduced form equation of firm productivity and agglomeration, and investigate if the agglomeration elasticity for trading firms is greater than for non-traders. International traders might benefit more from agglomeration due to a different set of externalities enjoyed by traders or a better utilization of externalities available for all firms.

First, a set of externalities are related to the diffusion of the knowledge to trade - possibly related to administration, marketing, packaging, finding distribution or importer channels. These costs depend on the information available about the foreign market at the point of production. There is growing evidence that knowledge spillovers regarding the ways and means of commerce in an agglomerated environment tend to reduce these costs. Production has to meet international quality standards and density allows the exchange of quality improvement information as well. For example, Lovely et al. (2005) investigate the location of the headquarters of U.S. exporters. They find that firms that export to not easily accessible countries tend to be located in the proximity of each other. In a recent study, Soon L. and Fraser (2006) interviewing Australian exporters, find that information on overseas business opportunities and on variations in export customer preference is a valued and not that easily accessible pointer for managers. Looking at detailed customs data, Koenig et al. (2010) and the next chapter of the thesis find evidence of rather specific export spillovers.

Second, trading firms may have a different production function where externalities are used more efficiently. Holl (2012) showed that infrastructure is an important factor in explaining the effects of agglomeration. If transport infrastructure (e.g. roads, motorways, truck services) is more prevalent in agglomerated areas - due to the presence of cities - and traders use more of this, these externalities will have a more positive impact on traders than non-traders. Also, trading firms may learn more efficiently. For instance, differences in product scope may yield different reactions to agglomeration. Traders typically deal with more products - international evidence suggests that exporters produce more varieties, see, e.g. Bernard et al. (2007). Dealing with a larger amount of products presupposes advanced management and learning skills as well as higher absorption capacity. As a result, these firms are more receptive to innovations in technology and knowledge.

We will consider not only exporters but firms engaged in importing as well. This comes from findings that importers are as productive as exporters or even more productive than firms exporting only (e.g. Muûls and Pisu (2009)). Altomonte and Békés (2010) using Hungarian data, argues that importers and firms doing both exports and imports are engaged in a more complex production and procurement process. Exporters and importers, however, might not draw the same benefits from agglomeration. Exporters require information in order to market their final product: they are in need of distribution channels, they require information on consumer behavior and on changes in regulations and standards. Importers require information for intermediate inputs: they are in need of foreign suppliers who provide input that meets their quality, price and timing requirements. Importing firms in an agglomerated environment, for example, are more easily targeted by foreign promoters and thus can import more easily from abroad.

We investigate the role of firms' international trade status in explaining heterogeneity in terms of agglomeration elasticity using firm level, location specific data from Hungary for the 1992-2003 period. In a pooled OLS model, we find a general agglomeration elasticity of 4-5 percent and for firms engaged in international trade having an additional productivity advantage of 2 percent. Moreover, looking at separate samples, while trading firms do indeed benefit from density, it is uncertain if non-trading firms gain at all. To address biases arising from firms' location selection, we use historical instruments of population density.[4]

As the trade literature (e.g. Bernard and Jensen (1999)) argues, while a part of the productivity premium of traders might be obtained after they enter foreign markets by learning, a growing body of empirical evidence suggests that bigger and better firms self-select into trader status. Indeed, it is possible that precisely the more productive firms become traders and when weighing up the different behavior of traders versus non-traders, we merely quantify the different reactions of more productive versus less productive firms in line with theories on absorptive capacity.[5]

Given that we focus on firms' trade participation, which is endogenous to firm performance, an important task of the paper is to offer some treatment of this endogeneity issue. We will apply three methods to treat this problem. First, we will increase the comparability of samples of non-trading and trading firms by a matching process. Second, we offer a placebo treatment exercise to attend to the endogeneity of trading status and find that only 25 percent of the original difference is related to simple productivity differences. Finally, to absorb any time invariant heterogeneity (e.g. related to management capacity leading to superior performance) at the firm level, we use firm fixed effects.

Furthermore, to test robustness of results from other angles, we add spatial lags, extend

[4]The location of firms is endogenous, leading to omitted variable bias, see, e.g. Ciccone and Hall (1996) or Combes et al. (2010). For a comprehensive summary on methodologies and results see the meta-analysis of Melo et al. (2009).

[5]Theoretically the relationship between self-selection, TFP and agglomeration is not straightforward. In a model where local features do not affect productivity, nationally more productive firms would become traders, and in our model, we would just wrongly assume a trader premium for what is effectively a productivity premium. However, let us assume that the productivity distribution of firms depends on local characteristics (agglomeration) as suggested by the literature following Ciccone and Hall (1996), but the cut-off point for self-selection is determined at the national market. In a less agglomerated area, one should find more unproductive firms and hence, the difference between non-trader and trader TFP would be actually higher in less agglomerated regions. Thus, at a simple cross-section OLS, one should see agglomeration negatively correlated with the difference between traders and non-traders.

results for the number of firms instead of density, and consider the impact of large or multi-site firms. All these methods confirm our results.

The rest of the paper is organized as follows. Section 2.2 describes the empirical strategy and our estimation methods. Section 2.3 introduces the dataset and discusses data-related issues. In Section 2.4, we present the results estimated in various models followed by some robustness checks and a comparison of exporters and importers. The last section concludes. In the Appendix we present additional descriptive statistics and robustness checks.

2.2 Model and estimation

This paper looks at how international trading activities of firms affect the agglomeration elasticity of productivity. In this section we formally present the inclusion of trade status into the production function and discuss challenges of directly estimating a reduced form equation. Various steps estimating the impact of agglomeration and trade on productivity are presented as well.

We assume that the production function takes a standard Cobb-Douglas form:

$$Y_{it} = A_{it} L_{it}^{\beta_L} K_{it}^{\beta_K} \tag{2.1}$$

where Y stands for the real value-added of firm i at time t, while L and K are the labor-force and the real capital stock used by the firm. Following Henderson (2003) we assume that agglomeration economies influence the total factor productivity of firms, A_{it} in the following fashion:

$$A_{it} = D_{rt}^{\gamma+\eta X_{it}} U_{it} \tag{2.2}$$

Where D_{rt} denotes the agglomeration variable in region r where firm i is located in time t. X represents the firms' trading status and U_{it} captures unobservables. After taking logs on both sides of eq. (2.1) and (2.2) the production function may be written as:

$$y_{it} = a_{it} + \beta_L l_{it} + \beta_K k_{it} \tag{2.3}$$

with log productivity defined as:

$$a_{it} = (\gamma + \eta X_{it}) d_{rt} + u_{it} \tag{2.4}$$

with lower case letters denoting the corresponding logarithmic values.

2.2.1 Tackling estimation issues

The key coefficients of our interest are γ and η. If u_{it} is exogenous, then by substituting (2.4) in (2.3) coefficients can be estimated by OLS. The γ coefficient represents general agglomeration elasticity and is expected to be positive. Coefficient η expresses the additional elasticity for trading firms. If it is positive and significant, then trading firm in one percent denser locations are $(\gamma + \eta)/100$ percent more productive

However, exogeneity does not necessarily hold. To discuss these issues let us assume that u_{it} takes the form of

$$u_{it} = \omega \mathbf{ctrls}_{it} + \mu_r + \psi_{rt} + \phi_i + \epsilon_{it} \tag{2.5}$$

where $\mathbf{ctrls}_{it}$ represents time-variant firm characteristics, μ_r represents time invariant local characteristics, ψ_{rt} local productivity shocks, ϕ_i time invariant unobservable characteristics at the firm level and residual ϵ_{it}, the exogenous error term. There are several estimation issues here, to be briefly discussed below.

Firstly, we control for foreign ownership as this may affect TFP as well as trading status and/or agglomeration. Note that ownership status is introduced to capture changes in the management and possible changes in the quality and the composition of the workforce.[6] o this point the most straightforward way would be to substitute (2.4) into (2.3) and estimate them in one step after adding $\mathbf{ctrls}_{it}$, aforementioned firm level controls.

Second, input variables (k_{it}, l_{it}) in the production function can be correlated with u_{it}; in the case of labor, we can either have $Cov(l_{it}, \phi_i) \neq 0$ or $Cov(l_{it}, \epsilon_{it}) \neq 0$. In practice this means that time invariant firm specific unobservable characteristics, such as organization structure or management skills may affect both the input choice and the value added of the firm. Furthermore, one-off shocks that are observable to the manager but not to the econometrician may cause a simultaneity problem: if the manager foresees or anticipates a positive shock, she may hire more workers or invest more into machinery as a response.

To tackle endogeneity of inputs, we adopt the approach offered by Olley and Pakes (1996) (OP)[7] and estimate equation (2.3) recover a_{it} and use it as independent variable in estimating (2.4). We prefer this specification to the joint estimation, given that the modified OP allows for comparing firms across various trading status. The log of firm-level total factor productivity is calculated using 2-digit NACE sector estimates of the

[6] On privatization and the impact of foreign takeover, see Brown et al. (2006)

[7] The other option for handling the endogeneity of the inputs and agglomeration variables together would be to use dynamic panel data models (see Bond (2002)). Our finding is, however, that GMM estimations on the Hungarian data show rather unstable results with the starting point being excessively important.

production function. This calculated value we denote with TFP_{it}.[8] Hence, we estimate eq. (2.6):

$$TFP_{it} = (\gamma + \eta X_{it})d_{rt} + \omega \mathbf{ctrls}_{it} + \mu_r + \epsilon_{it} \tag{2.6}$$

The OP method is adaptable when firms based on unobserved productivity shocks simultaneously decide to exit or to continue production and decide on the quantity of production inputs they require. We modify the standard OP procedure to reflect to the fact that trading firms face a different set of input prices. Furthermore, exchange rate changes over the examined period might induce a measurement error in the prices used in the estimation. To account for the trading status in the production function we used a modification of the OP procedure as proposed by Amiti and Konings (2007) and Altomonte and Békés (2010). This is carried out by introducing exchange rates as domestic and imported materials are distinguished in value added as well as changing the OP procedure's investment control equation to control for trade status and the origin of the input; the procedure is described in detail in the Appendix.

Third, a problem arises from using aggregate indicators as regressors on firm-level data. As pointed out by Moulton (1990), regressing aggregate variables on micro-level observations has the pitfall of underestimating the standard errors of the coefficient estimate. This implies that the null-hypothesis of no effect of the group level variable is rejected with a higher probability. In our regressions, agglomeration variables are aggregate variables and one might run the risk of underestimating the variance of the coefficient related to them. To control for the bias in the standard errors, we follow Moulton (1990) and cluster standard errors according to the spatial unit of aggregation. Our baseline results will thus use one-step and two-step OLS with Moulton correction of standard errors.

Fourth, note that the agglomeration variable, d_{rt} may be endogenous to the production function with $Cov(d_{rt}, \mu_r) \neq 0$ and $Cov(d_{rt}, \phi_i) \neq 0$. A correlation may arise due to unmeasured location specific characteristics, such as natural resources that attract firms and workers as well as increases the productivity of local firms. Additionally, there are unobserved firm characteristics that can make location endogenous. For instance, Combes et al. (2008, 2010) highlight the importance of the spatial sorting of better workers to cities. The abilities and skill of workers, quality of management will be reflected in the performance of the firms.

Time invariant unobservables, transitory local shocks, denoted by ψ_{rt}, may cause an additional problem: $Cov(d_{rt}, \psi_{rt}) \neq 0$. Furthermore, local transitory shocks can affect agglomeration and a firm's value added simultaneously, as firms may observe local shocks and simultaneously hire or lay off workers. For instance if demand dropped for

[8] We denote estimated/calculated TFP differently from the theoretical one, a_{it}. Note, that a can only be estimated together with the residual of the production function.

goods produced dominantly in one region, several local firms may close down (hence changing sectoral concentration) and workers may move to other locations (affect local agglomeration).

To address the endogeneity problem we instrument agglomeration (d) with historical values of population density. As argued by Ciccone and Hall (1996) or Combes et al. (2010), this is a valid instrument, as it is correlated with agglomeration and it should not affect present day firm TFP. Past population density captures location amenities, such as good climate, easy transport or nutrition access that affects spatial distribution of people but does not affect present productivity. For Hungary the Central Statistical Office compiled population data from previous census data consistent with current geographical units dating back to 1880.

Importantly for our exercise, the introducing instrumental variable technique makes estimating the trade status × agglomeration cross term problematic. Proper estimation would require separate instrument for density and for the density trader cross term, which we do not have. Instead, we opt for measuring agglomeration elasticity separately for traders and non-traders.

We set up three sub-samples, one for firms that never trade, one for firms that trade occasionally (i.e. includes firms that start and then stop trading, or trade temporarily), and one for firms that always trade.[9] This specification allows us to compare the agglomeration elasticity coefficient across sub-samples:

$$\begin{aligned} TFP_{it}|\textbf{trading} &= \gamma d_{rt} + \boldsymbol{\beta} ctrls_{it} + \epsilon_{it} \\ \textbf{trading} &= (never, occasionally, always) \end{aligned} \tag{2.7}$$

In the model described in eq. 2.7 we instrument d_{rt}.

2.2.2 Methods to manage trade status endogeneity

In addition to the aforementioned estimation issues, the potential endogenity of trading firms yields additional problems. Trading status can be endogenous as suggested by correlations and selection shown by Bernard and Jensen (1999, 2004) Internationalized firms are bigger in size, pay higher wages and are more capital intensive. Importantly, as trading firms need to pay a fixed cost when entering foreign markets, only the most productive can overcome this sunk cost and these firms will self-select into the trading status (Melitz, 2003). This implies that $Cov(X_{it}, \phi_i) \neq 0$.

We propose three separate procedures to tackle this endogeneity problem: adding firm fixed effects to treat unobserved characteristics leading to self-selection into trade, in-

[9] In this latter sample firms are allowed time to build, that is, firms not trading in their first year in the sample are still considered always traders. This first year is, however, omitted from the analysis.

creasing the comparability of sample by cutting outliers (hence, avoiding the bias caused for instance by large trading firms) and carry out a pseudo treatment exercise modeling self-selection explicitly.[10]

Our first approach to tackle the endogeneity caused by time invariant unobservable characteristics is to move to firm fixed effect panel model. In addition to firm level unobserved heterogeneity problems, firm fixed effects estimation is also able to attend to issues regarding (time-invariant) regional unobserved heterogeneity, initial conditions. That is, fixed effects model can also capture amenities that created past productivity and agglomeration including the effect of cities. Here, we do not use instruments. Hence, firm fixed effect estimates may be different to cross section results. We estimate:

$$TFP_{it}|\textbf{trading} = \gamma d_{rt} + \boldsymbol{\beta} ctrls_{it} + \phi_i + \epsilon_{it} \tag{2.8}$$
$$\textbf{trading} = (never, occasionally, always)$$

Second, given that traders are different - they are larger, more capital-intensive and more likely to be foreign-owned - one might argue that running regressions with the purpose of comparing these two subsets of firms runs the risk of making comparisons across different parameter distributions (see Table 2.1 on trader premia). Hence, the result of a different agglomeration coefficient of traders and non-traders is affected by the fact that we do not restrict other parameters to be equal across firms.

To attend to this we rely on matching of the samples. The procedure, taken from Imbens and Wooldridge (2009) consists of two steps: first, a logit regression is run to express the conditional probability of being a trader. Equation controls are productivity, ownership, size, agglomeration and also time, region and sector fixed effects. In the second step, having obtained the propensity score for each observation, the sub-sample of traders is trimmed by excluding the highest 25 percent of the score distribution of traders. For non-traders the lowest 25 percent of the respective score distribution was dropped. Consequently, the sample size is reduced. When employing the matching technique we use model described by equation (2.7).

Third, we suggest a placebo treatment exercise with pseudo-trader status. This tests what part of the heterogeneous results across subsamples is through heterogeneous impact form the TFP dimension, and what part is through the trading status instead. Part of the difference we place on trade status is due to productivity owing to the self-selection process of most productive firms into trade - at a national level. We aim at grasping the size of the bias rather than treating it explicitly. We do this, by first predicting the trader status and then using this predicted (rather than actual) trader

[10] In terms of an empirical investigation strategy, one could add TFP_{t-1} to the right hand side, thereby controlling for an a priori (self-selection) difference. This gives a significant coefficient and a somewhat reduced but still large difference between traders and non-traders. At the same time, it raises several econometric issues, e.g. serial correlation, as argued by Arellano and Bond (1991). Unfortunately, past experience regarding our data suggests that the GMM approach would, however, give arbitrary results based on a number of moment conditions used.

status in our main regression. If we find the predicted trade-agglomeration elasticity across likely-to-be-trader firms to be close to the one observed in the real data, then it is likely that most of our findings are actually due to such a selection bias. Otherwise, if we find that the placebo coefficients across groups defined by pseudo-trade the same, selection to trade is not driving our results.

We start by assigning a pseudo trading status to firms implied by a simple probit estimation, where P, the probability of being a trader, is determined by its TFP_t. The firm is a pseudo-trader if $P > \zeta$, where ζ is a uniform random variable on the zero-one interval, so that the expected share of (pseudo-)traders match the mean share of traders in the data. This provides us with one possible realization based on firms' first year of estimated productivity in the sample. Instead of defining firms by their actual trading status, we use the predicted indicator, and accordingly group firms as never and always traders. (Note that once again we skip firms switching trade status.) Using these sub-samples, based on pseudo-trader status, we re-estimate our models. To obtain distributions for the agglomeration coefficients, we generate ζ and run the regressions 500 times. This allows us to calculate means and standard errors from the empirical distribution given by the replications. Having done this exercise, we can compare the placebo results to those obtained on sub-samples defined on real trade status.

2.3 Data, variables and descriptive statistics

The empirical analysis uses the CeFiG database, a panel of Hungarian manufacturing firms between 1992-2003 with very detailed firm-level information on balance sheets and trading activity and location. The panel contains on average 15000 firms per year of the manufacturing sectors.[11]

Firm performance and activity

The balance sheet information in the data provides the necessary variables to estimate firm performance by total factor productivity (TFP) at the 2 digit NACE sector level. We defined foreign ownership if at least 5 percent of subscribed capital is held by foreigners. The labor variable is the average annual employment reported by the firms. We included firms with at least five employees reliability of the reported figures. At this sample, firms on average employ 62 workers.

The capital variable is constructed as follows. The nominal capital is calculated as the sum of fixed assets. To construct real capital and handle the problem of different vintages we use the perpetual inventory method. In the transition to market economy firm re-evaluated their capital stock which allows us to accumulate real investments since

[11]For a detailed description of the dataset see chapter 1.

1992. Deflator to produce real values of materials, output, value-added and investments are provided by the Hungarian Statistical Office's National Accounts at the two digit sectoral level.

The balance sheet data have been merged with customs information, and thus, we can see whether a firm is engaged in exporting or importing activity in the given year. In this study, we will refer to a firm being a trader ($X_{it} = 1$) in a given year if it is either exporting or importing (or both).

Table 2.1: Exporting and importing premia across manufacturers

	exporter premia	importer premia
log of employment	1.525	1.313
log of value added per worker	0.388	0.533
log of TFP	0.850	0.947
log of average wage	0.395	0.456
log of capital per worker	0.346	0.357

Each row shows coefficient estimates variables in the first column regressed on exporter and importer dummies. As independent variables are in logs the coefficient 1.52 with the log of employment implies: exp(1.52)-1 = 350% higher employment on average in exporter firms.

In our sample, 40 percent of firms does not trade at all, 15 percent imports but does not export, 7 percent exports without directly importing and 38 percent does both export and import. Trading firms differ from non-traders in a number of characteristics.

Table 2.1 illustrates the difference across trading firms in Hungarian manufacturing. It shows coefficient estimates of exporter and importer dummies regressed on the variables in the first column. In line with international evidence, we see that traders are more productive, more capital intensive and more than three times larger than non-traders. We collected additional descriptive statistics on the number of observations and main variables in Tables B.7 and B.10 in the Appendix.

Location issues and the agglomeration variable

The Hungarian company data at our disposal enlist the locations of the headquarters of firms, defined at micro-regions - our spatial level of analysis. In Table 4.4 Hungarian spatial units are summarized in harmony with the EU zoning. There are 150 micro-regions, each micro-region contains approximately 4-10 towns and villages, their average size is 620 km^2 with 70 thousand inhabitants. In the regressions we use county regional controls for broad first geography and market access - this is the NUTS 3 level at EU classification. See the Tables in the Appendix for the summary statistics of the micro-regions.[12]

[12] We kept only firms in the sample that do not change location over the period: only 3 percent of the firms have two or more location.

Table 2.2: *Summary of Hungarian administrative spatial zoning*

EU level units	Hungarian equivalent	number	avg. size km^2
NUTS2	EU administrative region	7	13861
NUTS3	20 regions (megye)	20	4651
NUTS4	micro regions (kistérség)	150	620
NUTS5	municipalities	3125	30

We define agglomeration (d_{rt}) variable as the logarithm of the employment of all manufacturing firms in the same micro-region. Obviously, agglomeration does not only have positive effects. As duly shown in Ciccone and Hall (1996), the empirically measured net agglomeration effect is a sum of (positive) externalities and (negative) congestion effects. The agglomeration variable is the same for all the firms in the given region within a year as it contains the firm itself and we control for firm employment in a separate variable.[13] The variable expresses the size of the active local manufacturing labor market. We introduce an additional measure of dense economy in Section 2.1.1.

Identifying firms by a single micro-region address may cause problems and biases in the case of multi-plant firms. First, we bias agglomeration measures towards more urban areas, where firms have their administrative center (also causing a downward bias for regions that may host manufacturing facilities only). Second, TFP of multi-plant firms should be a combination of productivity measured at the plant level and should be affected by several agglomeration externalities, not just one. Note that one would make no error when a multi-plant firm has an administrative office in the city, but a production facility in a satellite settlement within the micro-region. Unfortunately, given the data limitations, we cannot measure plant productivity and relate it to plant-level agglomeration measures. However, to check for this, using a different dataset and find that over 90 percent of firms have one site only; furthermore, for the remaining 10 percent the main site covers two-thirds of the employees, which suggests that the bias does not really give cause for concern (for details, see Appendix). Yet, this multi-plant problem necessitates the focus on manufacturing: in the service sector about third of the firms are multi-site with four or more locations.

Instrument

To instrument manufacturing population density we use population census data from 1880. The statistic is provided by the Hungarian Statistical Office. They have compiled information from the all past decennial census with the settlement structure updated to be consistent with the post 1990 Hungarian municipality structure. We have aggregated the population data to match the geography of the firm level database. The correlation between 1880 density and present density at the micro-region level is 0.53. At the firm level, where the spatial distribution of firms will multiply number of observations,

[13] Our results are robust in the alternative specification when excluding own employment.

correlation is higher, 0.909. The finding that the correlation is lower when measured at the micro region level than at the firm level suggests a higher persistence of density in highly agglomerated regions. The first-stage regression for the IV shows a significant partial correlation coefficient of 0.473 between our agglomeration measure and log 1880 population density at the firm. The statistics confirm the relevance of the instruments.[14]

2.4 Results

2.4.1 Basic results

The baseline results, from OLS estimations of equation 2.6, are presented in Table 2.3. The first half of the table (cols 1-3) reports results from one-step estimations of the augmented production function, while the second half (cols 4-6) covers the two-step estimations with TFP estimated first. In all regressions, standard errors are clustered at a micro-region level, as suggested by Moulton (1990).

Column (1) shows the cross section result on a (mid-sample) single year, 1997, while in column (2) we include additional regressors: the agglomeration-trader cross-term as well as a set of dummy variables for firms' trade status, foreign ownership, sector and region. Column (3) shows pooled OLS with year dummies. All estimated coefficients are significant with the expected sign.[15]

The agglomeration coefficient is positive and significant. It suggest, via the log-log specification, that firms in one percent more dense regions are 0.04-0.045 percent more productive. In column (2), we add the agglomeration-trade status cross terms, which is also positive and significant as expected. The productivity of traders is higher by 0.021 percent in one percent more dense areas, with the plain agglomeration elasticity declining to 0.036 percent. For the whole period, we get similar results, with a lower value for the cross term. In the fourth to sixth column of Table 2.3 we show results from the two step estimation, where TFP is first estimated by the modified OP procedure. Results are in line with previous findings.[16] Overall, we find these figures on agglomeration are in line with international evidence of 3-6 percent (Melo et al., 2009).

[14] We have also tried other years as well, from 1890 to 1910, they yield very similar results. Additionally we have calculated soil characteristics from the European Soil Database (EUSOILS) as Combes et al. (2010). In the case of Hungary the variance in the soil characteristics cannot sufficiently explain distribution of population. We also found that possible inclusion of several geology instruments would be rejected by Hansen's overidentification test.

[15] Coefficient on the production factors are significant and of the expected sign. Hungarian production is rather labor intensive, the elasticity of value added with respect to labor is around 75 percent. The same figure for capital is about 20 percent. Previous studies using production functions for the Hungarian manufacturing sectors find similar results, see e.g. Kátay and Wolf (2008). Adding industry level cross terms with K, L make no difference either - results available on request.

[16] We have also tried different TFP estimates in the case of the last three columns: (Levinsohn and Petrin, 2003) technique, FE estimates. Results, in line with Table 2.3, are available upon request.

Table 2.3: OLS regression results

dep. var.:	Value added			TFP		
sample:	1997	1997	all years	1997	1997	all years
labor	0.782***	0.757***	0.746***			
	[0.0219]	[0.0218]	[0.0201]			
capital	0.236***	0.203***	0.211***			
	[0.00679]	[0.00467]	[0.00317]			
agglomeration	0.0452***	0.0361***	0.0435***	0.0416***	0.0363***	0.0516***
	[0.0104]	[0.0106]	[0.00706]	[0.0121]	[0.0113]	[0.00796]
agglo. X trader		0.0217***	0.0109***		0.0227***	0.0133***
		[0.00711]	[0.00411]		[0.00595]	[0.00354]
trader		0.137*	0.201***		0.417***	0.429***
		[0.0717]	[0.0392]		[0.0682]	[0.0415]
foreign own.		0.140***	0.111***		0.284***	0.318***
		[0.0276]	[0.0289]		[0.0214]	[0.0235]
dummy: time			yes			yes
dummy: sector	yes	yes	yes	yes	yes	yes
dummy: nuts 3	yes	yes	yes	yes	yes	yes
Observations	8870	8870	96709	9651	9651	105683
R-squared	0.754	0.765	0.764	0.136	0.262	0.270

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Moulton corr. standard errors in parentheses

The Table shows two blocks of firm level regressions on agglomeration with different dependent variables: real value added on the left, firm level TFP. Each block contains 3 equations: two single year equation without and with agglomeration and trader cross terms and firm level controls and one regression on the pooled sample.

To control for endogeneity of the agglomeration variable we use instrumental variable strategy. We take equation (2.7) and instrument agglomeration (d_{rt}) with past population density (Z_i). As noted in the methodology section, we lack a separate instrument for the cross term and as a solution we estimate on separated subsamples for trading and non trading firms. The main results are summarized in Table 2.4. The table contains six columns. The first three are OLS estimations on subsamples of firms that never, occasionally or always trade. The OLS estimates for agglomeration elasticity range from 0.044 to 0.065 percents as trading activity increases across samples. That is we find significantly higher agglomeration elasticity for traders. The next three columns are the instrumented counterparts with diagnostic statistics for the IV are indicated at the lower panel of the Table. F-statistics from regressions on all exogenous variables show that instruments provide a good fit. Additionally, Cragg-Donald statistics are in all cases above the critical value reported in Stock and Yogo (2002). To address possible bias arising from weak instruments we also report Stock-Wright S statistic (Stock and Wright, 2000) which test the null hypothesis that coefficients of the endogenous variables are jointly zero.[17] The test statistics imply that the null hypothesis can be rejected only in the case of trading sample. This implies that in the case of never traders the agglomeration coefficient is in fact zero.

Compared to the OLS estimates, difference among IV coefficients seem larger. Im-

[17]The results from the first stage regressions are collected in Table B.5

portantly for the preferred IV specification, we do not find significant agglomeration elasticity for non traders and results suggest that for traders the coefficient is about ten percent.

Table 2.4: OLS and 2SLS regression results by trading activity - separate samples

Dep. var.: TFP	never	occasionally	always	never	occasionally	always
agglomeration	0.0440***	0.0515***	0.0648***	0.0192	0.0734**	0.106***
	[0.00500]	[0.00543]	[0.00748]	[0.0206]	[0.0296]	[0.0344]
foreign own.	-0.0132	0.359***	0.422***	-0.0164	0.358***	0.411***
	[0.0238]	[0.0274]	[0.0293]	[0.0234]	[0.0285]	[0.0303]
instrument:						
ln Pop dens 1880	no	no	no	yes	yes	yes
dummy: sector	yes	yes	yes	yes	yes	yes
dummy: nuts 3	yes	yes	yes	yes	yes	yes
dummy: year	yes	yes	yes	yes	yes	yes
First stage: F-stat				44.65	42.98	38.62
First stage: R-sq.				0.8537	0.8698	0.8669
Cragg-Donald Stat.				7417.55	16252.09	6389.3
Kleibergen-Paap stat.				44.65	42.98	38.62
Stock-Wright LM S stat.				0.78	5.38**	9.67***
F-stat.				143.51	245.79	103.49
Observations	25588	56686	23409	25588	56686	23409
R-squared	0.148	0.2	0.259	0.145	0.195	0.246

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Moulton corr. standard errors in parentheses

Each column show the results from regression eq.2.7 on three separate samples of firms: never traders, sometimes or occasionally traders and always traders. We instrument agglomeration with log of 1880 density in columns 4 to 6.

We carry out several robustness tests, addressing spatial correlation and considering the stability of results.

First, regions are not randomly placed and hence, we need to consider their spatial structure. When choosing micro-region level stratification as the basic unit of boundaries to external economies, we neglect the possibility that the agglomeration ranges further than this artificial unit. Artificial division of space causes a problem if it separates regions that are otherwise bound together economically, e.g. share a labor market or two regions share the same natural resource: a mountain with minerals or a river. This may lead to a spatially correlated population size in the neighboring regions and agglomeration elasticity actually rises for traders.

To control for agglomeration effects not bound within micro-regions (i.e. spatial autocorrelation), firm-level regressions including characteristics of the immediate neighboring micro-regions are estimated.[18] Note that controlling for this effect is different from the fixed effects specification as it allows for time variance in the characteristics of the wider neighborhood of the micro-region.

[18]For further details, see the Appendix.

The neglect of spatial dependence induces problems. For example, a prospering and growing neighborhood might attract employment and generate productivity spillovers at the same time. Therefore, own density and productivity will be correlated positively to both productivity and the density of neighbors. Ignoring such spatial autocorrelation will result in the overestimation of the agglomeration effect. The results from regressions including spatial lag variables for neighboring manufacturing density and productivity are displayed in Table B.3 (Appendix) - with no change in our basic inference about traders' agglomeration elasticity.

Second, let us make some observations on the stability of these results. As the premium in this strategy is identified through time-variation in density, the results may not actually capture if trading firms are more productive in denser areas, and we might be looking at simultaneous changes in TFP and very small changes in density (see potential pitfalls noted by Holmes (2010)). To make sure this is not the case, we look at the variation between two periods of time to see if variation in density measures is sufficient. In Table B.13 (Appendix) we present a transition matrix by deciles. Most deciles show substantial variation over time, i.e., identification is not solely the result of very small changes in density.[19]

Overall, trading firms show about 10-11 percent agglomeration elasticity, while non-traders may gain 0 to 2. The result implies that when agglomeration is measured with the density of the workforce, trading firms show a higher productivity in a more agglomerated environment while across nontrading firms the agglomeration elasticity is small or insignificant. To evaluate the difference between the agglomeration elasticities, we carry out a simple F-test on the difference between coefficients of non-traders and always traders. The difference is significant at a 5 percent level which remains when controlling for spatial lags.[20]

2.4.2 Endogeneity of trading status

In this section we provide three approaches to tackle the endogeneity of trader status. First we employ firm fixed effects estimation. Second, we use a simple matching technique to improve the overlap in covariate distributions. Lastly, we develop a placebo treatment exercise.

The first possibility to tackle the bias caused by time invariant unobservable characteristics is to use fixed-effect (FE) estimation strategy with the sample of firms is divided into groups. Results displayed in Table 2.5 indicate the strong difference of elasticities

[19]Further evidence on time variation is available on request.

[20]In this paper we look at the aggregate of agglomeration benefits. However, agglomeration benefits may enter (Glaeser et al., 1992) via localization (own industry effects) and urbanization (general diversity). To look into the source of the traders premium we included agglomeration variables separated by industry. We find that localization (own industry concentration) is significant in both the never- and always trader sub-samples, urbanization (other industry concentration) is significant for the traders only. Thus, the traders premium is more connected to cities than isolated trade platforms. Results may be found in Appendix, Table B.6.

estimated for traders versus non-traders. The evidence implies that firms that are involved in international trade show much higher productivity in agglomerated economies than non-trading firms. Also, one can observe a ranking of agglomeration elasticity as trade involvement over the sub-sample increases, both in terms of significance and magnitude.

Non-trading firms on average do not show significantly higher productivity in a more agglomerated environment, while always traders exhibit a 21.4 percent elasticity. Occasional traders show an elasticity in between non-traders and always traders. Results showing that always and occasionally trading firms show higher than 0.1 percent productivity in a one percent more dense economic environment suggest that a considerable part of the general agglomeration elasticity is due to international traders.

Table 2.5: Agglomeration premium by trading activity - separate samples FE

Dep. Var.: TFP	firms that trade in their time present		
	never	occasionally	always
agglomeration	0.052	0.139**	0.214***
	[0.0412]	[0.0559]	[0.0560]
foreign ownership	-0.0302*	0.0277	0.106***
	[0.0157]	[0.0214]	[0.0189]
dummy: year	yes	yes	yes
constant	yes	yes	yes
Observations	25588	56686	23409
R-squared	0.018	0.027	0.077
Number of id	6594	9697	3840

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Moulton corr. standard errors in parentheses

Each column show the results from regression eq.2.8 on three separate samples of firms: never traders, sometimes or occasionally traders and always traders.

Foreign ownership in fixed effect specifications refers to change, mostly foreign takeover during our period of observation. As this is a period of rising foreign activity, this may be an important control in addition to firm fixed effects. Results show that this has a positive and significant effect on TFP for trading firms only.[21]

Note that the coefficient estimates by the FE model are considerably higher than estimates by OLS. This may be caused by a different behavior of spatial sorting or short term reactions being stronger in Hungary. We found that adding a greater deal of geographical controls instead of firm fixed effects have a similar effect suggesting that spatial sorting is complex in Hungary, and is not fully explained by the selection mechanism emphasized by Syverson (2004), Combes et al. (2012).[22] The fixed effect approach

[21] All results presented in this paper are available in FE specification on request.

[22] Calculations are available upon request. It is possible that location choice of firms in transition economies in terms of cities and villages is related to transition specific issues, as the economy breaks away from central planning. Brülhart and Traeger (2003) or Foster and Stehrer (2008) find higher elasticities in Eastern Europe than elsewhere. While an interesting topic, this is outside the scope of this paper.

results also offer a different take addressing change in a different time dimension (Martin et al., 2011), and this may also lead to different coefficients.

Second, we consider a mechanism to control for different sample characteristics of non-trading and trading firms. As traders are different, running regressions with the purpose of comparing these two subsets of firms runs the risk of making comparisons across different parameter distributions. Results, based on the propensity score matching approach excluding 25% of observations, are displayed in the third and fourth column of Table 2.6. Results show that a higher agglomeration premium for traders is still present when using samples where traders and non-traders are matched to be more similar. At the same time, we can observe that the agglomeration elasticity of never traders is higher without small firms, though still not significant.

Table 2.6: Agglomeration coefficient estimates actual, matched samples and placebo treatment

	data		matched samples		pseudo data	
	never	always	never	always	never	always
agglomeration	0.0192	0.106***	0.0382	0.102***	0.0457***	0.0621***
	[0.0206]	[0.034]	[0.0237]	[0.0324]	[0.022]	[0.031]

Each column show the results from regression eq.2.7 on separate samples of firms: never traders and always traders. We instrument agglomeration with log of 1880 density. The first two columns show results from Table 2.4. In third and fourth columns samples are trimmed as suggested by Imbens and Wooldridge (2009) for the probability of being trader. In the last two columns pseudo data results are collected from the placebo treatment exercise. Here, the never and always trader samples are created from the generated trading status. Coefficients are the mean of respective estimated coefficients and standard errors are the means of s.e. obtained from the 500 replications. The standard errors of the estimated agglomeration coefficients are 0.003 in the never and 0.007 in the always trader case.

Our third method is based on running a placebo treatment regression and predicting a pseudo-trader status based on a simple probit model and 500 replications to get standard errors. In the last two columns of Table 2.6 we compare our placebo results to those obtained from the actual data (columns 1 and 2).[23] Results show that while the agglomeration effect differs greatly between actual traders and non-traders (0 to 10 percent) it is very similar between pseudo-traders and pseudo-nontraders (4.5 to 6 percent). F-test cannot reject the null that coefficients of pseudo-traders and pseudo non-traders are the same, while a similar null hypothesis is rejected at 5 percent for the actual data. This finding suggests that even controlling for initial productivity, trading behavior itself remains an important determinant of agglomeration elasticity.[24]

These last two results suggest when we control for trade self selection on observable characteristics, we find that a small part of our result for the higher agglomeration

[23] Details and robustness tests are available on request.

[24] Similar results are obtained when selection is based on the one step estimation using value added and inputs rather than TFP. A different approach would be to test if the agglomeration effect is strictly increasing with productivity, i.e. more productive firms benefit more from agglomeration. A quantile regression (comparing means of subsamples conditional on the independent variable, in this case: productivity) shows that traders along the full spectrum of productivity enjoy significant additional agglomeration benefits. Details available on request.

elasticity for traders is due to endogeneity of trade status. But it explains only a small fraction of our findings and our core results remain unchanged.

2.4.3 Exporters and importers

Following the voluminous literature on how exporters differ from other firms in many respects, recent studies have suggested that import activity is an equally important predictor of firm heterogeneity (see, e.g., Altomonte and Békés (2010)). No doubt, spillovers of information about the foreign market and foreign business channels are of key importance both for exporters and importers. However, exporters and importers might not draw the same benefits from agglomeration. Furthermore, it is important that the set of export and import partner countries differ in Hungary. While Germany and other European countries are the foremost partners in both cases, the share of imports from Asian and Far Eastern countries increased substantially over our sample period. Given the cross-cultural differences and language barriers involved, the access to trade related information might be more limited in the case of imports.

Table 2.7: *Regressions for exporters and importers separately*

Dep. Var.: TFP	firms exporting		firms importing	
	never	always	never	always
agglomeration	0.0155	0.143***	0.0141	0.115***
	[0.0224]	[0.0329]	[0.0164]	[0.0356]
foreign ow.	0.0609**	0.395***	-0.0557***	0.374***
	[0.0299]	[0.0411]	[0.0192]	[0.0432]
instrument:				
ln Pop dens 1880	yes	yes	yes	yes
dummy: sector	yes	yes	yes	yes
dummy: nuts 3	yes	yes	yes	yes
dummy: year	yes	yes	yes	yes
First stage: F-stat	46.67	31.15	50.85	34.23
First stage: R-sq.	0.8756	0.8283	0.8556	0.8702
Cragg-Donald Stat.	11449.83	6018.96	9664.3	8022.25
Kleibergen-Paap stat.	46.67	31.15	50.85	34.23
Stock-Wright LM S stat.	0.45	16.52***	0.68	10.04***
F-stat.	168.83	76.56	149.77	129.84
Observations	37108	26605	29018	34057
R-squared	0.155	0.223	0.148	0.218

Moulton corrected s. errors in brackets
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Each column shows results from separate 2SLS regressions. The first two are regressions where trader is now defined as exporter. The first column is on the sample of never exporting firms, while the second column is on always exporting firms. The third and four columns use only importing activity to define trade.

To assess the relative importance of the type of trade for the agglomeration elasticity, regressions are estimated both on the separated sample and on the full sample with cross terms of trade status and agglomeration included. The trading status is hence, examined separately for exporters and importers taking the direction of trade into account. The results are displayed in Table 2.7, where the first two columns present the full sample regressions for examining exporters' and importers' elasticity. Their specification is analogous to the last column of Table 2.3. The last two columns show within estimations for specific subsamples of firms, always exporters and always importers. The regressions are analogous to the third column of Table 2.5. Results imply that both exporters and importers show higher productivity in a more agglomerated environment than non-traders. Note however that always exporters and always importer subsamples overlap due to the large number of two-way traders in the Hungarian economy. As Altomonte and Békés (2010) suggest importers and two-way traders carry out a more complex production and procurement process which requires higher skills in labor and management. Agglomeration might be a better environment in order to satisfy their special needs.

2.5 Concluding Remarks

This paper investigated whether agglomeration has a larger effect on the productivity of firms engaged international traders than on those that only source and sell domestically. We used region specific firm level data from Hungary containing information on export and import status of firms. Our results indicate that the intensity of agglomeration economies depends on the trade status of firms, both exporters and importers gain more from agglomeration than non-traders. This result is qualitatively robust when controlling for the difference in the characteristics of trading and non-trading firms, as well as when including a spatial lag structure or combining employment density with the number of firms.

Our result suggests that apart from traditional spill-over and sorting arguments, proximity to other firms enhances foreign trade related activities, provides better flow of information on new market opportunities, offer better transportation and logistics services and supplies workers with higher skills and with the knowledge of foreign languages. From a policy point of view, the results suggest that when evaluating promotion of agglomerated economies or cluster formation, it is important to consider the international activities of participating firms. Producers of non-tradable goods or products that can be sold domestically only might not benefit from these policies to the same degree while firms active in import and export may benefit a great deal more. This also implies that policies promoting the agglomeration of trading firms could be a more specific tool for regional policy.

Chapter 3

Export spillovers in Hungary

3.1 Introduction

A key economic and policy interest in the globalized world economy is the firms' process of internationalization. Research of the past years has resulted in a consensus of explaining export behavior with entry costs and the vast heterogeneity in firm characteristics (Bernard and Jensen, 1999; Melitz, 2003; Bernard and Jensen, 2004; Mayer and Ottaviano, 2008). While the most effort was directed at discovering the influence of firm characteristics on export behavior, some have taken the route of investigating the effect of the firms' immediate environment, the effect of export spillovers. This paper takes this latter route.

Spillovers are the net effect of several agglomeration economies. These can affect the firms directly or indirectly. They have been categorized by Duranton and Puga (2004) as sharing, matching and learning mechanisms. Benefits from sharing arise from indivisible goods and facilities that are affordable to larger economic communities only. Also, firms in a more agglomerated environment benefit from the larger variety of inputs and hence more specialized products. Matching allows firms to find the right employment or intermediate inputs and services with a higher probability. Learning facilitates the diffusion of knowledge and information about, e.g., production technologies and market opportunities. Sharing, matching and learning benefits, however come at a price. Congestion, high rent prices, traffic and commuting can be costly to both workers and employers. These mechanisms are hard to distinguish empirically, primarily due to the lack of precise data. For these reasons this paper investigates the export spillover effect in general, capturing the net of benefit from the aforementioned channels.

Exporting firms can benefit from agglomeration mechanisms in several ways. First, for many exporters sharing such indivisibilities as harbors, airports or other logistics centers is an undoubted benefit. Sharing variety is also key. To successfully compete on foreign markets, production has to meet international quality and scale requirements.

The latter can be substantial based on the size of targeted markets. Agglomeration economies - via input sharing - are able to create sufficient backward linkages to find more suppliers or ones that can provide materials at a larger scale. In addition, the local outsourcing of parts of the production process is more likely in agglomerations.

Second, innovation in product quality and services is essential in order to survive the competition on international markets. For example, when explaining the relatively small ratio of Colombian exporters, Brooks (2006) finds that the poor level of product quality plays a crucial role. More recently, Imbriani et al. (2008), investigating the export propensity of Italian firms find that product quality gives a strict ordering to firms in trading activity. Firms in a dense economic environment have a better chance of finding matching - either domestic or foreign - quality input to their production process which makes the firm more productive and enables it to export its own products.

Furthermore, dense economies and/or industrially specialized regions provide a better matching labor force in terms of skills and a higher quality of human capital, which increases firm performance. Managers' past experience with export markets can be regarded as such human capital. Mion and Opromolla (2011), e.g., highlight that managers with export experience and skills are better paid and increase the probability of the export entry of Portuguese firms.

Third, exporters also benefit from learning. Learning and knowledge spillovers can bring about information that can significantly reduce the costs of establishing an international trade relationship. These can be knowledge spillovers on the techniques of trade, administration related, marketing issues, repackagingm or distribution channels. For example, Lovely et al. (2005) investigate the location of exporting firm headquarters in the U.S. They find that the headquarters of firms that export to countries that are more difficult to access tend to locate in each others' proximity. Also, trade-related tacit knowledge is more likely to circulate better in dense environments. Investigating tacit export knowledge, Soon L. and Fraser (2006) find that information on overseas business opportunities, customer preference and demand fluctuations is valued information for managers.

Recent studies have shown that the presence of other exporting firms in the close vicinity increases the probability of a firm's trade participation. Investigations take two approaches. The first is after effects on trade entry irrespective of the traded good or destination country. Aitken et al. (1997) examine Mexican manufacturing plants' export behavior and find that the propensity to trade is positively affected by the presence of multinational firms in the same location only but not traders in general. On Colombian, Mexican and Moroccan data Clerides et al. (1998) find evidence of positive regional externalities. A similar conclusion is drawn by Greenaway and Kneller (2008) for domestic manufacturers in the UK and by Pupato (2007) for Argentine firms. However, spillover effects were found to be not significant in countries such as the US (Bernard and Jensen, 2004) and Ireland (Lawless, 2009, 2010).

The second approach looks at spillovers specific to products and destination. Koenig et al. (2010) have shown for French firms the presence of positive spillovers from local exporters on trade participation, but not on the intensity of trade. In addition, in a series of papers they uncover heterogeneities in the spillover effects. Focusing on French firms they show that spillovers matter more upon entry into markets that are difficult to trade with (Koenig et al., 2011). Related to this study, two of the authors document the heterogeneity of spillover effects across various export destinations in Asian markets (Mayneris and Poncet, 2011c). The presence of heterogeneous spillovers has been documented in other countries as well. Dumont et al. (2010) show that product- and destination-specific spillover effects encourage export participation for Belgian firms. In two papers, Mayneris and Poncet (2011a,b) find spillover effects across Chinese firms.

This paper investigates the existence and scope of local spillovers generated by exporting firms to facilitate the export entry of firms. It asks whether firms are more likely to enter foreign markets when there are more trading firms in their vicinity. To answer these questions, the approach developed by Koenig et al. (2010) is applied to examine the export behavior of Hungarian manufacturers from 1993 to 2003, whose location and trade activity is known at the product and country level.

The contribution of the paper is twofold. First, it examines spillovers on a new, very detailed dataset on firms' export activity, where location information is available at the municipality level. Second, the paper offers investigations into the heterogeneity of the spillover effect with respect to country and firm characteristics.

Results show a positive effect of local peers on export entry and also that these spillovers are rather specific to destination country and product. I find that spillovers are stronger when peers export the same product. An additional peer exporting to the same country increases entry probability by 0.3 per cent. An additional local peer exporting the same product to the same county increased entry probability by 3.2 per cents. Result suggest that industry specific spillovers, such as sharing or matching play an important role in agglomeration benefits. General knowledge or experience about trade with a destination country has to be specific to the targeted product market.

Examining the heterogeneity of spillovers reveals that spillovers differ significantly with respect to the composition of the peers and the characteristics of the firm who enjoys the benefit. First, with respect to ownership, I find that while foreign-owned firms benefit from peers generally, domestic firms do not appear to benefit from more foreign peers, only more domestic ones. State-owned firms do not seem to generate any spillover effect. Second, larger firms benefit relatively more from export-agglomerations and also firms in less dense locations, where an additional peer is more valued. Third, the strength of spillover depends inversely on the destination country's gravity characteristics. Spillovers matter more for distant countries and for countries with smaller markets.

The rest of the paper is structured as follows. Next, section 3.2 offers a general empirical strategy to model export spillovers. Section 3.3 discusses econometric issues and threats to identification. Section 3.4 gives a description of the data, the construction of the dataset and the variables, and also looks at the spatial distribution of traders by trading partner country and traded products. Section 4.4 discusses results and offers an examination of spillover heterogeneities and robustness. Finally, section 4.6 concludes.

3.2 An empirical model of export spillovers

To describe participation in export the following model is proposed.[1] A firm engages in exporting if it finds such an action profitable. To capture export incentives, I assume simply that a firm i decides to trade good g to country k at time t, if it is better off than not doing so.[2] That is, a firm trades if revenues from trading minus the fixed cost of a new trade entry is higher than not engaging in trade. Formally, with T being a dummy variable indicating established trade connection:

$$\Pi_{it}(\varphi_i, T_{igkt} = 1) - F_{gkt}(T_{igk(t-1)} = 0) > \Pi_{it}(\varphi_i, T_{igkt} = 0) \tag{3.1}$$

where Π_{it} is the present and expected profit of the firm, which depends the firms productivity φ and its trading behavior. F_{gk} is a country and product-specific fixed cost which the firm incurs when establishing a new trade relationship.

The assumption that the fixed cost of export entry varies by product or destination country is not uncommon in the literature. For example, Akerman and Forslid (2009) model export entry cost as being dependent on the market size of destination and home country. They argue that entry cost and require productivity premium increases with market size. One explanation for this issue is the agglomeration effect which makes firms in larger markets more productive, tougher to compete with. Analyzing French exporters, Eaton et al. (2011) also argue for country specific entry costs and the correlation between market size and firm productivity. This suggests that less efficient firms target a smaller market share of any destination country.

Trade costs also differs also across goods, mostly depending on the degree of product differentiation (See Rauch (1999), Koenig (2009)). Homogeneous are more easily traded, information on price and specification details are more easily accessible. The heterogeneity of fixed costs across destination countries and sectors was incorporated into theory by Chaney (2008). Koenig et al. (2010) also allows the fixed cost of trade entry is allowed to vary across destination and by products when estimating local trade spillovers.

[1] Dynamic trade participation decision is not easy to model. Except for the structural approach on export entry by Das et al. (2007) studies use reduced form models e.g. Clerides et al. (1998) and model decision of engaging in trading via choice modeling. This study takes this latter route.

[2] In this paper I will use terms good and product interchangeably.

Country-product specific trade cost can be best imagined as costs related to re-designing product or advertisement campaigns to countries specific needs or regulations. For a European car manufacturer to enter US market needs to install automatic gearbox, for the Japanese or New-Zealand market it needs to design the dashboard for driving on the left. For producers of household electrical appliances one needs to have different plugs for Italy, UK and Switzerland. For laptop manufacturers one has to design keyboards to fit several alphabets.[3]

Consequently, the probability of a product being traded by the firm is modeled by the probability that the following inequality holds.

$$\Pi_{it}(\varphi_i, T_{igkt} = 1) - \Pi_{it}(\varphi_i, T_{igkt} = 0) - F_{gkt} \times (1 - T_{igk(t-1)}) > 0 \tag{3.2}$$

I assume that other firms in the vicinity that are engaged in the same or similar trading activity, can help exporting by either reducing the fixed cost of entry for the firm or by increasing its productivity. Cost-reducing and productivity enhancing effects might work by direct communication about trade channels, market opportunities, distribution channels or indirectly by witnessing another firm's successful business activity due to trade, imitation or through sharing and matching gains from agglomeration economies created by exporters firms discussed in Section 3.1.

The effect of other traders (peers_{itr}) in region r on the fixed cost of trade is modeled either the following way:

$$F_{gk} = F^0_{gk} \text{peers}_{itr}^{-\frac{1}{\theta}} \tag{3.3}$$

where F^0_{gk} is a baseline cost, which is mitigated by the presence of peers in a decreasing way driven by parameter θ. An effect on productivity could be modeled analogously.

However, to model trade participation as in equation 3.2 has empirical impediments. On the one hand, the counterfactual profit of the firm if it did not engage in trade is not observable. On the other hand, the fixed cost the firm has to pay to establish trade channels is also not directly observable: its effects can be assessed only indirectly. To overcome these impediments, it will be assumed that the net gain from trade participation depends on the observed firm, country and good level characteristics. These considerations suggest the following empirical model, to be estimated with the following specification.

$$T^{start}_{igkt} = \begin{cases} 1, & \text{if } \gamma \text{peers}_{it} + \beta X_{irtgk} + u_{igkt} > 0 \\ 0, & \text{otherwise} \end{cases} \tag{3.4}$$

[3]Note that these examples contain both fixed and variable cost elements.

where X_{irtgk} is a vector of firm, region, country, and product characteristics and peers_{irt} is the trading activity of other firms. If we assume that peers_{irt} and X_{irtgk} are not correlated with u_{irgkt} then the γ obtained from a simple logistic estimation will allow us to assess the effect of peers on trade probability.

The dependent variable, T^{start}_{igkt}, is specified to grasp firms trade entry behavior and is a modification of the participation dummy. The modification follows Koenig et al. (2010). Let the dependent variable be one if the firm starts to export a good to a given country, that is it exports in year *t* but not in *t-1* and is zero when the firm does not export. When the firm exported in *t-1* a good to a country, the next years dependent variable for the same good and country is rendered missing. Using trade entry dummy has several advantages. First, rendering post-export years missing does not allow continuous and discontinuous trade spells to play a role in the estimation and allows us to concentrate on export activities when firms might incur fixed costs of entry. Second, it allows for repeated entries, that is it may take up the value of one more than once in the country-product dimension for a firm.[4]

Note, the variables of equation 3.4 are not necessarily exogenous. The main concerns are geographically correlated omitted variables, reverse causality and simultaneity. The next section discusses the estimation problems.

3.3 Estimation and identification issues

To identify the effect of local peers on trade entry several identification threats need to be eliminated. These are (1) reverse causality, (2) simultaneity and (3) omitted variables.

(1) Firm characteristics, location and trade behavior are correlated. The strand of trade literature on the heterogeneity of trading firms suggests that those engaged in international trade look different from non-traders along a number of dimensions. Exporters are on average larger, more productive, pay higher wages and are more capital intensive. This phenomenon has been documented both for the U.S. and European countries for example in Bernard et al. (2007) or in Mayer and Ottaviano (2008) and Castellani et al. (2010), and recently, also for Hungary by Altomonte and Békés (2010). These results suggest introducing firm size, productivity and average wage into the vector of control variables as they also influence potential benefits from trade. While most of the aforementioned literature suggest that exporting firms outperform others before inter-

[4]A third benefit is avoiding the following econometric problem. Simply using trade dummies would require the use of lagged dependent variables. Lagged dependent variables would control for the persistent nature of export behavior in the presence of fixed costs. However, in the case we one would like to use a fixed effects model, as I will in this paper, including lagged dependent variable would result in biased estimation. While, there are econometric techniques developed for models with lagged dependent variables with fixed effects using dynamic panel data models (see Bond (2002)), previous finding is, however, that GMM estimations on the Hungarian data show very unstable results with the starting points and lag structure being excessively important.

nationalization, hence better firms self-select to trade, firms also benefit from export entry. When firms decide to enter foreign markets, at the same time they may choose to hire more or better qualified workers, invest in new machinery. This raises issues about causality. To attend to this issue and avoid reverse causality bias all control variables will be lagged.

(2) As peers can influence the trade entry of a firm, so can the entry of the firm affects the behavior of the peers. In addition, firms can act in reaction to various shocks, e.g., exchange rate, demand shocks execute similar actions, may chose to enter or exit foreign markets at the same time. Parallel to the reverse causality issue, the identification problem of simultaneous decisions is handled by lagging the variable capturing the influence of peers by one year.[5]

(3) Geographically correlated, omitted observed and unobserved variables can be threats to the identification across all indices of equation 3.4. Correlation at the regional level is possible at the firm, the product, the destination/origin levels: (a) location can be correlated with firms' characteristics and willingness to trade. (b) it may determine the product that the firms trade with, (c) location may matter for the choice of trading partner, (d) temporary shocks may have effects through all these aforementioned channels.

(a) A correlation between location and firms characteristics is a threat as, for example, more productive firms and those more willing to trade do not locate randomly. Firm characteristics including the sector of the firms and its products can be correlated across regions. The problem has two aspects.

First, there can be location characteristics that make firms more productive. On the one hand, there are the so-called first geography factors, such as mines, forests, or proximity to bodies of water that are indispensable or favorable to certain industries. Firms in such industries located in these regions will be more productive then their peers in the same industry and more likely to trade. On the other hand, there can also be agglomeration economies, second-nature geography at play.[6] That is, firms may gain productivity advantages from the proximity of other firms via various economic channels. These include a greater variety of inputs, more and more skilled labor, a larger pool of buyers. For example, a larger city allows for a variety of specialized legal services, or for a more reliable electricity service. These productivity-enhancing channels can all increase the probability of trade entry, however we would like to control for the effect of first-geography.

Second, there can be location characteristics that attract firms. More productive firms self-select to agglomerations and to bigger cities.[7] This implies that agglomeration does

[5]Lagging the peer variable by one year also targets the reflection problem raised by Manski (1993) where the individual's performance is explained by the average behavior of a group which the firm is part of.

[6]See, among many others, Marshall (1920), Henderson (2003) Puga (2010) Rosenthal and Strange (2004).

[7]The spatial sorting of heterogeneous firms has been investigated by Melitz and Ottaviano (2008) and Baldwin and Okubo (2006).

not only provide a good environment for traders via agglomeration benefits but also holds relatively more productive firms per se that are more likely to trade.

All in all, the number of trading peers to the firm depends on the location specific advantages and the density of the local economic environment. To assess the aforementioned two issues, firm, product fixed effects and a location specific control for agglomeration, the number of workers in the region can be introduced.

(b) Location specific benefits may vary across industries. Both the aforementioned first and second geography benefits may affects industries differently, determining their absolute and relative concentration in space. This is a widely documented feature of the spatial economy.[8] To control for this is necessary as industry concentration can explain the clustering of traders by itself leaving no room for trade related spillovers to be identified separately. To that end, sector level fixed effects can be introduced.[9]

(c) Country, trade behavior and location characteristics can be correlated. The voluminous literature of gravity model estimation (see, e.g Anderson and van Wincoop (2003)) suggest that bilateral trade is positively related to the partner countries' GDP and negatively with the distance. Distance increases variable costs, in turn discourages trade. GDP is expected to encourage trade, as firms might find it more profitable to sell their products on larger foreign markets in light of higher expected price or volume. Therefore, it is worth controlling for both the overall bilateral flow between countries of a given product and the GDP of the partner country. Separating the two demand variables also allows for the relaxing of homotheticity across goods.

Additionally, firms located in regions close to the national border have an advantage in trade. In the case of Hungary, regions west of the Danube have better access to Austria and Germany, which might induce the clustering of firms trading with the aforementioned countries on Hungary's western border. An analogous example can be set up for Eastern-Hungary and Ukrainian or Romanian foreign trade. A similar argument can be put forward for trade via air, with Budapest being the only international airport, or proximity to the two major rivers might help trade with countries down or up rivers. The geographical advantage in trade will result in the clustering of firms trading with similar partner countries, thus the higher propensity to trade is a consequence of the location and not the economic surroundings. To assess the aforementioned issues one needs to introduce country and location fixed effects.

(d) Firms in the same area might share common unobserved shocks that drive their behavior. The problem arises from using aggregate indicators as regressors on firm level data. As pointed out by Moulton (1990), regressing aggregate variables on micro-level observations has the pitfall of underestimating the standard errors of the coefficient

[8] See among many others Ellison and Glaeser (1997), Barrios et al. (2003), Maurel and Sedillot (1999) or Duranton and Overman (2008)

[9] Another option would be to use spatial concentration indices as they allow for time variation. Calculating Ellison and Glaeser (1997) over Hungarian manufacturing industries shows only little variation over time, hence sector dummies are sufficient.

estimate. To handle this estimation problem standard errors are clustered according to regions.

To attend to all issues above, I estimate the following, augmented version of 3.4:

$$T_{igkt}^{start} = \begin{cases} 1, & \textbf{if} \quad \gamma \text{peers}_{i(t-1)} + \beta X_{ir(t-1)gk} + u_{igkt} > 0 \\ 0, & \textbf{otherwise} \end{cases} \tag{3.5}$$

$$u_{igkt} = \nu_{ikg} + \tau_t + \varepsilon_{igkt}$$

Where X includes firm specific controls (size, ownership, productivity), country specific controls (GDP, distance of country k), product-country controls (log value demand and supply of good g to a country k), a location-specific control (density of labor force in the region). The error term is structured to capture possible correlated unobserved heterogeneity. It includes ν_{ikg}, which is a country-product-firm fixed effect, and time dummies τ_t. The remaining error term ε_{igkt} is assumed to be exogenous. That is, equation 3.6 identifies from temporal variation.

3.4 Data and Variables

This section presents the dataset. First, data sources and basic characteristics are introduced. The next subsection describes the spatial distribution of trade. The third subsection describes how different data sources are merged to fit the analysis and provides information on the construction and definition of variables.

3.4.1 Sources

The main source of data is the CEFiG-IEHAS dataset.[10] The dataset is compiled by the merger of two different dataset.

The first data contains balance-sheet and income statement information on firm that are subject to corporate income taxation. It is administrative dataset is collected by the Hungarian Tax Authority and maintained as dataset by the Central Statistical Office. The data includes additional firm information on average employment, location of firm the share of state and foreign ownership.[11] These informations allow to compute firm

[10]IE-HAS is the Institute of Economics of the Hungarian Economy of Sciences. CeFiG is a research project and community, Center for Firms in Global Economy, which is a joint effort of academic and researchers at Central European University and IE-HAS. For a detailed description of the dataset see Chapter 1 of this thesis.

[11]I will convert this information into a dummy variable, taking on the value of one if firm is more than 20 percent foreign/state owned.

performance variables, such as total factor productivity (TFP). Sectoral classification at the NACE 2 digit level. In this paper, only manufacturing firms are kept.

The location of the firm is available at the municipality level, which corresponds to NUTS5 EU classification. See Table 4.4. The location information refers to the headquarters of the firms and no information is available on location at the plant level. The consequences of measuring location with headquarter are discussed in Section 3.1.1 of the Appendix. Throughout the paper I will use NUTS5, that is, municipality level location information. Investigations at a different spatial zoning is provided later for robustness.

Table 3.1: Summary of Hungarian administrative spatial zoning

EU level units	Hungarian equivalent	number	avg. size km^2
NUTS2	EU administrative region	7	13861
NUTS3	20 regions (megye)	20	4651
NUTS4	micro regions (kistérség)	150	620
NUTS5	municipalities	3125	30

The second data is the collection of customs declarations, it contains all export transactions aggregated to the product-country level for economic entities in Hungary. The data was collected by the Customs Office from 1992 until the EU accession, 2003. The transactions are aggregated up to four digit levels of Harmonized System classification.[12] The first year of the sample is dropped due to changes in geopolitical entities.[13]

Table 3.2: Descriptive statistics of firm characteristics and trade in 2000

	obs.	mean	s.d.	min	max
number of products	4995	7.72	11.58	1.0	196.0
number of destinations	4995	4.66	7.26	1.0	99.0
average distance (km)	4995	1029.31	1109.24	159.1	18128.4
average value of exports (Mill. USD)	4996	4.56	52.21	0.0	2973.0
employment (logs)	4991	3.74	1.33	1.6	9.5
Share of foreign owned assets	4968	0.32	0.44	0.0	1.0
Share of state owned assets	4973	0.01	0.09	0.0	1.0
TFP (LP)	4175	-0.52	1.19	-8.0	3.6
distance from Budapest (logs)	4996	4.08	1.00	2.7	5.6
distance from Vienna (logs)	4996	4.99	0.73	-2.3	6.0
local employment (NUTS5) in logs	4995	8.47	2.68	1.6	12.0
local employment (NUTS4) in logs	4995	9.45	1.74	4.0	12.0

Over the sample period, manufacturing firms export 1182 goods defined at the HS4 level to 215 countries altogether. Table 3.2 collects descriptive statics related to trading behavior. The average firm export 7.2 different HS4 products at the average distance from Hungary of 1030 kilometers.[14] and trades 4.5 million USD in value. In addition to trading behavior, balance sheet data allows us to attach firm characteristics to trading

[12]Harmonized Commodity Description and Coding System

[13]Trade with transition countries being previously, e.g., Czechoslovakia, Soviet Union, Yugoslavia cannot be captured in 1992.

[14]The distance between Hungary and the partner country is taken from CEPI's GeoDist geography dataset.

firms. The variables included included in Table 3.2 are those used by the international trade literature, which suggest that firm size, foreign ownership and total factor productivity (TFP) are important predictors of firms' trade status.[15] Here the firm size is measured with the log of the average annual workforce, foreign and state share in the ownership of subscribed capital. TFP is measured by the control function approach suggested by Levinsohn and Petrin (2003). To characterize the regions the number of workers in the regions is included as controls for the spatial sorting of the better firms to agglomerated regions. An alternative measure for agglomeration is a dummy variable that takes on the value of one when the region holds the principal city of the county. To control for the access to trade of the regions their distance from Budapest and Vienna is measured as the crow flies.

3.4.2 Spatial descriptives of trade activity

A preliminary evidence on the existence of export spillovers can be that trading firms, especially those trading similar or the same good with the same country, should be the observed clustered in space. Furthermore, to be able to identify export spillover an uneven spatial distribution of firms, especially trading firms is necessary.[16] However, clustering need not be easily visible on, say, maps as relative concentration of exporters in an otherwise scattered or widespread industry can also be a result of agglomeration economies. In the following, the spatial distribution of trading firms and the corresponding trade volumes are portrayed.

Both the volume of Hungarian manufacturing production and international trade is rather concentrated in space. About half of manufacturing exports is concentrated in only 4 locations. Győr, Székesfehérvár, Vác and the capital city Budapest are responsible over 49.5 percent of export volume in 2000 (See Figure C.1 in the Appendix). These locations harbor several large multinational firms operating in high value added producing industries such as motor, vehicle machinery and producing electronic computing and telecommunication devices.

The spatial distribution of trading firms is less concentrated than the volume, half of trading firms are to be found in 20 locations. Most trading firms are concentrated in cities, especially in those located in the central and western part of Hungary (See Figure C.2 in the Appendix) . The capital city, Budapest, holding about one fifth of the population and 27 percent of exporters, employs several large law, accounting, logistics, IT and other service firms that help business and international trade. At the same time, it holds the only significant airport of the country. Firms in the western part of Hungary enjoy the relative proximity of Germany, the main export and import partner of Hungary. These firms can take advantage of their geographical position in trade via rail or road.

[15]On the heterogeneity of firms in international trade see, e.g., Bernard et al. (2007), Mayer and Ottaviano (2008), Andersson et al. (2008) or Muûls and Pisu (2009)

[16]Given the estimation strategy one actually need temporal variation in firm distribution as well.

Beside the absolute concentration in volume and the number of firms one can also witness some spatial bunching in trade activity at the product and country level. The data gives several examples when a good being traded with a particular country is concentrated in few or even in a single location. The examples are taken from goods that are traded by many location. That is, will try to avoid goods that are concentrated in their production or goods that only few firms use as inputs, because that would be concentrated because the industry is. Examples of relatively concentrated exporting patterns are the following: *Leather clothing* (HS4:4203) to Finland is only exported from the Pécs by 5 firms, while exported from 23 other location. Also, *insecticides* (HS4:3808) are sold only from the Balatonalmádi to China, whereas they are exported from 16 other locations too. The concentration is also present if only domestic firms are examined, e.g. Piliscsaba is the only one that sells *footwear* (HS4:6406) to France out of the 33 locations exporting the same good. For all these examples, a minimum number of three firms in the concentration region was a pre-requisite.

The distribution of trade, however, depends on product and country characteristics. On the one hand, product characteristics affect concentration via the underlying spatial distribution of industries. Products of industries that make use of agglomeration benefits or which consist of only a few firms due to market structure will be concentrated in trade as well. On the other hand, country characteristics influence spatial concentration similarly to a gravity equation.[17]

While the examples listed before shed light on the possible accumulation of product and country specific trade related knowledge, they were picked from various cross sections of time. To conduct a more precise inquiry, I will turn to econometric techniques in the next section.

3.4.3 Construction of the data and the variables for analysis

To analyze the effect of trading peers on firms' trading decisions two datasets are compiled. The first dataset will examine export at the country level, but not yet the product level. This will allow us to assess the importance of country level spillovers irrespective of the product dimension. The other dataset will examine export behavior at the country-product level allowing for the examination of the specificity of spillover effects. This approach allows comparing spillovers at the product and country dimensions. This section explains the construction of the country-product dataset, the country level data is compiled in a similar fashion with the exception that the production dimension is omitted.

[17] See Chaney (2008) for modeling trade at firm level with gravity variables.

Dimensions

The main export dataset is where the unit of observation is a firm-product-country cell. The three dimensions are determined as follows. For the firm the longitudinal dimension is given by the range set by the firm's minimum and maximum year observed in the balance sheet data. However, only those firms are kept which have exported at least once in their time present in the sample. That is, firms that never trade are excluded. The reason for this is purely technical. For firms where trading behavior cannot be observed, one cannot form choice sets of neither for products nor countries. For firms where trade information is available, the product and country dimensions take into account all the possibilities that can be described by the firms export behavior. A simple example will make this more clear. Assume that a firm exports two products,A and B. Product A is sold in countries a and b, while product B is sold to countries a and c. Then the choice set of the firm for a single year would look like this:

product	A	A	B	B
country	a	b	a	c

These choices are available for the firm for all years whenever it is observed. The construction process results in an unbalanced panel at the country-product-firm level. Notice that the country and product choices are restricted to those revealed by the firms, for two reasons. Once, what set of countries show demand for a particular product. This is known by the firm but not by the researcher. Second, the researcher does not know the exact product lines of individual firms. In this respect we can keep our focus on the timing of the entry.

Spillover variables

Variable $peers_{ir}$ is defined as the number of firms in the same location r as firm i engaged in the same export activity as the one firm i will enter. To allow for variation by product and country and capture the effect of agglomeration of exporters. Hence, four mutually exclusive variables are defined as the number of other firms in the same region who[18]

- export good other than g to country other than k
- export good g to a country other than k
- export good other than g to country k
- export good g to country k

[18]The definition of spillovers are different from the ones used in the analysis of Koenig et al. (2010). They consider "all countries" rather than countries other than k. This modification allows us to incorporate all spillover variable in a single regressions and test their difference within one model.

The first variable in the list variable counts all other firms whose trade relation has no common country or product element with $T_{i(r)gkt}$. The last variable in the list counts all firms in the same locality who have the exact trade relationship firm i is considering establishing.

This definition allows the capturing of several aspects of the agglomeration economies. For example, depending on th e g and k dimension, it captures the range available varieties in a location that are sufficiently good for international markets and also the variety of trade connections with other countries. It proxies the density of productive, internationally active firms. It can proxy the availability of managers with exporting experience in general and specific country in a given product line. With that, it sums up the successful local strategies and market channels and the size of the pool of local information. In section 3.5.4, an alternative definition of the $peers_{ir}$ variable is investigated.[19]

Table 3.3: Distribution of peers across firms by country in 2000

Dependent variable is:	0		1	
Number of	cells	firms	cells	firms
with other country peer				
0	14289	4229	1889	958
1-10	1721	948	517	384
11-20	1516	635	479	264
21-50	2833	886	942	468
over 50	12258	2823	3368	1464
with same country peer				
0	19293	5135	3310	1565
1-10	7406	3246	2186	1367
11-20	1339	963	341	305
21-50	2369	1271	654	482
over 50	2210	1384	704	569

Cell is country-firm

The effect of the number of peers is the focus of the present paper and requires defining proximity. I define firms to be geographically close if their headquarters that most likely call on trade decisions are located in the same municipality (NUTS 5).

The following tables describe the distribution of spillover variables over the choice-sets defined in Section 3.4.3. Table 3.3 collects statistics for the number of peers by trading partner countries. The first two columns of the table describes distribution of choice cells and the number of firms when the dependent variable is zero.[20] The last columns show the analogous statistics for instances when the dependent variable is zero. The upper panel describes the spillover variable for other country trade, the lower panel for same country trade. The distribution of peers is bimodal in both firms and the number of cells. Most firms do not have any peers at all and up-to a point, the share of firms with high number of peers decreases. At the same time a significant share of firms have

[19] I will include the value of trade to give weight to local information or export strategies.

[20] It is important to note that the distribution of the number of firms is not additive. As a firm can export to more than one country it can appear in more than once in the Table.

also many peers. This second modus in the peer distribution is caused by the large share of firms located in the capital, Budapest. In this extreme case, that more than 500 firms are found, who start to export in 2000 have more than 50 peers that export to the same country.

To look at the more specific peer relations, Table 3.4 collects statistics on the product and country level distribution of peers. The Table is constructed analogously to 3.3, but instead of two, describes four spillover variables. First the different product peers, then the same product peers. In this table one can also observe the bimodal nature of firm number and cell distribution. Again, the reason for this is the capital, which holds significant share of all firms. At the same time, it also hold relatively more multi-country and multi-product firms that results in high numbers in the 21-50 or above 50 peer categories. As the definition of peers gets more narrow and more specific, the fewer and fewer number of firms and cell have higher and higher number of peers. However, in the most specific case, about a hundred different firms is detected who start exporting in 2000 and has between 21 to 50 peers, who have already traded the same good with the same country.

Table 3.4: Distribution of exporting firms by country and product, 2000

Dependent variable is:	0		1	
Number of	cells	firms	cells	firms
with same country, different product peers				
0	77186	7854	15070	3567
1-10	1995	934	751	408
11-20	1324	627	416	235
21-50	1682	803	586	353
over 50	12297	2070	3353	1098
with other country, different product peers				
0	76942	7847	15001	3558
1-10	640	294	180	123
11-20	444	208	224	110
21-50	1211	513	409	236
over 50	15247	2503	4362	1356
with different country, same products peers				
0	78356	7926	15411	3648
1-10	7840	2439	2432	1188
11-20	2770	982	760	400
21-50	4133	1139	1200	501
over 50	1385	495	373	200
with same country, same product peers				
0	77609	7898	15659	3617
1-10	15607	3228	4121	1586
11-20	929	586	280	216
21-50	339	256	116	96

Cell is country-product-firm

3.5 Results

This section estimates spillovers first at the country level, then at the country and product level. For easier display of the results, the spillover variables are rescaled to express figures in 1000 firms.

3.5.1 Country level spillover

To examine the effect of local spillovers from peers exporting to the same country on export entry I estimate a version of equation 3.5 that has no product dimension. Without the product dimension one is left with only two spillover variables: (i) the number of firms in the same region exporting to any other country and (ii) the number of peers exporting to the same country.

The results from the regressions are displayed in Table 3.5. Each column collects results from a separate regression. The first regression contains only the spillover variables and time dummies but no other control variables. Results suggest that the number of local firms exporting to the same country has positive effects on probability of export entry, while the number of peers exporting to other countries has no effect. However, the results in the first column of Table 3.5 not necessarily reflect the effect of additional neighbors. The result can be driven purely by spatial clustering of firms with characteristics that facilitate export entry omitted from the regression.

In column (2) I add firm level observable characteristics in logs, firm size and total factor productivity and ownership dummies. Not all coefficients on the newly added variables are significant. TFP and the foreign ownership dummy are insignificant, while size and state ownership seems to be positively related to starting to export.[21] The same country spillover is still found positive and significant.

The results still might not reflect the effect of peers. It can be a result of location specific characteristics that favor trade and agglomeration jointly. To this end, column (3) includes local observable characteristics. None of the newly added variables turn out to be significant and they do not alter the spillover inference. However, not all endogeneity or selection issue are yet attended to.

Column (4) introduces country level controls. I find that the coefficients on the GDP, the traded value and distance variable are significant. The signs are in line with the gravity literature, they suggest that firms are more likely to start trading with larger markets and less likely to trade with distant countries.

Column (5) holds our preferred specification which includes firm and country level fixed effects additionally. In this case several time invariant control variables are dropped. On the one hand, as firm locations do not change over time, time invariant location specific characteristics, such as distance from Vienna and distance from Budapest are now omitted. On the other hand, I include country fixed effects to capture all time

[21] While in the literature size often correlates positively with trade entry, the results on the state dummy is not as expected. However, the results is not stable over time, the coefficient gets negative if regression is carried out for the post 1997 period. This reflects the results of the privatization literature, foreign investors cherry-picking the more productive firms. See, e.g.,Brown et al. (2006).

invariant cross-country heterogeneity. Consequently, the variable that measures the distance of the partner country from Hungary is omitted.

There are three important changes in the regression results compared to the previous specifications. First, including firm fixed effects now makes firm level TFP a significant variable. In line with expectations, it suggest that more productive firms are more likely to start exporting. Second, local employment is now of a different sign and significant. The result implies that firms with more dense labor markets are more likely to start trading. Lastly, we observe that the coefficient on the same country spillover variable is now higher.

The point estimate with the variable counting the same country peers is 0.47. This suggest, that given the average probability of exporting is 17 percent, one additional exporting local peer increases firm probability of entering a specific market by 0.3 percentage. In the Hungarian context, this mean that hypothetically moving a firm from isolation to Budapest, where the most peers are located increases trade entry probability by cc. 14 percentage points, a 83 percent increase in probability.

Table 3.5: Estimations for local export spillovers at the country level

Dep. Var. Export entry	[1]	[2]	[3]	[4]	[5]
# of local firms exporting to					
another country	0.00753	-0.00485	0.0147	-0.0214***	-0.00129
	[0.00571]	[0.00308]	[0.0129]	[0.00457]	[0.00862]
same country	0.328***	0.373***	0.293***	0.186***	0.470***
	[0.0113]	[0.00554]	[0.0174]	[0.0116]	[0.0277]
ln (size)		0.007***	0.009***	0.0124***	0.0760***
		[0.00177]	[0.00111]	[0.00128]	[0.00551]
ln (TFP)		-0.00036	0.00179	0.00400***	0.0288***
		[0.00144]	[0.00132]	[0.00142]	[0.00301]
dummy: foreign own.		0.00485	0.00714*	0.0104**	0.0258*
		[0.00425]	[0.00419]	[0.00468]	[0.0144]
dummy: state own.		0.00905**	0.00957**	0.0127**	0.0236***
		[0.00406]	[0.00418]	[0.00536]	[0.00896]
ln (local employment)			-0.00448	0.00401***	0.0309**
			[0.00321]	[0.00135]	[0.0156]
ln (distance from Wien)			-3.76E-05	0.00186	
			[0.00187]	[0.00172]	
ln (distance from Budapest)			0.00389	-0.00330*	
			[0.00351]	[0.00181]	
ln (distance to country)				-0.0224***	
				[0.00140]	
ln (GDP of country)				0.00801***	0.0684***
				[0.000939]	[0.0133]
ln (trade with country)				0.00754***	0.00119
				[0.000929]	[0.00111]
dummy: year	yes	yes	yes	yes	yes
dummy: product-country-firm					yes
constant: year	yes	yes	yes	yes	yes
Observations	414395	310993	310970	237578	237596
R-squared	0.031	0.026	0.028	0.027	0.026
Number of ID					51290

Moulton corr. standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The Table shows the results from 5 separate regressions. Firm level, region level and country level controls are introduced gradually. The last equation includes both country and firm fixed effects.

3.5.2 Country-product level spillover

Having estimated country level spillovers, I now extend the scope of inquiry and include the product dimension as well. I estimate equation 3.5 for the effect of exporting peers and collect the results in Table 3.6. Its layout is analogous to that of Table 3.5 used to display country specific results. Column (1) includes only the variables that intend to capture the spillover effects. The first two variables measure the number of firms trading with other countries. The first variable capture traders of other goods, the second one captures trade with the same good. The third and fourth capture the same for trade with the same country. Additional controls are included from columns (2) to (4), while column (5) shows the preferred specification using triple fixed effect.

The results show that the first group of peers, least related to firms' country-product choice have a slight negative effect on starting to trade, while other spillover variables show a positive impact. The magnitude of the coefficients allows for two observations.[22]

Table 3.6: Estimations for local export spillovers at the country - product level

Dep. Var. Export entry	[1]	[2]	[3]	[4]	[5]
# of local firms exporting to					
another country and good	-0.0062	-0.0131***	-0.0048	-0.0459***	-0.0091***
	[0.00475]	[0.00387]	[0.00389]	[0.00184]	[0.00240]
another country, same good	0.683***	0.665***	0.647***	0.646***	0.420***
	[0.0285]	[0.0172]	[0.0180]	[0.0131]	[0.0814]
same country, other good	0.0534***	0.0503***	0.0374***	0.0806***	0.0230***
	[0.000812]	[0.00221]	[0.00402]	[0.00514]	[0.00758]
same country and good	0.842**	1.323***	1.336***	0.988***	4.811***
	[0.356]	[0.348]	[0.329]	[0.117]	[0.439]
dummy: year	yes	yes	yes	yes	yes
dummy: product-country-firm					yes
constant	yes	yes	yes	yes	yes
Observations	1174981	905049	905017	608935	608960
R-squared	0.03	0.024	0.025	0.011	0.028
Number of ID					133118

Moulton corr. standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The Table shows the results from 5 separate regressions. Firm level, region level and country level controls are introduced gradually. The last equation includes country-product-firm fixed effects.

First, I find that regardless of the product definition, same or other, the coefficients are always higher when peers trade with the same country. This is in fact the same result as we got when examining the country case only. From the two observations it follows that the highest coefficient and consequently the highest effect of an additional peer is in the same country, same good case.

Second, country spillovers are less important then product related ones. I find that regardless of the country definition, same or other, the coefficients are always higher

[22]The result are analogous in an alternative specification when spillover variables are included separately. See Table C.2 in the Appendix.

when peers trade the same good than when they trade different goods.[23]

These results reveal that product and therefore industry specific spillover mechanisms are more important. That is, country specific spillovers such as information trade with a foreign country (customs and shipping regulations, trade documents, special legal services, language barriers) are outweighed by product specific spillovers such as benefits from sharing skilled labor, specific intermediate variables. However, results show that synergies between the country and product specific spillovers are the strongest. These could be information on product specific demand or distribution channels at a given country or sharing intermediate producers of specific products.

The significance on the highest coefficient on the most specific spillover variable remains as extra control variables are included gradually. At the same time, the value of the coefficient is unchanged until the fixed effects are introduced in the fifth column. In the preferred specification, column (5), the coefficient is 4.811. This suggests that an additional firm in the locality having exported the same product to the same country increases the probability that the firms enters a specific market with its product increases by 0.48 percentage points. Given that the average probability of starting to export is 15 percent, the entry probability increases by 3.2 percents. In the hypothetical scenario, was an exporting firms moved from isolation to a location with the most peers, 150 firms, the probability of starting to export increases above 80 percent.

3.5.3 Robustness

This section offers several robustness checks to show that the results are also valid in various subsamples of our data.

First, I will consider the rather special position of Budapest firms. Since, Budapest holds about one fifth of the Hungarian population and about the fourth of the manufacturing firms in our data, often Budapest is treated as an outlier. To look into whether this drives the results I omit Budapest located firms from our analysis. Table 3.7 collects the coefficients on the same country, same product spillovers for export entry equation from our preferred specification and the first column show the results when omitting Budapest located firms. The result suggest that the effect of an additional firm is about three times higher than for all Hungarian manufacturing firms. This is not surprising, as without Budapest the standard deviation of the spillover variable is significantly smaller.

Second, I indirectly investigate a threat to identification from spatially correlated shocks. An improvement in the bilateral trade relationship between Hungary and another country may falsely appear as an outcome of spatial spillover if firms are concentrated. The most likely case is when the country has a common border with Hungary.

[23]The inference is reinforced by investigating the result when the country dimension is shut down entirely. Results are available at request.

If for any reason trade with Austria becomes more profitable, firms close to Austria will have an advantage over firms in the East of Hungary. Their joint entry to trade will appear as if it were generated by spillover effects. Note, that country specific shocks are do not hinder identification at all times. For example, China's WTO entry in 2001 makes trade with China less costly, hence more profitable. However, access to Chinese trade will be relatively the same for all Hungarian firms before and after 2001. The is no spatial dispersion in the ease of trade, the effect of change can be considered geographically uniform.

Table 3.7: Robustness of results to geographic idiosyncracies

Dropped observations	Budapest	Border regions	Neighbors
# of local firms exporting	13.72***	4.995***	4.213***
same country, same good	[2.093]	[0.350]	[0.457]

Moulton corr. standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The Table shows results from 3 separate logistic regressions. The upper panel contains 3 estimations of 3.5 for export entry. Controls include: year dummies, firm size, firm TFP, a foreign ownership dummy and product-firm-country fixed effects. Only the indicated spillover variable is included. The first equation omits firms in Budapest, the second those in border regions, the third excludes trade to neighboring countries.

To check the possible effects of spatially correlated country effects I take a dual approach. First I omit firms in regions that are on the Hungarian border, next I omit the trade with neighboring countries. Results are collected in the second and third columns of Table 3.7. The results do not indicate significant changes to the baseline results.

Third, in Table C.4 (in the Appendix) I investigate the sensitivity of results to period choice. Instead of running regressions on the full sample, six overlapping four-year periods are chosen. The overlapping periods start from 1994-1997 and ends in 1999-2002 with the starting year increasing gradually. The results show positive and significant spillover coefficients without clear pattern in size over time.

3.5.4 Alternative spillover specifications

This section investigates how results depend on the specification of the spillover variables in two ways. First, it looks into the scope of spillovers and redefine the spatial unit on which the peer effect is defined. Second, it takes the value of trade into account when expressing peer effects.

The main analysis assumed that spillovers work mainly within the same settlement. However, the effect of peers might come from a greater distance. Instead of using NUTS5 level administrative areas, the spillover variables are recalculated as the number of peer traders at the NUTS 4 level. Table 3.8 collects regression results with this alternative geographic scope. The first column replicates the results shown in the last column of Table 3.6 for easier comparison. The second columns uses NUTS4 specification. Results indicate a slightly higher peer effect than the baseline figures. The third column uses two spillover variables splitting NUTS4 peers into those within the municipality and to those outside. The results show a positive and significant peer effect for these additional firms as well. However, the point estimate is significantly higher. This results partly comes from the fact outside NUTS5 peers can be positive only for small locations as for larger cities the NUTS4 and NUTS5 specifications coincide. This suggests that for exporting firms in smaller places the proximity of a middle size city can be beneficial.

Next, I look into the possibility of omitted variable bias via incorrectly specified spillover variables. In this study I assumed so far that spillover depends on the number of firms only and does not depend on, say, the traded quantity. The number of firms would successfully capture spillovers, like the available information on successful export strategies for a product or the possible variety of intermediate inputs. However, it would not necessarily capture sharing externalities, economies scale in available skilled labor or input quantity. In Table C.3 (in the Appendix) I included four additional spillover variables that stand for the value counterpart of the previously added four spillover variables expressed in logs.

The first column includes value spillovers only. All spillover variables are significant, though only one at the one percent level. Results imply that also in the value case, the most specific spillover have the biggest effect on export entry. The second column includes both value and number type spillovers. Adding all spillover variables renders all value spillover coefficient insignificant or borderline significant. At the same time, the coefficient on the spillover variables expressing the number of peers is unchanged. Results suggest that the effect of the spillover does not depend on the export intensity of firms but on the number of established relationships. This indicates that agglomeration benefits are more likely to be information and learning related than scale-related ones.

Table 3.8: Robustness of results to geographic scope

Dep. Var.: Export entry	[1]	[2]	[3]
# of firms exporting			
same country and product in the			
same NUTS5	4.811***		5.249***
	[0.439]		[0.400]
same NUTS4		5.381***	
		[0.914]	
in same NUTS4 (not in NUTS5)			22.41***
			[3.707]

Moulton corr. standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The Table shows results from 3 separate regressions. Controls include: year dummies, firm size, firm TFP, a foreign ownership dummy and product-firm-country fixed effects.

3.5.5 Heterogeneity

This section asks whether local trade spillovers have a heterogeneous effect across different firms. First, I look into the heterogeneity in the spillover itself, next I look into differences across the firms and trade relations.

Heterogeneity in the spillover itself is assumed to be based on the type of firms it originates from. To this end, the spillover variable counting the number of peers to the given trade relation is differentiated by ownership. Two dimensions are taken, the effect of foreign ownership and that of state ownership. Ownership dimension might be an indicator for the quality of the trade action of the other firms. Foreign firms can be expected to export easier and be aware of lucrative export opportunities. At the same time, their trade channels might not be accessible to domestic firms as they can trade within network of affiliates. In this respect, domestic firms' knowledge can be more beneficial to local exporters. In the case of state versus private ownership one would expect that state firms do necessarily seek strategic rather than most profitable trade relations and hence they do not always set an example to be imitated. Hence, spillover variables are split into two: number of foreign peers and domestic peers and number of privately owned and number of state owned firms.

Ownership heterogeneity results are collected Table 3.9. The first column shows same country, same product spillovers divided by foreign and domestic ownership. Results imply that firms enjoy spillovers from both domestic and foreign firms, while coefficients are positive and significant the domestic spillover is slightly higher. In the second and third columns, the sample of firms is restricted to domestic ones and privately owned domestic ones only. The spillover from foreign firms is no longer significant. This suggest that domestic firms enjoy spillovers mostly from other domestic firms.[24]

Results with respect to private and state ownership are collected in the last three columns of Table 3.9. They indicate that firms do not enjoy any agglomeration benefit from the presence of state owned exporters. At the same time, the concentration of private firms encourage other firms in the locality to start exporting. The results remains unchanged if one looks at domestic and privately owned domestic firms only.

[24] Regressions on foreign firms, available at request, suggest that foreign owned firms enjoy spillovers from other foreign firms mainly. As foreign firms exporting the same product can be assumed competitors, this is more likely to be caused by sharing and matching mechanism, rather than learning.

Table 3.9: Heterogeneity in the spillover by ownership

Dep. Var.: Export entry	[1]	[2]	[3]	[4]	[5]	[6]
sample	all	domestic	dom. & private	all	domestic	dom. & private
# of local firms exporting the same country and product						
foreign owned	4.29***	2.60	2.71			
	[0.949]	[1.780]	[1.784]			
domestic owned	5.45***	8.39***	8.52***			
	[0.616]	[0.751]	[0.813]			
state owned				7.83	12.5	2.25
				[5.381]	[8.285]	[6.061]
private owned				3.72***	4.09***	4.12***
				[0.251]	[0.550]	[0.553]

Moulton corr. standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The Table shows results from 2 separate logistic regressions. The first is the estimation of equation3.5 for export entry. Controls include: year dummies, firm size, firm TFP, foreign ownership dummy and product-firm-country fixed effects. Only two spillover variables are included which counts the number of foreign and domestic peers. In the second equation another two spillover variables are included which counts the number of foreign and domestic peers..

As for another aspect of heterogeneity, I look into how differences across firms and trade relations affect the strength of spillovers. To do this I introduce cross-terms with same country same product spillovers of groups of variables. First, I take firm heterogeneity (foreign ownership, firm size and firm productivity). Next, I look into the characteristics of the location of the firm. Proxies are employed for agglomeration economies that might facilitate more interaction and various benefits. The included variable is the sum of local employment. Third, I add cross-terms of partner country characteristics, which include the two classic variables of trade gravity modeling, the distance and the GDP of the partner country.

The results on the heterogeneous effects of spillovers are collected in Table 3.10. When firm heterogeneity is introduced I find that foreign firm are more likely to benefit from additional peers. For previous section, we also know that foreign firms benefit from spillovers generally, while domestic firms benefit mostly from domestic firms. Results in column (2) reveal that state owned firms do not benefit from spillovers differently, while from previous section we know they are not likely to generate spillovers either. Column (3) and (4) indicates that larger firms are more likely to benefit from spillovers, while more productive firms do not.

I find that there is a significant difference across firms with respect to their location. Firms situated in more agglomerated environments and in cities enjoy smaller benefits from an additional trading peer. Alternatively, an additional peer plays a more important role in smaller settlements. This finding is in line with the expectation that a small number of specialized peers has a higher value added with respect to none than an additional peer when there are already many available. Also, the result is in line with the findings when Budapest firms are excluded.

Gravity variables affect spillovers in the same way as they affect trade. Spillovers tend to have larger effects in trade relations where the partner country is further away and this finding is in line with previous findings in the literature. Lovely et al. (2005), Mayneris and Poncet (2011a) and Koenig et al. (2011) find that firms export into countries that are difficult to access (either because of language or cultural barrier or because of trade policies), are more likely to be localized and benefit more from spillovers than other firms do.

Table 3.10: Heterogeneity in control characteristics: Exports

Dep var: export entry	[1]	[2]	[3]	[4]	[5]	[6]	[7]
# of local firms exp							
same country-product	3.5***	5.28***	2.84***	5.03***	31.52***	5.65***	38.93***
	[0.396]	[0.458]	[0.672]	[0.494]	[7.498]	[0.493]	[2.301]
× foreign ownership	4.47***						
	[0.500]						
× state ownership		-1.628					
		[2.213]					
× size			0.62***				
			[0.216]				
× TFP				0.187			
				[0.274]			
× local employment					-3.58***		
					[1.014]		
× distance of country						0.85***	
						[0.326]	
× GDP of country							-3.42***
							[0.237]
Observations	608960	608960	608960	608960	608960	608960	608960
R-squared	0.028	0.028	0.028	0.028	0.028	0.028	0.028
Number of ID	133118	133118	133118	133118	133118	133118	133118

Moulton corr. standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The Table shows results from 7 separate logistic regressions. They are the estimations of equation 3.5 for export entry. Controls include: year dummies, a firm size, firm TFP, a foreign ownership dummy and product-firm-country fixed effects. Each regression contains a cross term with the same country-product spillover variable: firm characteristics (ownership, size, TFP), local agglomeration (density, city dummy), country characteristics (distance and GDP)

3.6 Concluding Remarks

This paper examined how spillover effects generated by neighboring firms affect trade probabilities on a Hungarian product-destination level trade dataset of manufacturing firms from 1993 to 2003. The paper found significant spillover effects on the firms exporting decision related to a country-product choice. Benefits appear to be realized mostly by firms exporting the same products.

The spillover effects are heterogeneous both with respect to the composition of peers and the characteristics of trade partner countries. Results indicate that domestic firms do not enjoys the trade related spillovers from foreign peers, who in turn benefit from agglomeration economies in general. Spillovers seem to be inversely governed by international trade's gravity equation. Spillovers are more important in the case of further away countries with smaller markets.

The findings suggest that academic studies or policy examining or promoting trade or cluster policies should rather target specific channels.

Chapter 4

Machine imports, technology adoption and local agglomeration

4.1 Introduction

Capital goods and manufacturing technologies are produced only in a handful of developed economies. Countries who do take part in developing these technologies can benefit from them via knowledge spillovers. This is suggested by endogenous growth theories which highlight the external nature of technology(see Romer, 1990; Rivera-Batiz and Romer, 1991). A key vehicle for spillovers and growth in developing countries are imports. Indeed, Coe and Helpman (1995) find large spillover effects from imports from foreign, R&D-abundant countries on domestic productivity at the aggregate level. Investigating at the sector level Acharya and Keller (2009) arrived at similar results.

There is ample evidence on the productivity enhancing effect of imports also at the firm level.[1] The sources of these positive effects can be different mechanisms. Some explain the increased productivity with the technology embedded in the inputs and the wide variety imports make accessible (Halpern et al., 2009; Goldberg et al., 2010; Bas and Strauss-Kahn, 2011). Others highlight the R&D-generating nature of imports. MacGarvie (2006), e.g., uses patent citations to show that importing firms are more likely to generate new patents. More recently, Halpern et al. (2013) shed light on the productivity-enhancing effect of the imported technology on capital items.

Despite the advantages only a fraction of firms import. For firms to be able to trade internationally, they need to be competitive and highly productive. This is often explained by the sizable up-front cost that only the most productive ones can afford. See, e.g., Bernard and Jensen (1999), Bernard et al. (2007), Amiti and Konings (2007) or

[1] Amongst others, Kasahara and Rodrigue (2008) find evindence for Indonesia, Amiti and Konings (2007) for Chile and Kugler and Verhoogen (2009) for Columbian firms.

Castellani et al. (2010). Also, future trading firms are already bigger, employ more skilled and better paid workers and are more capital intensive than their peers in the same sector who do not trade.

For exporters, empirical evidence suggests that location can be an important factor influencing internationalization. Agglomeration economies can help firms overcome up-front costs and engage in trade.[2] Benefits arise from sharing indivisible goods and facilities and a larger variety of more specialized inputs, from better matching of the right employment or intermediate inputs and services and from learning and the diffusion of knowledge about, e.g., production technologies and market opportunities (Duranton and Puga, 2004). A positive effect of agglomeration for exports was documented in Mexico (Aitken et al., 1997), in Argenina (Pupato, 2007) in France (Koenig et al., 2010) and in Belgium (Dumont et al., 2010).

We know little about the effect of agglomeration on importing activity at the firm level, especially for capital items, even though importers may face a harder challenge than exporters. First, evidence suggests that the productivity premium needed to start importing is higher than in the case of exporting (Altomonte and Békés, 2010). Second, while exporters often experiment their profitability on foreign markets for a year or two (Eaton et al., 2011), capital importers make long term investment decisions which might result in a higher fixed cost. Firms deciding to invest in an imported technology face the screening cost of potential foreign suppliers, the cost of the technology itself and adapting equipment to foreign conditions and standards. They also require information about the skill requirements for workers and operating difficulties (see Eaton and Kortum, 2001; Bas and Berthou, 2012). While this information may be available via the manufacturer, local industry experience with a given machine may also prove beneficial and encourage adoption.

There is some evidence at the firm level that the characteristics of the location affect the adoption of advanced machinery.[3] These studies, however, do not relate machinery adoption to trade activity. They suggest that the rate and beneficial effects of technology diffusion differ across location characteristics: regions distant from the innovation leader adopt the technology much later, while successful adoption depends on other location characteristics such as the level of existing knowledge and technology, the absorption capacity of the location and the availability of a skilled workforce. Kelley and Helper (1999) show a positive effect of localized economies on the numerically controlled machine adoption of U.S. firms. Also, No (2008) takes a similar approach and investigates the adoption of advanced manufacturing technologies (design, fabrication and inspection) across Canadian firms.[4]

[2]Agglomeration economies can either increase the firms' productivity or can decrease the fixed costs of trade entry, or both.

[3]For an aggregate approach see, e.g., Comin et al. (2012); Keller (2002)

[4]There is some evidence on the import of manufacturing scheme, but not machinery. Holl et al. (2010, 2013) who focuses on the adoption of the Japanese just-in-time strategy in Spain and reveal considerable role of location and congestion.

This paper looks at the extent to which locally accumulated knowledge of machine imports affects new adoptions. I ask whether the previous machine imports by local firms encourage other firms to also invest in the same specific machinery. I assume that the more firms in the location have imported a machine, the easier it is for another firm to be informed about the advantages and the specifics of certain innovations. It will be able to learn more easily whether a machine fits firms' expectations about adaptability and profitability. In addition, if the machine is available from many countries, firms learn whether it is worth substituting a machine from one country with one from another. If these learning channels are at work, I hypothesize that in the absence of peers a firm would be less inclined to import a given machine or it would import it much later. Also, the firms' country choice for a machine would not differ across regions.

To answer these questions, I compile a dataset that matches machine level import observations to Hungarian manufacturing firms for 1992-2003. The period provides several advantages. The period starts with Hungary's early transition years, prior to which foreign machinery was not generally available to domestic firms. Possibly, every machine imported in the early 1990's can be regarded as technologically more modern and more advanced then previously installed machinery. In addition, the transition invited waves of foreign direct investments, which introduced new imported machines and technology to many sectors. This is not only true for green-field investment, but also for a portion of the privatized companies as well where firms upgraded their production facilities through imports. In the examined period, foreign machinery indeed plays an important role in manufacturing investments. The share of machinery investment of manufacturing firms is over 60 percent, see Figure D.1 in the Appendix.

I find that the presence of an additional previous importer of a specific machine in the same location increases the probability of a firm importing the same machine by about eight per cent. Furthermore, the results suggests that the firms' import decision is also positively affected by the presence of firms having previously imported the same machine in the larger spatial neighborhood, other than firms in the same location. The results stay robust after controlling for location-specific and location-sector-specific unobserved heterogeneity and location-specific business cycles.

In addition to the decision on importing machinery, I investigate which country the machine is chosen to be imported from. The results show that firms tend to import a particular machine from the country which was chosen by the prior importers. At the same time, I find a negative relationship when other firms have imported the same machine from a different country. The positive effect from peers diminishes over distance. The results stay robust after controlling for location-specific and location-sector-specific unobserved heterogeneity and location-specific business cycles.

To better understand the sources and the nature of the spillovers I investigate the heterogeneity of the peer effect depending on the characteristics of the peer and the benefiting firms. Results reveal that non-exporters and exporters are benefiting more from firms who serve the same respective foreign or domestic markets. Also, investigations with respect to the size of the firm and the unit price of the machinery reveal that smaller firms benefit from larger firms' import of non-expensive machinery. The larger firms, at the same time, benefit more from the non-cheap imports of larger firms. Finally, results reveal that domestic firms benefit mostly from other domestic firms and not from foreign-owned firms.

This study contributes to the literature by broadening the scope of spillovers in trade behavior by showing that they not only encourage exporting behavior but can affect the importing of capital items.

The rest of the paper is structured as follows. Section 4.2, which discusses empirical strategy is followed by section 4.3 introducing the dataset. It gives details on data compilation and the construction of the main variables and portrays spatial distribution of machine imports. Section 4.4 discusses the results, Section 4.5 offers additional insight to the sources and heterogeneity of the spillovers, and finally section 4.6 concludes.

4.2 Empirical Strategy

I model the probability that firm i at location l of sector s imports a new machine m from country c at time t. A firm decides to invest in a new machinery if at time t the balance of perceived cost of importing and installation and expected future benefit is positive.

$$y_{ilmct} = \begin{cases} 1 & \text{if } y^*_{ilmct} > 0 \\ 0, & \text{otherwise} \end{cases} \tag{4.1}$$

In equation 4.1 variable y^*_{ilmct} captures the net benefit of the machine import. The benefits of machine imports are not observable. I assume, however, that the benefit is correlated with firm characteristics and the presence of previous adopters. Previous adopters can reveal the benefits of importing to the firm via various channels e.g. demonstration, outsourcing or demanding supply specifications. Hence, y^*_{ilmct} is modeled as:

$$y^*_{ilmct} = \alpha_0 + \alpha_1 \mathbf{priors}^N_{lmct} + \beta_1 \mathbf{X}_{it} + \tau_t + \varepsilon_{ilmct} \tag{4.2}$$

where **priors** is a vector of spillover variables representing the presence of machine importers in the past N years before the firm's import decision. Depending, on the specificity of the spillover effect under scrutiny different spillover variables will be defined. In this paper, I propose two groups of question: (1) Is a firm more likely to import machine m if there are more firms in the vicinity already have done so. (2)

Given that the firm is going to import machine m, is it more likely to choose a country from which other locals have previously chosen when importing m.

First, when estimating the total effect of previous local machine importers on the probability that a firm will import machine m in year t vector of $\mathbf{priors}_{lmt}^{M}$ is defined as:

$$\begin{bmatrix} \sum_{t-N-1}^{t-1} \sum_{i' \neq i, i' \in l} d_{ilmt} \\ \sum_{t-N-1}^{t-1} \sum_{i' \neq i, i' \notin l} d_{ilmt} \end{bmatrix}$$

where the upper index M is an abbreviation for machine choice, d is a dummy variable indicating the incident when a firm for the first time imports machine m at time t. That is, the first variable in **priors** gives the sum of firms who, in the past N years, have imported machine m in location l, while the second expression denotes the number of importers outside the location.

Note, that this latter variable can be treated as a vector when space outside location l is divided into subspaces based on their distance from l. Given that these subspaces are close enough to original location, firms in these locations can still be considered peers.[5]

Second, when estimating the effect of previous importers's country choice when importing m $\mathbf{priors}_{lmct}^{C}$ is defined as:

$$\begin{bmatrix} \mathbf{I}_{[>0]} \left(\sum_{t-N-1}^{t-1} \sum_{i' \neq i, i' \in l} d_{ilmct} \right) \\ \mathbf{I}_{[>0]} \left(\sum_{t-N-1}^{t-1} \sum_{i' \neq i, i' \notin l} d_{ilmct} \right) \end{bmatrix}$$

where the upper index stands for country choice, d_{ilmct} is a dummy variable indicating the incident when a firm for the first time imports machine m from country c. I is a indicator function for positive values. In other words, the first element of $\mathbf{priors}_{lmct}$ is a dummy which takes on the value one if in the past N years there was a firm other than i which imported machine m from country c in location l. The second element indicates a prior importer from the same country outside location l. In this question a dummy variable is promoted instead of using the number of firms as we are interested specifically in the whether the information that a specific machine is available from country c exist locally or not.[6]

Spillover variables $\mathbf{priors}^{C}$ can be supplemented with additional peers. These additional peers may be those firms who have imported the same machine from another country. These firms are expected to discourage a firm, once it has decided to import machine m, from choosing country c as supplier. Including firms importing from another country as peers has the underlying assumption that machines from country c and c' are substitutes.[7]

[5]In the next section we will define these close proximity areas.

[6]Results using number of firms instead of indicator variables are available at request.

[7]A similar assumption cannot be made in the priors^{M} case. One cannot form a similarly plausible assumption on the relationship between any m and m'.

Variable X_{it} is a vector of firm level characteristics that can influence technology adoption and international trade activity as firm characteristics, location and trade behavior are correlated. The strand of trade literature on the heterogeneity of trading firms suggests that those engaged in international trade look different from non-traders along a number of dimensions. See, e.g., Bernard et al. (2007) or Mayer and Ottaviano (2008). In their footsteps, X includes size, ownership dummy, productivity and indicators for past export or import activity as firm characteristics. The number of firms and total of local manufacturing employment is also included X_{it}. All previous variables were also found significantly affecting trade behavior when investigating spillover effects by Koenig et al. (2010).

Machinery import is not only a trade decision, it is also an investment decision which would call for including firm characteristics affecting financial decisions. Bas and Berthou (2012) argue that financial constraints of the firm is an important factor in the capital importing decision. Especially so for backward economies. Only financially less constrained firms are able to afford and get financing for the screening, adoption and operation costs of an advanced machine. To for control financial constraints X_{it} also includes depreciation, return-on-assets, debt-to-equity and firm age.

In the case when the effect of peers on the firms' country choice is investigated, an indicator variable is included about the firm's previous trade connection. This variable is able to control for the possibility of a missing link, should the country information arrive entirely from first hand trade experience and not from the peer firms.

If equation 4.2 is correctly specified the coefficient we would like to estimate, α_1, will show the effect of previous machine adopters on the probability of firm i importing. In this case, α_1 would tell effect of an additional previous adopter of machine m the percentage points increase in the probability of importing at time t.

4.2.1 Threats to identification

Equation 4.2 is not necessarily correctly specified yet. A possible positive correlation between y^* and the number of previous adopters can be explained by a phenomenon other than the presence of spillovers. In fact, there can be several other hypotheses which could be consistent with such a result. In this section I investigate these explanations and offer an estimation that controls for or excludes alternate explanations.

First, unobserved heterogeneity at the level of location may cause an identification problem. Unobserved time invariant characteristics may have affected imports both in the past and in the present. This implies a positive correlation between the presence or the number of past importers and current import decisions. While in X I control for the size of agglomeration, there are several other factors that need to be taken into account. Such factors could be, for example, local policies that facilitate investments, creation of special clusters or introducing favorable municipal tax schemes.[8] The availability of scientists or abundant skilled labor who help adopting and operating new machinery can also be such an unobserved factor. Reliable infrastructure (electricity supply), sufficient local input suppliers or local costumers can also make installing a new machinery worthwhile. In addition, the spaciousness of the location influences how close are firms to each other, and the probability of knowledge flow. Solving this issue would require adding μ_l, a location-specific fixed effect to equation 4.2.

Second, location-specific unobserved heterogeneity may cause identification problems jointly at the country or industry levels. For example, certain sectors are more eager capital users than others, in which case it is more likely that local firms have already have imported the necessary machines. In addition, the number of machines we investigate varies per sector. This is especially worrisome, if the sector that depends on the specific machine heavily is concentrated. Then the region hosting these firms will show correlation between past and present import, without firms actually learning from each other. Similarly, a missing country $\times$ location level unobserved heterogeneity can explain positive correlation between import choice and presence of past imports. For example, factors that can help local access to certain countries, such as geographical or cultural proximity, e.g. presence of embassies. To control for the above issues ψ_{ls}, γ_{lc} are introduced into equation 4.2.

Third, country and sectoral unobserved heterogeneity can induce a correlation between present and past import choices. For example, it is easier to import a machine from Germany than from, e.g, China because of language barrier. Similarly, more firm in a given sector will import a cheaper, more basic machine than a more expensive, highly specialized one. These issues only cause identification problems when they are systematically different across locations. If so, including their interaction terms with location is sufficient.

Fourth, the positive correlation between the number of past and present importers can also be caused by local business cycles. If certain regions in a given period of time are experiencing economic boom while others are in downturn then the positive correlation between the presence of past and present importers can be purely driven by a series of region-specific shocks. Series of persistent local productivity shocks will be a common accelerator of machine imports for all local firms. However, these underlying shocks need not to be necessarily persistent to cause a problem. If local shocks have effect for over two calendar years, a positive correlation will occur that we would falsely identify with spillovers. In addition, such shocks can be foreseen by managers and adjust labor, capital and other firm characteristics accordingly. This implies that business cycle not only introduces bias through a correlation between an unobserved shock and number of e.g. last years importers, but also through the control variables. To solve this issue, we include κ_{lt} or θ_{it} location-year or firm-year fixed effects in equation 4.2. If a firm

[8] The Hungarian corporate tax code (Act LXXXI of 1996), encourages investment in backward and developing regions by facilitating local tax credit schemes. The scheme was especially generous in the pre-2002 era. See Békés and Harasztosi (2012).

does not move (see data section) firm fixed effects will take care of location fixed effects too. An alternative and less effective approach is first, to lag all firm level control by one year. In addition, to choose N to be larger than one or two the short terms of good times and bad times can cancel out across regions.[9] N is chosen to be 4, but alternatives are tested as well.

Fifth, if firms that have already decided to import a certain machine move to locations which is abundant of importers of m, a positive correlation between the number of past and present importers appears. A similar argument can be made regarding any country-machine dimension. Such a self-selection of firms may bias the estimation of spillover effects. I attend to this issue by excluding firms that have been established later than our sample period.

Sixth, as the spillover variables are the same for the firms in the same location, one can underestimate the standard errors of the parameters of the estimation. Consequently this can lead to a false rejection of a hypothesis that, e.g., α_1 is zero. Following Moulton (1990), in all estimations I use location clustered standard errors.

To understand which of the alternative hypotheses above, if any, can also explain a positive correlation between the past and present machine importers I take a stepwise approach. First, I will estimate Equation 4.2 with lagged control variables and specifying N to be 4. Next, I test two groups of alternative hypotheses. The first alternative is that a positive α_1 can be explained by time invariant unobservables. In order to test this alternative I add location level fixed effects and cross terms with countries and sector in equation 4.3.

$$y^*_{ilmct} = \alpha_0 + \alpha_1 \mathbf{priors}^4_{lmct} + \beta_1 \mathbf{X}_{i,t-1} + \mu_l + \psi_{ls} + \gamma_{lc} + \tau_t + \varepsilon_{ilmct} \tag{4.3}$$

The second alternative is that results are driven by local business cycles. To control for this alternative, location-year or alternatively firm-year are included in addition to location fixed effects.

$$y^*_{ilmct} = \alpha_0 + \alpha_1 \mathbf{priors}^4_{lmct} + \beta_1 \mathbf{X}_{i,t-1} + \mu_l + \kappa_{lt} + \tau_t + \varepsilon_{ilmct} \tag{4.4}$$

Note that fixed effects estimation with within transformation can be problematic when the data is not a balanced panel, especially in higher dimensions. In the unbalanced case the within transformation corresponding to the specific fixed effects model to be estimated does not necessarily clear the fixed effect, hence makes the estimation biased (Mátyás and Balázsi, 2012). In our case, as firms are expected to enter and exit, the data would be unbalanced. To overcome the estimation problem, I use least squares dummy variable estimation.

[9] These solution can be used when θ_{it} is not included.

4.2.2 Limitations in identification

Aforementioned steps of identification have some limits. First is an alternative hypothesis. The spatial clustering of machine imports, especially that of the same country machines, can also occur when firms are subject to promotion activity. If a regional sales agent of a foreign manufacturer for a particular machine is especially efficient, then her activity will result a positive correlation current and past machine imports. Not being able to track regional sales records for each machine, a solution could be to include machine × location fixed effects or machine × location × country fixed effects. This would suggest that the only variation to identify from is the temporal dimension (especially when country dimension is not considered). This however leaves only little variation as firms mostly import a machine only once.[10] Additionally, note that promotion is not necessarily a time-invariant unobservable as it depends on the time the agents spends with promotion. All in all, as it cannot be satisfactorily controlled for, I assume that while promotion activity can be an important influence in spatial clustering of machine imports, it does not drive all of them.

Second, if a firm introduces a new and better production technology, its competitors are also likely to adopt the technology to prevent them from gaining higher market share and eventually forcing them out of business. Such a mechanism would also result in the spatial clustering of machine imports if the local firms are competing on the same markets. The identification strategy so far cannot tell apart the competition and the spillover effects. To remedy this, I will look at the difference in spillovers across exporting and non-exporting firms. Here I rely on the assumption that non-trading firms are competing locally and that exporters do not. Hence, if all correlation between the past and the present machine imports are due to competition effect one should not find affect across exporters. However, firms do not only compete on product market but on labor market as well. The firm that does not import better machine can loose its skilled labor to the competition.[11] For our approach to be able to control for competition effect we have to assume that the labor market competition's affect on spatial clustering on machine imports is the same across exporting and non-exporting firms.

Third, note that this paper considers only machine purchases via direct import. This implies that a possibly important source of machine acquisition is not in the scope of the study, namely indirect import. Firms can acquire imported foreign technology via a domestic wholesaler of specific machines. Though, I have limited the machine imports to industry-specific equipment by leaving out widely domestically available items, such vehicles and information technology, the one has to bear in mind that this study can capture only a part of the underlying economics.

Lastly, not all firms can afford the same machine. For example, a large and very expensive machine might not be profitable for a small enterprise. Even tough peers

[10] And in fact I examine the effect on spillovers on th e first import of a specific machine.

[11] Csillag and Koren (2011) argues that firms that import machines pay higher wages for their skilled workers.

accumulate such machinery in the vicinity the smaller firm will not be able to reap the benefits from the experience of others. Unfortunately, our model does not allow firms to choose machines of different prices because such choiceset cannot be compiled. The prices of the machines not chosen are not observed. Controlling for the financial situation of the firm might not be sufficient to solve the problem. However, I will be able to look at the peer effect of differently priced machines and differentiate spillovers accordingly.

4.3 Data and descriptives

This section gives a detailed description about the compilation of the dataset used to estimate equations 4.2 to 4.4. The section describes the main variables and provides a descriptive portrait of the spatial distribution of machine imports.

4.3.1 Compiling the dataset

The empirical analysis is based primarily on the Customs Statistics (CS). It contains the universe of exports and imports by Hungarian economic agents between 1992 and 2003. It gives information on yearly trade aggregated to the 6-digit Harmonized System product level and gives the country of origins and destinations as well. The quantity measurements allow the calculation of unit prices.

This dataset is merged with firm level information from CeFiG-IEHAS database[12], a panel of Hungarian manufacturing firms between 1992-2003 with very detailed firm-level information on balance sheets. It allows to include the following firm level characteristics into the empirical estimations: firm size defined by the average annual employment, foreign ownership indicating majority foreign share in the subscribed capital of the firm and total factor productivity (TFP).[13] The dataset provides sectoral classification of NACE rev. 1. and location information at the municipality level. For more details on this data see Chapter 1.

To identify events of machine import I rely on the Standard International Trade Classification (SITC) rev. 3. which I match to CS. No. 7 group of SITC classification titled *Machinery and transport equipment* defines capital products used in sector specific production. As in this study the focus is on manufacturing machines only, transport equipments and vehicles are excluded. Anyway, vehicles are less production-specific and most widely available via wholesalers in Hungary and importing them is less likely than

[12] IE-HAS is the Institute of Economics of the Hungarian Economy of Sciences. CeFiG is a research project and community, Center for Firms in Global Economy, which is a joint effort of academic and researchers at Central European University and IE-HAS.

[13] To calculate total factor productivity we rely on the control function approach proposed by Levinsohn and Petrin (2003)

procuring them locally. This leaves us with a range of machinery listed in SITC classification from *Power generating machinery and equipments* (71) to *Electrical machinery, apparatus and appliances* (77).

As a next step, I allow the list of machinery imported by specific sectors to be borne out of the data. I consider only a subset of the manufacturing sectors and omit industries where the imported machinery can be in fact materials to firms' final product, i.e *Manufacture of machinery and equipment*. See Table 4.1 for the list of manufacturing sectors considered. I match the set of machines from SITC 71-77 at the 5 digits to each sector by looking at actual machine imports from 1992-2003. A machine is matched to the sector if it is imported by at least 3 firms. Additionally, machines for general industry purposes such as computers, air conditioning are excluded. I have also checked that the machine is in line with industry activity. That is, matches like *Manufacture of textiles* (17) and *gas-operated metalworking machinery* (73742) are not considered for the analysis. The matching resulted in allocating 143 individual machines to industries, with Tobacco industry having only 3 and the Food and Beverages sector having the maximal number of 37 machines. In Table 4.1 the sum of machines is 210, which implies that I matched one machine to more than one sector. For example industrial sewing machines can be used by both textiles and wearing apparel industries.[14] For details on the list of machines, see Table D.9 (In the Appendix).

Table 4.1: Number of machines allocated to manufacturing sectors

NACE	sector	number of machines	%
15	Manufacture of food products and beverages	37	17.62
16	Manufacture of tobacco products	3	1.43
17	Manufacture of textiles	15	7.14
18	Manufacture of wearing apparel	10	4.76
19	Tanning and dressing of leather	7	3.33
20	Manufacture of wood and wood products	8	3.81
21	Manufacture of pulp, paper and paper products	16	7.62
22	Publishing, printing	13	6.19
24	Manufacture of chemicals and chemical products	14	6.67
25	Manufacture of rubber and plastic products	4	1.9
26	Manufacture of other non-metallic mineral products	10	4.76
27	Manufacture of basic metals	16	7.62
28	Manufacture of fabricated metal products	40	19.05
36	Manufacture of furniture	17	8.1
Sum		210	100.00

Given the list of machines per sectors one can look at machine importing events at the firm. Only the first import of a machine is considered, subsequent imports afterwards are omitted. To improve reliability of the data and improve economic significance of the research we omit firms with less than 10 employees on average.

I also make some restrictions on the country dimension. For each machine we consider

[14] When creating peers we will not concentrate only on within sector peers for two reasons. One is that a machine in a related industry can equally inspire imports as within sectors import do. Second, Hungarian sector classification only shows main activity and not second and third product line of a company. Hence, firms in different but close sectors can actually be in the same sector.

only the 15 most important trade partners ranked by volume share of imports for that particular machine and only those machines are considered that are imported from at least 3 countries. This ensures that firms have country choices. The partner list consist of 35 countries with Germany, Italy and Austria as chief suppliers of imported machinery. The list of countries are provided by Table D.1.

4.3.2 Descriptions of machines and machine importers

Only a small fraction of manufacturers import machinery directly. Table 4.2 shows the number of firms in the selected manufacturing sample of the CeFiG data. It shows that only about half of the firms import any goods from abroad, intermediate goods included. Capital importers are even more scarce. Only about fifth of the firms import capital items. Note that these are only those firms who import from our list, which actually underestimates their share.

Table 4.2: Number of firms by import activity

	firms	importers	capital importers
1992	4293	2288	1065
1993	4798	2505	929
1994	5003	2690	890
1995	5227	2771	837
1996	5404	2858	833
1997	5709	3046	857
1998	5865	3215	969
1999	5930	3239	906
2000	5946	3397	950
2001	5841	3482	887
2002	5907	3549	883
2003	5875	3571	848

An average capital importer firm imports 1.9 machines in a year a bit over 6 different machines all-in-all. The number of countries the average firm imports from is 3.8. The most machines imported by one firm is 31, the firm that imports machine from the highest variety of sources imports from 16 countries all together.

Machine importing firms are really good firms. From the firm level empirical trade literature[15] and also from previous estimations on Hungarian firm level data (Chapter 1 of this thesis) we know that both importing and exporting firms are bigger, more productive and more high wage paying firms than others in an economy. Table B.10 describes how capital importers relate to other firms. The first column compares importers to the rest of the economy by regressing importer dummy on a set of firm characteristics. In the second column, a capital importer dummy is regressed on various firm characteristics. Capital importer dummy takes on the value one if the firm in a given year has imported any of the machines defined by the choice-set in Table D.9. The results show

[15]See, e.g., Castellani et al. (2010) or Mayer and Ottaviano (2008) amongst many.

that importing firms, capital importing firms included, are on average larger, more productive, pay higher wages and are more capital intensive. These results confirm what we already know about importing firms. The third column, however, considers only importing firms and thus compares capital importer to all importing firms. All in all, one can conclude that firms importing machines outperform other importers in all explored dimensions.

Table 4.3: Characteristics of machine importers

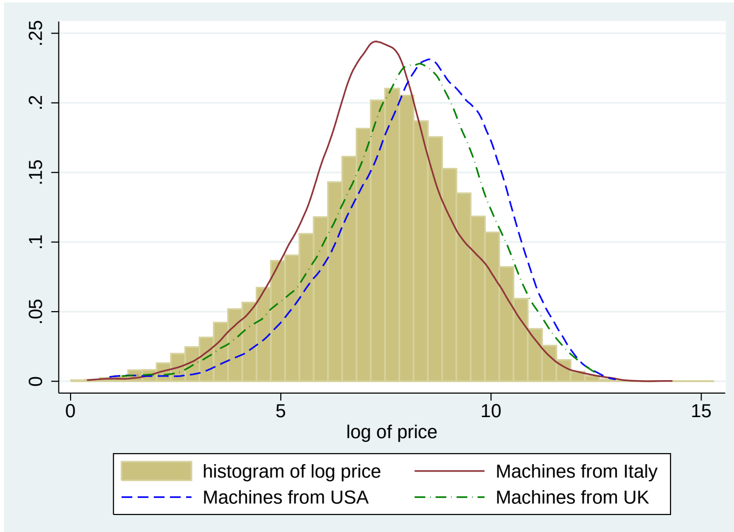
premia of	importers	capital importers	capital importers vs. importers
Log of employment	0.774	0.906	0.756
Log of value added per worker	0.489	0.468	0.318
Log of TFP	0.452	0.430	0.299
Log of average wage	0.236	0.237	0.178
Log of capital per worker	0.717	0.826	0.689
Number of exported goods			6.744
Number of destinations			3.139

Each row shows coefficient estimates variables in the first column regressed on importer and capital importer dummies. When independent variables are in logs the coefficient 0.756 with the log of employment implies: exp(0.756)-1 = 112% higher employment on average in capital importers firms compared to importing firms.

In Hungary most internationalized firms are two-way traders, that is, most importing firms do export as well. This allows for an additional comparison along the dimensions of export activity. We learn that firms importing machines show higher average export activity in terms of sold goods (defined at HS6 level) and serve a higher number of destination countries on average.

The data allows to describe the distribution of the unit prices of the machines firms import. The prices show considerably heterogeneity both across and within the machine category. Average within machine category standard deviation of log price equals standard deviation of all the prices. They vary considerably across countries as well, for at least two reasons. Import prices are recorded including cost, insurance and freight (CiF) which suuggest that duties and distance increase the price of the machines. Also, prices vary due to the value added and the price of technology embedded in the machines. Figure 4.1 illustrates this showing the difference in the price distribution of machines from Italy, USA and UK. The difference in the average price between Italy and the U.S. can be most probably explained by the difference in shipping costs and the varieties. While, the difference in the average price between Italy and the UK may be mostly attributed to the difference in machine varieties and qualities as the distance is considerably less in their relation.

Figure 4.1: Distribution of machine unit prices (in logs and 1992 terms)



4.3.3 Location and timing of imports

Investigating the effect of peers on importing activity requires heterogeneity across time. If machine imports exhibit stickiness in space, that is, a new machine importer is influenced by previous importers, new importers should be relatively close to previous ones. In this section, first I show that mainly due to agglomerations and cities machine importers cluster in space. Then I use two approaches to describe and analyze the timing and peer distribution of capital importers from 1992 to 2003.

The location of the firms provided by the CeFiG dataset is at the municipal level, which corresponds to NUTS5 level EU classification.[16] For the summary of Hungarian NUTS structure, see Table 4.4. Machine importing activity is observed in 769 municipalities.

Table 4.4: *Summary of Hungarian administrative spatial zoning*

EU level units	Hungarian equivalent	number	avg. size km^2
NUTS2	EU admin. region	7	13861
NUTS3	countries (megye)	20	4651
NUTS4	micro regions (kistérség)	150	620
NUTS5	municipalities	3125	30

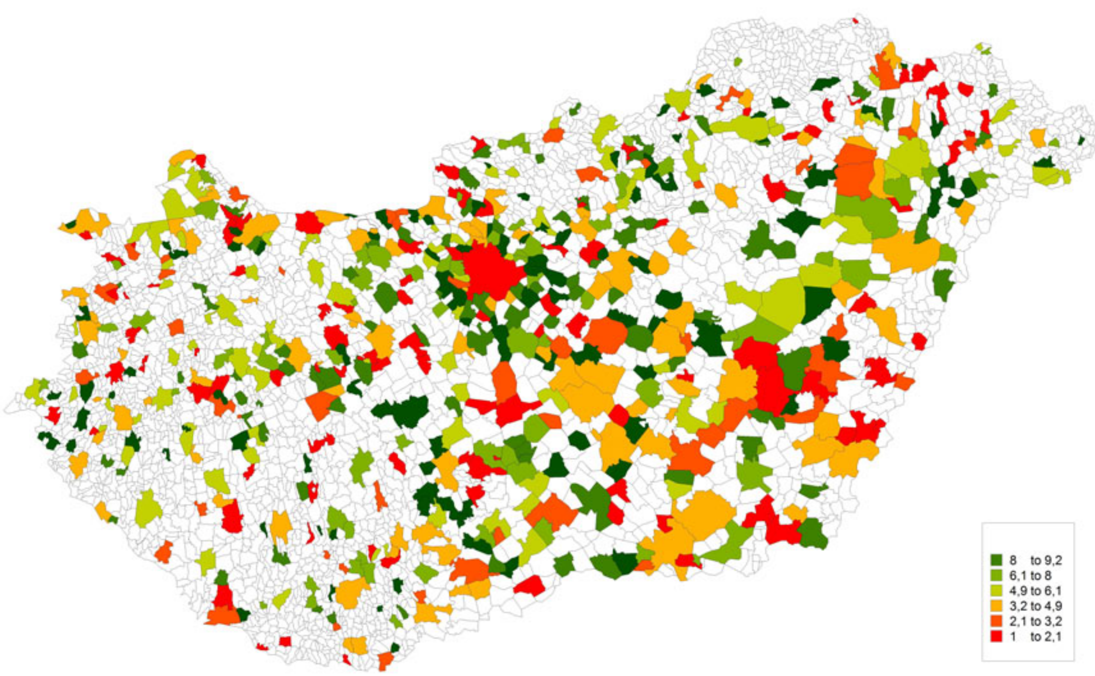
This is about 62 percent of all municipalities where any production activity in the selected manufacturing sectors can be detected. This is illustrated in Figure D.2 (in the Appendix) which displays the map of Hungary at municipal level and shows the distribution the total number of machines imported in each municipality over the sample

[16]We kept only firms in the sample that do not change location over the period: only 3 percent of all firms have two or more location.

period. In about twenty percent of the municipalities more than 20 machines gets imported. These are the 145 largest townships in Hungary. While in about the half of the municipalities import only 6 machines or less.

To investigate the timing of machine imports first, let us plot how many years pass after the first import of machine m until the same machine is first imported in location l. Figure 4.2 shows the average of years passed for any technology imported by the municipality. The distribution of timing shows considerable variation. It shows that, on average, timing is negatively correlated with city size. Foreign machinery is adopted in smaller municipalities later than in larger cities. In fact, in major cities the imported machine arrives first, in 1992 or 1993. New machines get imported in smaller settlements much later, in some cases even in the 2000's. Nevertheless, there are some pioneering small municipalities.

Figure 4.2: Time average machine being imported after the pioneer



The Figure show the average time elapsed for machines imported in a municipality after the specific machine is imported first in the country at all. It is at NUTS5 level and the heatmap is constructed from red to green, as time elapsed increases.

As the first approach, I look at machine import instances and categorize them according to existence of previous activities. I use three NUTS levels to describe peer distributions: I look at immediate peers in the municipality (NUTS5), peers outside the municipality within the same micro-region (NUTS4) and at peers outside the micro-region but in the same county (NUTS3). The results are collected in Table 4.5.

Table 4.5: Share of imports with and without previous importers in selected years

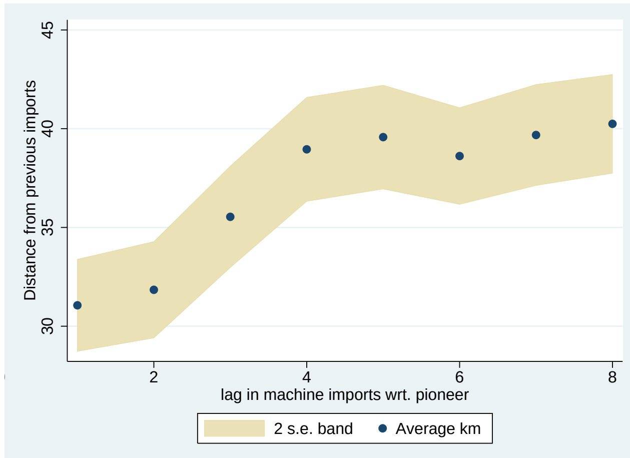
share of machine imports with		1993	1997	2000
local peer	of same machine	51%	70%	73%
no local, but micro region peer		8%	7%	9%
no micro-region, but county peer		20%	15%	15%
no peers within county		20%	8%	4%
local peer	of same machine, same country	26%	38%	42%
no local, but micro region peer		5%	7%	9%
no micro-region, but county peer		17%	21%	22%
no peers within county		51%	34%	26%

The table categorizes country-machine firm level imports by the existence of prior imports according to Hungarian administrative zoning. The sums of each block of each year adds up to 100.

Even in the second year of our sample, in 1993, 51 percent of the importing events are involving machines that have been imported in the previous year by other firms. For about half of these events the machine has already been imported from the same country. The other half have peers importing the same machine from a different country. The table considers any previous importing since 1992, hence as time advances the chance of not having any a peer diminishes. However, in all years in the sample I find that the share of import events with same country peer is higher that those with other country peers. At the same time this difference in increasing over time. This would be consistent with firms more likely to choose to import a machine from a country, from which others have imported before.

Additionally, Table 4.5 reveals that machine import events without a local peer can still be influenced by nearby firms. In 1993, eight percent of import events have same machine peers in the same micro-region but not in the same municipality and about twice of them have distant peers within the county. As the number of importers increase over time, the share of imports without any peers diminishes.

Figure 4.3: The average distance a machine travels a year after the first import



The figure shows the average kilometer distance of a new machine import from the first imports of that machine in Hungary. Standard errors are gained from regressing distance from pioneer importer on time dummies indicating time elapsed from pioneer importer of the product at import observation level.

As the second approach, I look at continuous space. I examine the possible spatial dependence of imports by looking at average distances between importers in kilometers over time. Figure 4.3 investigates how far technology as embodied by machines travels in time. The distance is calculated in the following manner. Assume that at time zero (1992 in our case) K firms import machine m. The next year new firms import machine m. Measure their distance from the closest firm of the existing K. If the new importers is in the same location as any of the previous K importers the distance can be assumed to be zero. An average of the distances so calculated will tell us how much a machine travels a year. The distance is calculated for each year after the first import of a given m, always with respect to the original K firm. If the locations of the successive waves of imports are independent of location of the pioneer importers distance should be uniform over time. Figure 4.3 shows that in years immediately after the first import followers are located closer on average than in later years. It shows that if new machine imports tend to be close to old ones within 3-4 year of the first import.[17] Additionally, it also shows that investigation should cover only micro-region distance, but county distance at the most given the size of the spatial units. The within 30 km radius can be considered for a large city or a micro-region, while 40 km radius and above is consistent with a distance outside the micro-region but within the county (See Table 4.4 for area figures). All-in-all, these results are consistent with the idea that machine imports exhibit peer effects.

[17]This gives an extra motivation to use N=4 in the definition of **priors**.

4.3.4 Basic spatial unit choice

So far the distribution of peers was examined at the municipality level (NUTS5). While Table 4.5 shows that a large share of firms have local peers in the same municipality it does not reveal whether it is true for most locations or just the more populous ones. In smaller municipalities, where, e.g., knowledge spillovers are faster there might not be enough firms to benefit from them. This section examines how the possible number of peers for imported machines changes with municipality size.

Table 4.6: Imported machines without local sectoral peers

	1993	1997	2000
number of firms			
Large cities	491	369	383
Medium cities	548	373	426
Small cities	382	376	406
no sector peers in the same city (NUTS5)			
Large cities	1%	0%	0%
Medium cities	10%	8%	5%
Small cities	51%	46%	49%
no sector peers in the micro-region (NUTS4)			
Large cities	1%	0%	0%
Medium cities	6%	3%	2%
Small cities	9%	9%	4%

City types categorized by size: Large cities (20 locations) are over 50 thousand inhabitants, medium cities (119) are below 50 thousand but over 10 thousand and small cities are below 10 thousand inhabitants.

Table 4.6 shows the machine imports without local peers in three blocks. The uppermost block shows the number of imported machines by municipality size. The middle one shows the share of machine imports in each size category where no possible local peer can be detected in the same city. For example, in 51 percent of the 1993 machine imports in small cities there is no other firm in the next 4 year in the same sector. These results suggest that if the peers are defined at the municipality level the spillover variable is mostly zero in smaller settlement because there are simply not enough firms for the spillover to take place. In this case, the estimation of spillover effect for small cities will mix lack of interaction between firms with the no possibility for interaction. To overcome this one can increase the basic spatial unit to allow for more possibilities for spillovers. In line with this, the bottom block of Table 4.6 investigates the existence of possible peers at the micro-region level. Now only 9% the 1993 machine imports are located in such locations where there is no other firm in the next 4 year in the same sector. While the possibility of spillover is still lower in the case of small cities, if the peers are defined at the micro-region level the number of zero spillovers is reduced. In the rest of the paper the spillovers will be defined at the micro-region or higher aggregation level.

4.4 Results

This section presents the results of our empirical investigation. The first subsection will discuss results regarding the effect of previous importers of the machine m on present import decisions about m. The second subsection collects results from exploring the effect of country choice firms previously imported on the country choice of new machine importers.

4.4.1 Results on machine import spillovers

First, the equation 4.2 with the peers defined by vector $\mathbf{priors}_{lmt}^{M}$ is estimated. The results are collected in Table 4.7. Note, that in this Table and all afterwards the spillover variable is divided by thousand for easier readability.

In column (1) only the spillover variables are included. The results imply a positive correlation between importing a specific machine and the number of past importers. The relationship is significant for municipality peers and also for those in the micro-region and the county. The value of municipality spillovers suggest that an additional firm having already imported machine m increases import probability for firm i by 0.08 percentage points. Compared to the average propensity of importing machine is about 1 percent,[18] our results mean an 8 percent increase in the probability of machine import in a given year. The number of peers not in the same micro-region but county have a somewhat higher effect.[19]

In columns (2) to (4) I add additional control variables as column (1) estimates can be biased due to missing firm- and location-specific variables. First, firm level lagged controls such as size, foreign ownership, past trade experience dummies and productivity are added. All controls are significant and are of expected signs. Foreign owned firms, larger firms and more productive firms are more likely to adopt foreign machinery via imports. Firms that have trade experience, exporters and importers are also more likely to import capital items. In column (3) controls for observable characteristics of the firms' immediate environment are added: number of firms and the log of local employment. Results suggest that the firms in larger cities and in larger labor markets are more likely to import.[20] These finding are in line with descriptive statistics of subsection 4.3.3. The variable expressing the number of firms is insignificant. In column (4) variables characterizing firms financial situation are added. Results suggest that

[18]The probability of import is this low because in this section we consider all firms in the examined sectors to be a possible importers, not only those who actually are going to import.

[19]This, at the first sight surprising result, comes from the special position of Budapest. It holds one fifth of the population and a correspondingly large share of firms. However, it is a city, a microresion and a county in itself which means that for all these firms the second spillover variable is by definition zero. When Budapest firms are excluded (Table D.2 in the Appendix) the main results still stand and peers in farther away locations, in other micro-regions have a smaller or an equal sized effect.

[20]These allow to compare the spillover results. One additional peer has one-third of the effect of being an exporter, one fifth of the effect of being an importer previously.

Table 4.7: Machine import spillover estimation

Dep. var: import dummy	[1]	[2]	[3]	[4]
num. of prior importers of the same machine				
same NUTS4	0.822***	0.675***	0.897***	0.859***
	[0.0615]	[0.0270]	[0.0387]	[0.0416]
NUTS3, other NUTS4	2.336***	2.181***	2.066***	2.038***
	[0.247]	[0.198]	[0.130]	[0.130]
dummy: exporter		0.00367***	0.00363***	0.00365***
		[0.000296]	[0.000298]	[0.000311]
dummy: importer		0.00533***	0.00543***	0.00517***
		[0.000365]	[0.000286]	[0.000314]
size (logs)		0.00263***	0.00250***	0.00114***
		[0.000291]	[0.000245]	[0.000190]
dummy: foreign own.		0.0111***	0.0109***	0.00987***
		[0.00112]	[0.00109]	[0.00116]
TFP (logs)		0.000316	0.000392**	0.000486**
		[0.000227]	[0.000171]	[0.000201]
local employment (logs)			0.00263***	0.00251***
			[0.000456]	[0.000448]
local # of firms			0.00001	0.00006
			[0.000143]	[0.000133]
firm age				-0.00032***
				[4.62e-05]
return on equity				0.00286***
				[0.000393]
debt on assests				0.0001
				[9.84e-05]
depreciation rate				0.00285***
				[0.000336]
constant:	yes	yes	yes	yes
dummy: year	yes	yes	yes	yes
Observations	1714005	1278853	1278853	1267975
R-squared	0.003	0.009	0.01	0.01

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Moulton corrected s.e. in parentheses
Each columns contain results from three separate linear probability regressions as defined in eq. 4.2. Spillover variables are divided by 1000, all other control variables are lagged by one year.

younger, more profitable and firms with higher capital replacement are more likely to import capital goods. These are in line with expectation. All in all, I find that none of the added control variables change the initial results in column (1).

To see, how the results depend on the number of past years taken into account when defining the spillover variables, I replicate the last column of Table 4.7 with various definitions of N. I find that as N increases, so do the coefficient estimates gets smaller. The significance, sign and interpretation do not change. See Table D.3 in the Appendix.

Testing the results on machine import spillovers against alternate hypotheses

The findings so far can be explained by alternative hypotheses. Table 4.8 offers regression results testing if these hypotheses can also explain our findings. Columns (1) and (2) look into the effects on local time-invariant unobservables, while the next two columns of the table look into the how including controls for local business cycles affect our findings. In other words, columns (1) and (2) look at equation 4.3 type regressions, while columns (3) and (4) looks into equation 4.4.

Table 4.8: Machine spillover LSDV regressions: testing alternate hypotheses

dep. Var: import dummy	[1]	[2]	[3]	[4]
num. of prior importers of the same machine in				
same NUTS4	0.934***	0.939***	0.939***	0.987***
	[0.0371]	[0.0320]	[0.0394]	[0.0221]
same NUTS3, other NUTS4	2.187***	2.446***	2.217***	2.530***
	[0.132]	[0.133]	[0.139]	[0.145]
dummy: year	yes	yes	yes	yes
dummy: nuts4	yes	yes	yes	
dummy: nuts4 × sector		yes		
dummy: nuts4 × year			yes	
dummy: firm × year				yes
Controls:	yes	yes	yes	yes
Observations	1278777	1278777	1278777	1278777
R-squared	0.011	0.015	0.021	0.003

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, Moulton corrected s.e. in parentheses

Controls: size, foreign ownership, TFP, local agglomeration, number of firms in NUTS5, all controls are lagged by one year. Each column shows results from separate regressions. The first two regressions test for the effect of time invariant unobservables, while the next two test for the effects of local business cycles.

Column (1) shows that including location fixed effects do not change our basic inference. In column (2) location × sector fixed effects are included to control for the effect of unobserved local benefits for certain industries. To control for local business cycles, in column (3) location × year fixed effects, while in column (4) firm × year fixed effects are included. Note that as firm dimension defines both location and sector dimensions, column (4) implicitly controls for these cross-terms as well. Results do not change the previous findings.

In addition, to the alternative hypotheses I also check for the possibility that a firm moves into a location where it expects that adopting a specific machine will be easier. In order to control for this possibility I re-run the last regression of Table 4.7 on subsample of firms established before the year our sample starts. This avoids self-selection into a location that, in the post-transition era, is abundant of future importers of m. Table D.4 collects regressions on subsamples that contain firms started business before 1992, 1990 or 1988. I find positive significant correlation between firms' capital import propensity and the presence of past importers for pre-transition firms too.

4.4.2 Results effect of spillovers on country choices

Once the firm has decided to import machine m it has to make a choice which country should it procure the machine from. This subsection investigates the effect of the choice made by nearby previous importers on firm i's decision about which supplier country it chooses.

Table 4.9: Regressions for country choices

Dep. var: import dummy	[1]	[2]	[3]	[4]	[5]
same NUTS4 peers					
same country	59.04***	51.78***	48.18***	48.80***	48.26***
	[16.24]	[13.98]	[12.52]	[12.59]	[12.62]
other country	-38.61***	-33.08***	-30.05***	-29.08***	-28.93***
	[9.640]	[9.049]	[8.055]	[7.553]	[7.563]
other NUTS4, same NUTS3 peers					
same country		21.35***	21.24***	20.96***	19.93***
		[1.438]	[1.566]	[1.540]	[1.525]
other country		3.977*	2.85	2.419	2.758
		[2.181]	[2.167]	[2.209]	[2.191]
size (logs)			0.00109***	0.00044***	0.00037***
			[0.00005]	[0.00005]	[0.00005]
dummy: foreign own.			0.00229***	0.00193***	0.00166***
			[0.0001]	[0.0001]	[0.0001]
TFP (logs)			0.000247***	-0.0001	-0.0002**
			[0.00008]	[0.0001]	[0.0001]
local employment (logs)				0.00063***	0.0006***
				[0.0001]	[0.0001]
local # of firms				-0.00135***	-0.00129***
				[0.0002]	[0.0002]
firm age				-0.00013***	-0.00016***
				[0.0001]	[0.0001]
return on equity				0.00176***	0.00174***
				[0.0002]	[0.0002]
debt on assests				0.0005***	0.0004***
				[0.0001]	[0.0001]
depreciation rate				0.00131***	0.001***
				[0.0001]	[0.0001]
export experience with C					0.0009***
					[0.0001]
import experience with C					0.0038***
					[0.0001]
constant:	yes	yes	yes	yes	yes
dummy: year	yes	yes	yes	yes	yes
Observations	8398619	8398619	6680137	6247918	6247918
R-squared	0.018	0.018	0.02	0.02	0.021

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Moulton corrected t-statistics in parentheses.

Each columns contain results from three separate linear probability regressions as defined in eq. 4.2 Moulton corrected s.e. in parentheses. The spillover dummies are divided by 1000.

Table 4.9 contains our basic specification. Column (1) includes only the spillover variables that indicate whether the previous municipality firms have chosen country c and or country c' when importing machine m. The data indicates that the baseline probability of importing machine m from country c at time t is 0.3 percent. Our result suggest that, if the model is correctly specified, this baseline probability is about doubled when there is a local peer who have made the import from country c. At the same time, results show that previous importers of machine m who chose another source country c' have a repelling effect.

In column (2) I add information about the choices of prior machine importers in the county but other micro-region. While the coefficient of micro-region peers are somewhat smaller, the results reveal positive correlation for country peers as well. I find that the magnitude of the coefficients on the same country peers are decreasing as the distance from the firm increases. These suggest that the country information is more valuable to the firm when its observed closely.

Column (3) and (4) adds firm and location level control variables. Their signs and significances are mostly analogous to those in Table 4.7 with the exception of number of firms and the leverage variable. [21] In column (5) I add two dummy variables, they indicate whether the firm had any trade relation with country c in the past N years. I add variables for export and import separately, both indicate a positive correlation with import decision. The additional controls do not change our basic findings, but indicate that past trade experience with country c affects its choice positively.

Testing against alternative hypotheses

This section tests the results about the peer effect on the country choice of machine importing firms. First, I look into the possibility that the findings are driven by time-invariant unobserved heterogeneity as defined by equation 4.3. Second, we check for the possibility that the positive correlation between the country choice of previous exporter and firm i's choice is driven by local country or machine specific business cycles as defined by equation 4.4.

Table 4.10: Regressions on countries choices with location interactions

dep. Var: import dummy	[1]	[2]	[3]	[4]
same NUTS4 peers				
same country	48.54***	48.45***	48.02***	47.75***
	[12.67]	[12.67]	[13.08]	[13.01]
other country	-28.58***	-28.45***	-27.84***	-27.48***
	[7.379]	[7.320]	[7.233]	[7.008]
other NUTS4, same NUTS3 peers				
same country	21.05***	21.10***	19.11***	19.28***
	[1.711]	[1.716]	[1.658]	[1.660]
other country	2.408	2.373	3.005	2.794
	[2.302]	[2.313]	[2.412]	[2.444]
dummy: location	yes	yes	yes	yes
dummy: nuts4 × sector		yes		yes
dummy: nuts4 × country			yes	yes
controls	yes	yes	yes	yes
year dummies:	yes	yes	yes	yes
Observations	6247918	6247918	6247918	6238238
R-squared	0.021	0.03	0.022	0.03

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Moulton corrected s.e. in parentheses.
Each column contains a results from a separate regression. Controls: size, foreign ownership, TFP, local agglomeration, number of firms in NUTS5 and dummies for past export and import activities. The regressions are estimated using within transformation. See Table D.8 in the Appendix for the specifications.

In the column (1) of Table 4.10 location dummies are included to control for unobserved heterogeneity at the micro-region level. Column (2) includes location × sector cross-terms, while column (3) includes location × country cross-terms to control for local

[21] While there was a clear expectation of the sign of the variable in the machine import decision case those do not necessarily apply to choosing the country.

unobserved heterogeneity specific to certain sector or facilitate trade relations with a specific country. Column (4) combines the two previous columns. None of the estimated equations differ significantly from the primer findings which indicates that our results are not driven by time-invariant unobservables.

Table 4.11: Regressions on countries choices with year interactions

dep. Var: import dummy	[1]	[2]	[3]
same NUTS4 peers			
same country	48.44***	48.54***	47.42***
	[12.65]	[12.65]	[12.88]
other country	-28.48***	-28.66***	-28.14***
	[7.359]	[7.355]	[7.553]
other NUTS4, same NUTS3 peers			
same country	21.03***	21.05***	19.52***
	[1.711]	[1.715]	[1.672]
other country	2.419	2.328	3.148
	[2.300]	[2.294]	[2.297]
dummy: location	yes	yes	yes
dummy: year × location	yes		
dummy: year × sector		yes	
dummy: year × country			yes
controls	yes	yes	yes
year dummies:	yes	yes	yes
Observations	6247918	6247918	6247918
R-squared	0.021	0.019	0.018

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Moulton corrected s.e. in parentheses
Each column contains a results from a separate regression. Controls: size, foreign ownership, TFP, local agglomeration, number of firms in NUTS5 and dummies for past export and import activities. The control variables are lagged. The regressions are estimated using within transformation. See Table D.8 in the Appendix.

In the column (1) of Table 4.11 include location × year dummies are included to controls for local business cycles. Column (2) includes year × sector cross-terms to control for industry cycles and importing waves of a group of machines. Column (3) includes year × country cross-terms to control for fluctuations in trade relation with respect to a certain trade partner. None of the estimated equations differ significantly from the baseline findings which indicates that our results are not driven by unobservable machine- or country-specific cycles.

All-in-all, results suggest that when firm i having decided to import machine m will more likely to choose country c to import the machine from if those neighboring firms which have already imported m from that country. The local presence of such firm more than doubles the baseline choice probability. This positive correlation can be regarded as peer effect or can be considered a sign of learning or imitation because testing against alternative hypotheses did not invalidate general findings.

4.5 Extensions

This section examines four additional issues. First, I examine whether spillovers depends on the firm operating on foreign or domestic markets. Second, I examine whether the spillover is heterogeneous with respect to the price of the machine or the size of the firm that is assumed as a peer influence. Third, I examine whether the results depend on the ownership of the firm. Fourth, I look into whether the results depend on the number of countries where a specific machine is available.

4.5.1 Does domestic competition matter?

The spatial clustering of machine imports can also occur because of the competitive pressure experienced by the second or third importer. This mechanism can be partially interpreted as demonstration effect but competition is not necessarily regarded as agglomeration effect. To control for the strength of competition I split the spillover variable by the export status of the peers. This will allow to examine whether spillover effect exist between exporter or non-trading firms. As exporters do not necessarily compete on the same product market, a detected spillover effect can be less likely to be due to competition pressure.

Table 4.12: Regressions on machine imports: the local competition

dep. Var: import dummy sample:	[1] all firms	[2] non-exporters	[3] exporters
num. of prior importers of the same machine in the same NUTS4			
who do not export	0.497*** [0.126]	1.965*** [0.221]	0.336* [0.174]
who export	0.993*** [0.0428]	0.222*** [0.0230]	1.198*** [0.0464]
controls	yes	yes	yes
dummy: year	yes	yes	yes
Observations	1278885	332577	946308
R-squared	0.009	0.002	0.007

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Moulton corrected s.e. in parentheses

The table present result from three separate equation. The first column gives result for all firms, while others are estimated exporter dummy defined samples. Controls: size, foreign ownership, TFP, local agglomeration, number of firms and financial variables, all lagged. The NUTS3 spillover variables are also included, though not reported. The spillover variables are divided by 1000.

Table 4.12 reports regression results for machine import choice by the trading activity of firms. The first column shows results for all firms, while the second and the third columns show results for never exporters and exporters respectively. Results imply, that spillover originating from exporters has a higher effect on import probability. Also, results suggest that peer effects are the strongest across firms who trade (or not trade) similarly. As peer effects seem to exist across trading firms as well, one can conclude that the our spillover results are not entirely the consequence of competitive pressure.

4.5.2 Does the size of the peer and the price of the machine matter?

So far it was implicitly assumed that all machine imports have or can have the same effect on subsequent imports. However, cheap widely available machinery might not generate the same spillover mechanisms as expensive or larger machinery. Also, a very sophisticated and expensive machinery imported by a manufacturing giant will not be suitable for a small firms. To investigate the heterogeneity of spillovers with respect to firm size and the price of machines I differentiate the spillover variable accordingly.

Table 4.13: Regressions on machine imports: by firm size

dep. Var: import dummy	[1]	[2]	[3]
sample by firm size	small	medium	large
# of prior importers of the same machine in the same NUTS4 of			
small firm	0.535***	1.405***	1.808***
	[0.0863]	[0.487]	[0.456]
medium sized firm	1.188***	0.71	3.754**
	[0.208]	[0.632]	[1.835]
large firm	0.115	2.057***	0.578
	[0.101]	[0.338]	[0.745]
controls	yes	yes	yes
dummy: year	yes	yes	yes
Observations	842151	339375	97359
R-squared	0.005	0.006	0.01

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Moulton corrected s.e. in parentheses

The table present result from three separate equation in each column, estimated for various firm sizes defined by average employment. The first column gives result for small firm (10-50), the second for middle-sized firm (50-250), the third for large firm (over 250). Spillover variables divided by size of the peer who imported the same machine. Controls: size, foreign ownership, TFP, local agglomeration, number of firms and financial variables. The NUTS3 spillover variables are also included, though not reported. The spillover variables are divided by 1000.

Table 4.13 divides the same machine, same micro-region spillover variable by the size category of the importer peer. The size is defined by the employment definition of small and medium sized enterprises.[22] The first column estimates equation 4.2 with this newly defined spillover variables for small firms. Results suggest that the import decision of small firms can mostly be influenced the imports of other small firms and of the medium sized firms. Column (2) collects results for middle-sized firms. It shows that middle sized firms benefit from imports by small firms and large firms only. The effect of an additional large firm is more than one and half times bigger than the effect induced by a small firm. Lastly, column (1) estimated spillovers for large firms only. Results suggest that large firms may benefit mostly from the presence of middle sized firms.

Table 4.14 divides the same machine, same micro-region spillover variable by the price category of the machine imported by the peer. The price category is defined by the within machine distribution of the real unit price. Cheap imports is the lowest, while

[22] Small firms are below 50 and above 10 employees. Middle sized firms have employment over 50 and below 250. Large firms have more than 250 employees. See http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/

Table 4.14: Regressions on machine imports: by the price of machinery

dep. Var: import dummy	[1]	[2]	[3]
sample by firm size	small	medium	large
# of prior importers of the same machine in the same NUTS4 of			
low price	0.827***	0.776*	0.941**
	[0.155]	[0.422]	[0.368]
mid price	0.651***	1.326***	2.476***
	[0.0573]	[0.181]	[0.436]
high price	0.457***	1.798***	1.611***
	[0.139]	[0.335]	[0.475]
controls	yes	yes	yes
dummy: year	yes	yes	yes
Observations	842151	339375	97359
R-squared	0.005	0.006	0.01

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Moulton corrected s.e. in parentheses

The table present result from three separate equation in each column, estimated for various firm sizes defined by average employment. The first column gives result for small firm (10-50), the second for middle-sized firm (50-250), the third for large firm (over 250). Spillover variable is divided according to the price of the machine the peer has imported. Low price is lowest 20%, while high price is the most expensive 20%. Controls: size, foreign ownership, TFP, local agglomeration, number of firms and financial variables. The NUTS3 spillover variables are also included, though not reported. The spillover variables are divided by 1000.

the expensive machine is the highest 20 percent of the real price over the sample period. The first column of Table 4.14 collects results from estimates equation 4.2 with price divided spillover variables for small firms. Results suggests that small firms might benefit from same machine spillovers of all prices. However, the highest benefit can be expected from the cheap price imports of peers. The coefficient on cheap spillover is about twice as high as the coefficient on high price spillover variable. Column (2) holds estimates for medium sized firms. Results imply that medium sized firms might primarily benefit from medium and high priced imports of their peers. Similarly, large sized firms, column (3), seem to benefit also from medium and high priced imports.

All in all, investigating heterogeneity of spillovers by size and price reveals plausible results. Firms seem to be benefiting mostly from peers that are of similar size and import a machine in the expected price-range. That is, small firms are mostly influenced by relatively cheaper machines and less from the most expensive ones. Similarly, I find that larger or middle sized firms would be influenced by the import activity of small firms only to a smaller extent and irrespective of the price of the machine they import. In line with this, I find that the strongest spillovers could be generated by the middle sized and large firms. This could be consistent with the notion that spillovers are propagated more efficiently through more employees.

4.5.3 Do domestic learn from foreign firms?

Foreign owned firms are overrepresented across machine importers. While 25 percent of the firms are foreign owned, about they have an about 40 percent share in the capital importing group. Assuming that foreign firms have ex-ante advantage in the knowledge about foreign technology, in this section I look into whether this knowledge spills over to domestic firms. I do this by, on the one hand, by separating spillover variable by the ownership of the peers and running regressions by subsamples of domestic and foreign firms of different size categories, on the other. Estimates of the spillover variables for machine choice are collected in Table 4.15.

Table 4.15 has two blocks. The upper contains results from regressions on domestic firms. The column (1) estimates equation 4.2 for machine choice for small firms. Results suggest that both foreign and domestic firms generate spillovers. Though the spillovers by domestic firms is twice as that of generated by the machine imports of foreign firms. The second column shows estimated spillover effects on middle sized domestic firms only. Here, the magnitude is twice as large as with small firms and spillovers from domestic firms still matter relatively more. The third column collects results for large firms and it shows that the estimated coefficients are three to four times are high as the estimate for middle sized firms.

The lower block contains results from regressions on foreign firms. Results indicate that foreign firms benefit from domestic firms about the same, irrespective of their sizes. At the same time except for small firms, there is no peer effect detected across foreign owned firms.

Results indicate that while domestic firms are more probable to import machinery when foreign machine importers are present in the same location, the effect does not exceed the benefit enjoyed from domestic firms.

Table 4.15: Regressions on machine imports by ownership

dep. Var: import dummy	[1] small	[2] middle	[3] large
for sample of domestic firms			
# prior importers of the same machine in same NUTS4			
domestic	0.790***	1.526***	4.111***
	[0.0384]	[0.157]	[0.469]
foreign	0.268***	0.663***	3.157***
	[0.0419]	[0.118]	[1.075]
for sample of foreign firms			
# prior importers of the same machine in same NUTS4			
domestic	0.953***	1.441***	1.392*
	[0.105]	[0.401]	[0.785]
foreign	0.572**	0.799	-1.48
	[0.238]	[1.094]	[1.151]

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Moulton corrected s.e. in parentheses

The table present result from six equations in two blocks. The upper block are results from 3 equations on domestic sample by the firm size categories:Small firm (10-50), middle-sized firm (50-250) large firm (over 250). The lower block shows results for domestic firms. Controls: size, foreign ownership, TFP, local agglomeration, number of firms and financial variables, all lagged. The NUTS3 spillover variables are also included, though not reported. The spillover variables are divided by 1000.

4.5.4 Is the machine available from many countries?

In order to ensure that firms indeed have the choice to pick machines from different countries, only those machines were considered that are available in at least three countries. Naturally, if some machines in the choiceset were available in only one country, machine imports from that country was clustered in space. Technically, there was no choiceset. Still, the number of countries where the machine is available might influence our results. Observed clustering may be the result of few seller countries rather than spillovers. In order to see how this affects the results, I estimate equation 4.2 on subsamples defined by number of source countries.

Table D.6 (in the Appendix) investigates the influence of the number of source countries. Column (1) estimates country choice on all firms and include a variable expressing the number of countries where the given machine is available.[23] Columns (2) to (4) collects results from estimations on subsamples defined by the number of countries. The second column uses only machines that are available in 3 to 5 countries, third includes machines imported from 6 to 10 countries and the last columns includes those imported from more than 10 countries. The results on the spillover coefficients are not statistically different from each other, which indicates that the extent of global availability does not change the baseline results.

4.6 Concluding remarks

This paper investigated whether the firms decision to import a sector-specific machine is influenced by the local accumulation of the same machine. That is, do the example and success of previous machine employers and thus easier access to knowledge about certain production units facilitate further adoption of imported machinery. Using very detailed product level import dataset the paper has identified the firms' first investment into a specific foreign machinery. The results suggested that an additional local importer in the firms vicinity increases import probability significantly. Robustness checks and testing our hypothesis against alternatives reveal that the effect of prior importers is heterogeneous with respect to the size of firms, whether its targeting domestic or export markets and the affordability of the machinery from the firms perspective.

From a policy perspective the results of the paper suggest that policies aiming at regional development and investment or cluster formation should be specific to the firm size and also take into account the presence of existing internationalized firms. Results indicate that middle sized and large firms are the most to benefit from preceding machine imports. Also, these group of firms might generate stronger spillovers.

[23]The number of countries is the number of all countries where the given machine was imported from throughout the sample period.

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Appendix A

Appendix for Chapter 1

1.1 Appendix

Table A.1: A listing of main variables

Variable	Description
id	firm ID
year	Year
nace	NACE 4 digit
sales	Sales*
labor	Employment, average annual
capital	Fixed assets
VA	Value added**
nomcapt	Subscribed capital
forsh	Share of foreign ownership
psh	Share of private ownership
materials	Materials costs
wagebill	Total wagebill paid in a given year
pt	PPI deflator, 1992==1
pe	Export price deflator, 1992==1
ph	Domestic price deflator, 1992==1
totexp	Total exports
totimp	Total imports
numdest	Number of countries firm exports to
numorigin	Number of countries firm imports from
expvarhs6	Export variety in terms different HS6 categories firm exports
impvarhs6	Import variety in terms different HS6 categories firm imports
city	Location of headquarters, city or settlement
kist150	NUTS-4 (150 stratification)
county	NUTS-3 (20)

*Annual, in Million HUFs, current price as all nominal variables unless otherwise indicated

**Value added is calculated the following way: Before 2001, VA equals Sales plus Capitalized value of self-manufactured assets minus Materials, Cost of goods sold and Other costs. After 2001, Other costs are not subtracted

Table A.2: Number of observations by year and NACE chapters

		1992	1993	1994	1995	1996	1997	1998	1999
A	Agriculture, Hunting and Forestry	3136	4025	4543	5108	8689	8940	9951	6594
B	Fishing	46	53	65	70	428	546	670	102
C	Mining and quarrying	126	165	182	206	233	258	282	291
D	Manufacturing	11146	12932	14175	15511	16855	18892	20037	20142
E	Electricity, gas and water supply	185	252	306	340	359	415	430	439
F	Construction	5446	6178	6950	7764	8709	10073	10880	10804
G	Wholesale and retail trade	19160	23477	27873	32017	35312	39451	41818	41871
H	Hotels and restaurants	1801	2220	2688	3084	3500	4100	4483	4558
I	Transport, storage and communication	2196	2567	3012	3448	4017	4627	5100	5288
J	Financial intermediation	555	648	751	862	978	1120	1272	1333
K	Real estate, renting and business activities	11276	13889	16687	19571	22979	27186	30083	31325
L	Public administration and defence							1	
M	Education	354	429	498	579	677	804	887	941
N	Health and social work	352	469	578	766	1038	1391	1599	1717
O	Other community service activities	2022	2423	2836	3513	3807	4338	4955	5074
Q	Extra-territorial organizations and bodies		1	1	1	1	2	2	3
	No data	62	377	543	740	904	870	466	5610
	TOTAL	57863	70105	81688	93580	108486	123013	132916	136092

		2000	2001	2002	2003	2004	2005	2006
A	Agriculture, Hunting and Forestry	3589	3544	3545	3394	3322	3098	2822
B	Fishing	55	55	60	63	64	63	60
C	Mining and quarrying	171	172	180	180	186	168	156
D	Manufacturing	14039	13945	14437	14321	13798	13028	12058
E	Electricity, gas and water supply	332	341	353	391	410	400	382
F	Construction	4760	4904	5021	5050	4802	4616	4139
G	Wholesale and retail trade	23494	23700	24613	24422	23430	22022	19538
H	Hotels and restaurants	1727	1816	1892	1920	1856	1796	1634
I	Transport, storage and communication	2724	2767	2886	2883	2732	2587	2386
J	Financial intermediation	566	570	579	577	556	538	502
K	Real estate, renting and business activities	9686	9763	10191	10553	10046	9384	8594
L	Public administration and defence				1	2	2	6
M	Education	313	315	332	355	367	371	331
N	Health and social work	590	654	717	762	781	776	748
O	Other community service activities	1666	1667	1738	1752	1715	1666	1485
Q	Extra-territorial organizations and bodies	1	1	2	2	2	2	1
	No data	700	611	556	144	216	422	6
	TOTAL	64413	64825	67102	66770	64285	60939	54848

Table A.3: Employment share of NACE chapters over years, in %

	NACE Chapters	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
A	Agriculture, Hunting and Forestry	11.8	10.3	9.4	8.8	9.2	8.5	8.3	7.0	6.6	6.1	5.7	5.4	5.0	4.8	4.7
B	Fishing	0.1	0.1	0.1	0.1	0.3	0.4	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
C	Mining and quarrying	0.6	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3
D	Manufacturing	36.0	35.3	35.3	36.0	36.0	37.4	37.9	37.5	40.8	40.4	39.5	39.1	37.8	36.4	37.1
E	Electricity, gas and water supply	4.6	4.7	5.2	5.1	4.8	5.0	4.2	3.9	3.8	3.7	3.5	3.5	3.3	3.3	3.2
F	Construction	6.6	6.6	6.6	6.1	5.7	5.9	5.9	6.0	5.5	5.6	5.5	5.5	5.4	5.4	5.3
G	Wholesale and retail trade	13.6	13.3	14.7	14.1	15.2	14.3	15.0	15.7	15.2	15.9	16.1	16.7	17.3	17.1	17.5
H	Hotels and restaurants	2.0	2.4	2.3	2.3	2.3	2.4	2.5	2.5	2.3	2.4	2.3	2.4	2.3	2.4	2.4
I	Transport, storage and communication	12.1	12.2	12.5	13.3	11.9	11.4	11.2	11.2	11.8	12.0	12.2	12.1	12.0	11.7	12.0
J	Financial intermediation	2.3	3.0	3.3	3.4	3.2	3.2	3.0	2.9	2.8	2.7	2.9	2.9	2.9	3.2	3.5
K	Real estate, renting and business activities	7.9	7.6	7.2	7.0	8.0	7.8	8.2	8.5	7.5	7.8	8.5	8.3	9.4	9.4	9.6
L	Public administration and defence	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
M	Education	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
N	Health and social work	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8	1.0	1.2	1.1	1.3
O	Other community service activities	2.0	3.3	2.2	2.2	2.0	2.1	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.5	2.6
Q	Extra-territorial organizations and bodies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No data	0.1	0.2	0.0	0.7	0.3	0.5	0.1	1.4	0.2	0.1	0.1	0.3	0.4	2.2	0.0
TOTAL		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table A.4: Product export share of NACE chapters and years, in %

	NACE Chapters	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
A	Agriculture, Hunting and Forestry	3.6	1.7	2.2	2.1	1.8	1.4	1.2	0.9	0.9	0.8	0.7	0.6
B	Fishing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	Mining and quarrying	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D	Manufacturing	73.3	75.7	77.8	79.6	85.4	88.2	89.8	91.3	91.2	91.5	89.8	88.6
E	Electricity, gas and water supply	0.3	0.4	0.3	0.1	0.6	0.5	0.5	0.4	0.3	0.3	0.1	0.1
F	Construction	0.5	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1
G	Wholesale and retail trade	17.6	17.6	14.4	14.5	9.2	8.3	7.2	6.0	6.2	6.1	5.6	5.4
H	Hotels and restaurants	0.0	0.1	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I	Transport, storage and communication	0.4	0.4	1.9	0.2	0.2	0.1	0.1	0.1	0.3	0.2	0.2	0.2
J	Financial intermediation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
K	Real estate, renting and business activities	4.0	3.0	2.5	2.6	2.2	1.1	0.8	0.7	0.8	0.8	0.6	0.6
L	Public administration and defence	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
M	Education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N	Health and social work	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O	Other community service activities	0.3	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.0
Q	Extra-territorial organizations and bodies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No data	0.0	0.5	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0	2.6	4.2
TOTAL		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table A.5: Product import volume share of NACE chapters and years, in %

	NACE Chapters	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
A	Agriculture, Hunting and Forestry	0.8	0.5	0.7	0.6	0.8	0.7	0.7	0.3	0.3	0.3	0.3	0.2
B	Fishing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	Mining and quarrying	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
D	Manufacturing	49.0	43.4	45.6	54.2	60.4	63.1	65.1	67.4	68.6	68.6	63.9	61.7
E	Electricity, gas and water supply	1.4	1.2	1.4	1.5	1.0	1.2	0.9	0.9	1.1	0.7	0.8	1.0
F	Construction	1.4	1.0	1.1	0.9	0.8	0.7	0.6	0.7	0.6	0.5	0.6	0.5
G	Wholesale and retail trade	37.3	42.3	40.9	34.7	31.0	30.3	29.2	27.2	26.0	26.7	28.9	30.1
H	Hotels and restaurants	0.5	0.3	0.2	0.2	0.2	0.1	0.0	0.0	0.1	0.0	0.1	0.0
I	Transport, storage and communication	1.8	3.8	4.3	3.4	2.2	1.4	1.2	1.3	1.6	1.2	1.1	1.0
J	Financial intermediation	0.3	0.6	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
K	Real estate, renting and business activities	6.6	5.3	4.7	3.4	3.1	2.1	1.7	1.5	1.4	1.5	1.6	1.3
L	Public administration and defence	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
M	Education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N	Health and social work	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
O	Other community service activities	0.5	0.5	0.5	0.3	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Q	Extra-territorial organizations and bodies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No data	0.0	0.4	0.1	0.3	0.1	0.1	0.1	0.4	0.0	0.0	2.3	3.7
TOTAL		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table A.6: Firm level correlation of APEH and customs export volumes by year and NACE chapter

	NACE Chapters	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
A	Agriculture, Hunting and Forestry	0.86	0.65	0.92	0.97	0.95	0.95	0.95	0.96	0.97	0.98	0.71	0.95
B	Fishing	0.61	0.87	0.98	1.00	1.00	0.97	0.69	1.00	0.99	0.98	0.99	1.00
C	Mining and quarrying	0.56	0.34	0.25	0.29	0.22	0.38	0.45	0.33	0.37	0.33	0.50	0.51
D	Manufacturing	0.94	0.96	0.90	0.70	0.93	0.98	0.97	0.96	0.92	0.98	0.99	0.98
E	Electricity, gas and water supply	0.12	0.09	0.64	0.76	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.77
F	Construction	0.70	0.35	0.47	0.59	0.71	0.32	0.38	0.26	0.27	0.40	0.49	0.34
G	Wholesale and retail trade	0.82	0.89	0.70	0.56	0.36	0.37	0.39	0.22	0.44	0.34	0.53	0.13
H	Hotels and restaurants	0.15	0.71	0.85	0.94	0.14	0.51	0.51	0.32	0.13	0.21	0.27	0.48
I	Transport, storage and communication	0.53	0.78	0.83	0.78	0.47	0.20	0.09	0.09	0.12	0.15	0.91	0.89
J	Financial intermediation	0.00	0.16	0.02	0.10	0.01	0.04	0.01	0.13	0.04	0.00	0.00	0.00
K	Real estate, renting and business activities	0.66	0.57	0.51	0.75	0.23	0.17	0.24	0.28	0.40	0.46	0.24	0.11
L	Public administration and defence	.	.	.	.	.	.	.	.	.	.	.	.
M	Education	0.90	0.69	0.56	0.79	0.52	0.65	0.63	0.33	0.05	0.15	0.06	0.08
N	Health and social work	0.48	0.01	0.78	0.57	0.21	0.40	0.58	0.74	0.82	0.92	0.19	0.25
O	Other community service activities	0.18	0.16	0.10	0.05	0.06	0.18	0.17	0.06	0.16	0.50	0.02	0.02
Q	Extra-territorial organizations and bodies	.	.	.	.	.	.	.	.	.	.	.	.
	No data	.	.	.	.	.	.	.	.	.	.	.	.

Table A.7: Firm level correlation of APEH and customs export volumes by year in manufacturing

		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
15	Food products and beverages	0.92	0.94	0.99	0.97	0.99	0.99	0.98	0.98	0.97	1.00	0.99	1.00
16	Tobacco products	0.82	0.78	0.73	0.77	0.81	1.00	0.99	0.98	0.96	0.96	0.99	0.99
17	Textiles	0.68	0.81	0.81	0.71	0.60	0.67	0.71	0.70	0.94	0.62	0.90	0.92
18	Wearing apparel	0.88	0.90	0.85	0.86	0.84	0.86	0.88	0.95	0.97	0.99	0.99	0.99
19	Tanning and dressing of leather	0.80	0.82	0.87	0.91	0.86	0.92	0.85	0.82	0.81	0.79	0.77	0.78
20	Wood	0.76	0.76	0.89	0.67	0.84	0.92	0.95	0.91	0.96	0.98	0.98	0.99
21	Pulp, paper	0.99	0.90	0.99	0.99	0.95	0.96	0.98	0.95	1.00	1.00	0.98	0.94
22	Publishing, printing	0.85	0.37	0.55	0.58	0.81	0.90	0.93	0.78	0.81	0.87	0.62	0.80
23	Coke, refined petroleum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
24	Chemicals, and chemical products	0.89	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99
25	Rubber and plastic products	1.00	0.76	0.93	0.95	0.93	0.78	0.68	0.82	0.78	0.93	0.94	0.80
26	Other non-metallic mineral products	0.95	0.99	0.99	1.00	0.96	1.00	1.00	0.99	0.99	0.99	0.99	0.94
27	Basic metals	1.00	0.98	1.00	0.99	0.99	0.99	0.99	0.98	1.00	1.00	1.00	1.00
28	Fabricated metal products	0.89	0.81	0.85	0.81	0.95	0.96	0.98	0.96	0.92	0.64	0.95	0.92
29	Machinery	0.90	0.94	0.96	0.96	0.96	0.97	0.97	0.98	0.98	0.99	0.99	0.96
30	Office machinery and computers	0.88	0.37	0.47	0.26	0.99	1.00	0.97	0.93	0.94	0.99	0.96	0.99
31	Electrical machinery	0.99	0.98	0.97	0.95	0.73	0.97	0.99	0.98	0.95	1.00	0.99	0.95
32	Radio, television and communication	0.35	0.47	0.59	0.70	0.91	0.94	0.88	0.90	0.66	0.96	1.00	0.99
33	Medical, precision and optical instruments	0.92	0.99	0.99	0.98	0.96	0.98	0.97	0.95	0.92	0.95	0.97	0.97
34	Motor vehicles	0.98	0.93	0.44	0.16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
35	Other transport equipment	0.81	0.59	0.92	0.66	0.59	0.87	0.96	0.98	0.90	0.85	0.94	0.91
36	Furniture	0.80	0.87	0.90	0.87	0.93	0.95	0.97	0.95	0.98	0.99	0.98	0.97
37	Recycling	0.71	1.00	1.00	0.97	0.97	0.99	0.99	0.98	1.00	0.91	0.97	0.98

Table A.8: Discrepancy in the sources of exports volumes

NACE	*industry*	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
15	Food products and beverages	-8.5	-8.0	1.2	-1.9	0.8	-2.8	0.9	4.4	2.4	-0.6	-4.6	-4.1
16	Tobacco products	85.7	68.4	51.5	41.0	38.2	70.9	66.0	75.0	69.8	44.0	23.2	31.6
17	Textiles	35.4	33.3	43.8	37.4	50.0	43.6	47.7	54.5	33.9	48.3	34.3	34.5
18	Wearing apparel	75.9	62.8	70.2	68.1	67.9	66.7	64.4	58.7	55.0	52.9	49.5	50.0
19	Tanning and dressing of leather	76.9	60.4	66.5	62.3	66.4	64.6	57.2	57.4	55.9	53.7	53.1	56.3
20	Wood	22.2	31.4	11.8	0.0	3.7	9.2	12.7	16.0	10.5	4.0	9.8	7.1
21	Pulp, paper	37.0	-8.3	4.3	-7.5	24.2	16.3	22.8	25.5	7.9	6.6	9.9	2.7
22	Publishing, printing	-54.5	-150.0	-275.0	-126.7	-33.3	-15.6	-2.1	-36.7	-18.4	-10.9	-51.7	-53.7
23	Coke, refined petroleum	8.7	5.1	-0.7	6.2	5.1	6.3	10.9	-10.8	-13.0	2.9	-1.5	-4.4
24	Chemicals, and chemical products	-16.4	-11.0	4.9	-0.2	2.4	-0.9	-1.3	-0.4	-1.0	3.5	0.1	1.6
25	Rubber and plastic products	7.4	-40.8	20.3	12.3	19.7	22.2	24.2	15.3	11.1	11.2	9.5	-12.5
26	Other non-metallic mineral products	5.0	4.4	4.6	-3.2	-1.1	3.0	4.0	8.5	4.1	6.1	3.6	8.0
27	Basic metals	11.5	-1.8	5.1	13.4	10.5	4.5	-1.7	-9.9	-1.9	-0.3	1.4	-3.9
28	Fabricated metal products	-20.2	-41.6	-16.0	-18.2	3.8	4.5	6.5	7.0	9.4	-7.5	4.8	2.7
29	Machinery	-20.7	-16.0	5.2	0.1	7.4	8.8	9.9	8.2	9.6	6.7	4.4	-2.3
30	Office machinery and computers	0.0	-562.5	-200.0	-125.0	-25.8	-25.9	-4.9	-14.8	-43.5	-2.8	19.8	26.4
31	Electrical machinery	17.0	-6.1	-1.3	2.0	-13.6	16.7	24.2	20.8	-1.7	2.1	-8.1	-19.5
32	Radio, TV and communication equip.	60.8	60.6	67.5	60.0	45.5	41.2	30.6	29.3	46.2	5.8	7.1	-7.1
33	Medical, precision and optical instruments	21.1	-7.7	5.4	5.8	9.1	1.1	8.1	14.3	20.0	15.0	15.6	11.8
34	Motor vehicles	-11.1	-8.2	-66.2	-202.2	2.7	-9.0	-2.1	1.4	-1.4	12.0	10.7	5.4
35	Other transport equipment	-25.0	18.2	23.5	16.3	34.4	25.2	-24.8	-9.6	14.2	20.5	13.8	21.1
36	Furniture	-2.9	-33.3	5.6	-2.5	9.3	3.8	8.5	12.7	5.3	5.0	11.4	6.4
37	Recycling	0.0	0.0	-3.2	-28.3	-26.7	-30.0	-8.0	-11.9	-4.5	18.3	-15.2	-6.0

Figures show the percentage difference of the APEH and CUSTOMS export data as: (CUSTOMS-APEH)/CUSTOMS*100

Table A.9: Share of exporting manufacturers per sector, in %

NACE	Industry	avg. Obs	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
15	Food products and beverages	2252	25.0	21.1	20.4	22.4	22.7	22.5	22.3	20.8	32.8	34.6	33.6	34.7
16	Tobacco products	7	100.0	66.7	100.0	83.3	85.7	85.7	85.7	85.7	100.0	85.7	71.4	83.3
17	Textiles	625	42.2	40.8	37.0	33.1	33.0	30.3	32.5	35.2	49.6	52.6	52.2	52.9
18	Wearing apparel	932	48.1	47.5	47.3	44.0	42.7	40.0	36.9	37.5	47.9	53.3	52.2	50.0
19	Tanning and dressing of leather	319	50.4	49.2	52.7	49.4	50.6	49.6	48.2	45.9	56.4	57.5	56.5	56.3
20	Wood	977	30.4	29.5	31.1	31.3	27.4	27.7	28.6	28.3	39.4	42.7	37.8	37.6
21	Pulp, paper	201	36.7	33.6	35.4	27.9	34.0	28.8	31.1	29.6	41.3	48.0	40.7	46.6
22	Publishing, printing	1938	13.0	11.4	11.4	10.6	10.2	9.8	9.9	9.7	22.8	26.3	25.6	26.4
23	Coke, refined petroleum	7	50.0	75.0	42.9	18.2	25.0	22.2	22.2	25.0	75.0	75.0	80.0	66.7
24	Chemicals, and chemical products	452	39.8	41.3	44.6	41.2	40.7	38.2	42.0	41.1	51.8	56.5	58.2	55.3
25	Rubber and plastic products	881	32.5	34.6	37.4	37.0	36.8	39.7	40.7	40.6	53.1	57.2	59.6	58.3
26	Other non-metallic mineral products	600	32.9	30.3	29.5	31.9	30.1	28.6	28.3	27.1	38.8	42.6	38.3	42.8
27	Basic metals	197	50.7	46.9	49.7	45.4	44.4	44.4	44.7	47.6	61.0	65.7	69.7	71.6
28	Fabricated metal products	2126	32.0	30.2	29.7	29.5	28.9	29.8	30.4	30.2	46.1	49.6	48.0	47.2
29	Machinery	1671	29.2	28.4	27.5	28.3	27.7	26.6	28.8	29.2	43.1	48.3	51.0	49.9
30	Office machinery and computers	119	32.2	33.0	28.6	28.0	22.8	16.1	15.7	15.9	30.0	47.2	36.8	33.7
31	Electrical machinery	557	33.2	34.7	34.3	34.1	32.2	31.0	32.2	30.2	47.3	52.0	53.7	54.7
32	Radio, TV and communication equip.	417	31.4	33.1	36.5	35.1	32.1	28.1	26.8	31.7	46.4	55.0	50.4	52.4
33	Medical, precision and optical instruments	628	30.3	29.7	30.1	29.1	26.1	26.7	27.3	26.8	41.9	44.8	44.8	42.7
34	Motor vehicles	203	46.2	48.7	49.7	46.4	50.3	55.1	50.4	51.5	62.7	68.1	70.6	71.2
35	Other transport equipment	107	31.9	37.1	39.0	43.7	42.9	35.8	40.0	32.3	45.5	49.0	55.9	49.6
36	Furniture	847	34.3	32.3	32.4	31.0	29.9	26.9	28.6	26.7	38.5	41.1	42.4	39.5
37	Recycling	78	28.1	31.6	21.6	26.3	22.9	26.4	26.2	28.0	41.9	45.3	44.7	37.1

Table A.10: Share of importing manufacturers per sector, in %

NACE	industry	avg. Obs	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
15	Food products and beverages	2252	34.2	28.1	27.4	25.7	23.0	22.3	22.4	22.3	34.2	37.4	38.6	40.3
16	Tobacco products	7	100.0	100.0	100.0	83.3	85.7	100.0	100.0	100.0	100.0	100.0	100.0	83.3
17	Textiles	625	53.1	50.9	47.8	41.6	42.3	39.8	40.6	43.6	59.4	61.8	60.6	63.0
18	Wearing apparel	932	54.9	54.6	52.8	49.1	46.7	44.7	42.1	41.5	55.6	56.1	57.9	57.2
19	Tanning and dressing of leather	319	59.3	56.9	56.4	52.2	56.7	54.9	50.9	51.1	63.8	63.6	60.5	59.6
20	Wood	977	30.2	28.2	29.6	27.2	25.1	23.5	25.3	27.2	38.8	40.2	39.5	44.3
21	Pulp, paper	201	46.8	47.7	46.2	40.2	44.8	39.6	39.5	39.1	52.7	58.8	59.7	64.3
22	Publishing, printing	1938	23.2	22.3	22.8	20.2	17.8	17.5	18.9	16.4	36.1	37.5	38.8	40.4
23	Coke, refined petroleum	7	100.0	75.0	57.1	36.4	25.0	22.2	22.2	37.5	75.0	75.0	80.0	66.7
24	Chemicals, and chemical products	452	57.3	57.2	56.7	52.7	53.4	49.6	53.2	53.2	66.4	69.0	68.2	70.7
25	Rubber and plastic products	881	42.9	40.9	45.6	40.3	41.3	43.3	45.7	45.9	59.1	66.6	65.4	66.3
26	Other non-metallic mineral products	600	44.6	40.6	37.1	37.3	37.5	33.4	33.3	35.7	50.0	52.7	54.0	58.7
27	Basic metals	197	45.9	41.7	38.9	40.0	38.8	37.0	40.1	39.5	52.2	61.7	58.9	63.9
28	Fabricated metal products	2126	35.3	34.5	34.1	32.1	30.5	30.0	32.6	31.4	47.8	52.3	52.9	52.3
29	Machinery	1671	40.7	38.6	38.4	38.3	37.3	38.2	38.9	39.8	58.5	62.0	61.6	61.9
30	Office machinery and computers	119	52.9	51.5	46.9	45.8	39.0	34.2	28.9	32.3	54.4	65.2	62.1	56.5
31	Electrical machinery	557	43.6	43.8	45.1	44.9	44.4	39.6	41.4	41.9	60.1	62.3	65.5	66.0
32	Radio, TV and communication equip.	417	44.6	43.2	43.7	44.9	38.3	33.7	36.5	40.8	64.1	65.3	63.3	69.0
33	Medical, precision and optical instruments	628	48.1	42.5	43.1	39.3	40.0	38.6	38.6	38.4	60.0	55.9	59.7	61.0
34	Motor vehicles	203	55.4	50.0	58.0	54.7	56.3	58.8	57.4	57.3	73.0	76.5	73.4	77.2
35	Other transport equipment	107	46.4	47.1	51.9	56.3	49.5	45.5	41.5	42.5	56.4	61.0	66.7	58.4
36	Furniture	847	40.5	40.5	38.6	35.1	33.1	31.9	31.8	33.3	43.2	47.7	50.0	49.3
37	Recycling	78	34.4	36.8	33.3	28.1	22.9	26.4	26.2	25.2	43.5	53.1	42.1	46.1

Table A.11: Manufacturing sectors share in export volume, in %

NACE	*industry*	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
15	Food products and beverages	14.8	14.7	14.1	14.6	12.1	9.8	7.7	5.8	5.8	5.5	5.4	5.5
16	Tobacco products	0.5	0.4	0.5	0.5	0.7	0.5	0.4	0.2	0.1	0.1	0.1	0.1
17	Textiles	4.0	3.8	3.8	3.2	3.6	2.9	2.6	2.7	2.1	2.1	1.5	1.4
18	Wearing apparel	12.2	9.5	10.1	8.6	7.1	5.7	5.3	5.0	4.4	4.3	3.6	3.5
19	Tanning and dressing of leather	5.4	4.1	3.7	3.0	2.7	2.2	2.0	1.8	1.6	1.4	1.3	1.0
20	Wood	1.1	1.7	1.6	1.6	1.4	1.2	1.1	1.1	1.1	0.9	1.0	0.9
21	Pulp, paper	1.2	1.1	1.3	1.4	1.6	1.4	1.4	1.3	1.3	1.3	1.3	1.4
22	Publishing, printing	0.5	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1
23	Coke, refined petroleum	5.8	7.1	5.7	5.1	3.8	2.9	2.0	1.6	2.1	2.1	1.9	2.0
24	Chemicals, and chemical products	12.4	13.9	13.0	12.4	9.0	8.1	6.2	5.4	6.2	5.7	5.4	5.9
25	Rubber and plastic products	2.4	2.0	3.3	3.7	3.4	3.5	3.2	2.9	3.3	3.3	3.6	3.5
26	Other non-metallic mineral products	2.1	2.7	2.3	2.1	2.0	1.8	1.6	1.5	1.4	1.2	1.1	1.2
27	Basic metals	8.2	6.6	7.6	8.6	5.1	4.2	3.5	2.9	2.6	2.6	2.6	2.6
28	Fabricated metal products	3.8	3.4	3.6	3.5	3.2	2.9	2.8	2.7	2.8	2.6	2.6	2.7
29	Machinery	5.9	6.4	6.1	6.5	5.7	4.9	4.5	4.2	4.3	4.0	4.8	4.9
30	Office machinery and computers	0.4	0.2	0.2	0.2	3.5	9.5	10.9	11.0	6.8	7.3	5.5	2.9
31	Electrical machinery	6.7	6.5	8.3	9.0	11.2	9.6	8.8	9.3	11.3	14.3	14.0	9.5
32	Radio, TV and communication equipment	3.0	3.7	5.3	6.7	6.1	10.4	12.6	15.3	18.0	17.7	21.3	26.5
33	Medical, precision and optical instruments	1.4	1.3	1.3	1.4	1.1	1.0	1.0	0.8	0.8	0.8	0.7	0.8
34	Motor vehicles	6.4	8.5	5.5	5.5	14.3	15.6	20.6	22.9	22.3	21.3	21.0	22.2
35	Other transport equipment	0.4	0.5	0.5	0.4	0.5	0.5	0.4	0.3	0.4	0.5	0.4	0.5
36	Furniture	1.4	1.5	1.5	1.4	1.3	1.0	1.0	1.0	0.9	0.8	0.9	0.9
37	Recycling	0.1	0.2	0.4	0.4	0.3	0.2	0.2	0.1	0.2	0.2	0.1	0.1
	TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table A.12: Manufacturing sectors share in import volume, in %

NACE	*industry*	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
15	Food products and beverages	8.9	10.8	12.3	10.1	6.6	5.6	4.8	3.5	3.3	3.3	3.6	3.6
16	Tobacco products	2.0	2.2	1.7	1.3	1.1	1.0	0.8	0.6	0.3	0.4	0.3	0.3
17	Textiles	4.1	4.3	4.0	3.7	4.1	3.8	3.3	3.3	2.2	2.2	1.5	1.4
18	Wearing apparel	12.3	10.6	9.1	8.7	7.1	5.9	5.3	4.7	3.9	4.1	3.7	3.6
19	Tanning and dressing of leather	4.8	4.2	3.6	3.3	2.7	2.4	2.1	1.7	1.4	1.5	1.4	1.1
20	Wood	1.3	1.5	1.4	1.5	1.0	0.9	0.8	0.7	0.8	0.7	0.8	0.8
21	Pulp, paper	4.9	3.5	3.9	3.9	3.1	2.6	2.3	1.8	1.7	1.6	1.7	1.8
22	Publishing, printing	1.8	1.4	1.5	1.4	1.1	1.1	1.1	0.9	0.8	0.8	0.6	0.6
23	Coke, refined petroleum	12.5	12.4	9.1	11.9	11.1	8.1	5.5	5.3	8.2	6.8	6.7	6.8
24	Chemicals, and chemical products	10.4	10.8	10.5	10.1	7.3	6.2	5.1	4.8	4.2	3.7	3.5	4.5
25	Rubber and plastic products	3.8	4.0	3.8	4.3	3.3	3.4	3.6	3.4	3.3	3.1	3.6	3.7
26	Other non-metallic mineral products	1.7	1.9	1.7	1.6	1.5	1.2	1.2	1.0	0.8	0.9	0.9	1.1
27	Basic metals	7.0	3.9	6.4	7.9	4.4	4.5	3.0	2.5	2.4	2.1	2.2	2.0
28	Fabricated metal products	2.8	3.1	3.0	2.9	2.5	2.3	2.3	1.8	2.0	2.1	2.3	2.2
29	Machinery	4.5	5.2	4.8	5.1	4.2	3.9	3.8	3.6	3.4	3.4	4.4	4.6
30	Office machinery and computers	1.1	1.0	0.7	0.6	3.7	8.5	9.7	10.6	7.0	9.3	6.4	2.4
31	Electrical machinery	5.6	6.4	7.4	8.3	9.3	7.9	7.8	8.3	9.0	11.9	12.1	8.6
32	Radio, TV and communication equipment	3.7	4.7	7.2	6.3	9.3	13.6	15.4	18.3	24.7	21.7	22.8	27.8
33	Medical, precision and optical instruments	1.6	1.7	1.4	1.3	1.1	0.9	0.9	0.8	0.7	0.7	0.7	0.7
34	Motor vehicles	3.6	4.1	4.6	4.2	14.0	15.1	20.0	21.2	18.8	18.7	19.6	20.9
35	Other transport equipment	0.5	0.8	0.7	0.6	0.6	0.5	0.5	0.3	0.4	0.4	0.4	0.5
36	Furniture	1.0	1.4	1.2	1.0	0.8	0.7	0.7	0.8	0.7	0.7	0.9	0.9
37	Recycling	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
	TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table A.13: Herfindahl indices of within sector export volume distribution

NACE	*industry*	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
15	Food products and beverages	0.01	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
16	Tobacco products	0.52	0.54	0.58	0.54	0.50	0.67	0.77	0.80	0.65	0.31	0.28	0.38
17	Textiles	0.03	0.03	0.03	0.03	0.05	0.04	0.05	0.07	0.03	0.06	0.02	0.02
18	Wearing apparel	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.07	0.09	0.13
19	Tanning and dressing of leather	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.04	0.05
20	Wood	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.07	0.09
21	Pulp, paper	0.30	0.15	0.17	0.15	0.16	0.14	0.17	0.20	0.20	0.22	0.19	0.19
22	Publishing, printing	0.08	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.03	0.04
23	Coke, refined petroleum	1.00	0.98	0.93	0.90	0.91	0.90	0.95	0.99	0.92	0.95	0.96	0.94
24	Chemicals, and chemical products	0.08	0.11	0.10	0.10	0.09	0.09	0.09	0.08	0.09	0.09	0.10	0.10
25	Rubber and plastic products	0.35	0.03	0.04	0.04	0.04	0.05	0.05	0.04	0.04	0.03	0.04	0.04
26	Other non-metallic mineral products	0.12	0.09	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.04
27	Basic metals	0.17	0.17	0.16	0.14	0.18	0.21	0.19	0.20	0.28	0.23	0.23	0.26
28	Fabricated metal products	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
29	Machinery	0.06	0.04	0.04	0.04	0.04	0.05	0.04	0.05	0.06	0.06	0.06	0.05
30	Office machinery and computers	0.41	0.31	0.37	0.15	0.45	0.54	0.41	0.37	0.54	0.62	0.61	0.57
31	Electrical machinery	0.21	0.31	0.22	0.17	0.10	0.09	0.08	0.07	0.08	0.15	0.15	0.08
32	Radio, television and comm. equip.	0.21	0.19	0.14	0.12	0.13	0.17	0.15	0.13	0.11	0.15	0.26	0.17
33	Medical, precision and optical instruments	0.11	0.12	0.07	0.06	0.05	0.05	0.04	0.05	0.05	0.05	0.04	0.05
34	Motor vehicles	0.28	0.29	0.15	0.09	0.20	0.17	0.30	0.36	0.34	0.35	0.35	0.31
35	Other transport equipment	0.16	0.22	0.28	0.17	0.18	0.17	0.21	0.21	0.22	0.20	0.19	0.19
36	Furniture	0.03	0.02	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04
37	Recycling	0.35	0.37	0.36	0.44	0.32	0.24	0.20	0.16	0.20	0.19	0.14	0.17

Table A.14: Herfindahl indices of within sector import volume distribution

NACE	*industry*	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
15	Food products and beverages	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03
16	Tobacco products	0.36	0.30	0.38	0.38	0.39	0.44	0.48	0.44	0.36	0.31	0.32	0.42
17	Textiles	0.04	0.03	0.03	0.05	0.06	0.06	0.05	0.08	0.04	0.07	0.02	0.02
18	Wearing apparel	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.08	0.09	0.14
19	Tanning and dressing of leather	0.04	0.04	0.03	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.05	0.05
20	Wood	0.16	0.09	0.08	0.09	0.08	0.10	0.11	0.09	0.11	0.12	0.13	0.13
21	Pulp, paper	0.12	0.10	0.08	0.08	0.08	0.10	0.11	0.11	0.13	0.11	0.12	0.12
22	Publishing, printing	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.05	0.03	0.02
23	Coke, refined petroleum	1.00	0.89	0.77	0.85	0.87	0.90	1.00	1.00	0.91	0.90	0.90	0.91
24	Chemicals, and chemical products	0.05	0.06	0.05	0.05	0.04	0.05	0.05	0.06	0.06	0.05	0.06	0.08
25	Rubber and plastic products	0.10	0.03	0.03	0.03	0.03	0.06	0.05	0.04	0.03	0.02	0.03	0.03
26	Other non-metallic mineral products	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
27	Basic metals	0.28	0.28	0.31	0.21	0.31	0.27	0.23	0.25	0.38	0.33	0.32	0.29
28	Fabricated metal products	0.02	0.02	0.02	0.03	0.04	0.02	0.02	0.02	0.02	0.02	0.01	0.01
29	Machinery	0.05	0.06	0.05	0.05	0.05	0.06	0.04	0.05	0.05	0.05	0.06	0.06
30	Office machinery and computers	0.15	0.22	0.35	0.18	0.40	0.42	0.34	0.34	0.49	0.59	0.62	0.51
31	Electrical machinery	0.11	0.09	0.09	0.07	0.05	0.05	0.05	0.04	0.05	0.13	0.10	0.04
32	Radio, television and comm. equip.	0.08	0.07	0.09	0.06	0.11	0.13	0.11	0.10	0.10	0.13	0.21	0.15
33	Medical, precision and optical instruments	0.05	0.06	0.04	0.05	0.04	0.04	0.03	0.05	0.05	0.05	0.03	0.04
34	Motor vehicles	0.13	0.15	0.13	0.08	0.25	0.27	0.38	0.44	0.41	0.37	0.36	0.32
35	Other transport equipment	0.17	0.25	0.18	0.17	0.12	0.15	0.15	0.15	0.16	0.18	0.12	0.14
36	Furniture	0.03	0.04	0.03	0.05	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.04
37	Recycling	0.30	0.33	0.55	0.38	0.36	0.16	0.14	0.12	0.14	0.61	0.09	0.10

Table A.15: Spatial distribution of export volume, share of NUTS-3 level entities, in %

	County	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	Budapest	34.6	32.6	28.8	27.4	23.5	20.8	17.0	15.3	18.6	18.4	16.7	17.4
2	Baranya	2.2	1.5	1.5	1.6	1.9	2.3	2.3	1.9	0.9	0.9	0.9	0.9
3	Bács-Kiskun	3.6	4.1	4.5	4.2	3.3	2.6	2.6	2.3	2.3	2.3	2.3	2.3
4	Békés	3.8	3.4	3.2	2.7	2.3	1.8	1.4	1.0	1.0	0.9	0.9	0.8
5	Borsod-Abaúj-Zemplén	4.9	6.5	6.6	7.1	4.9	4.4	3.6	3.2	3.7	3.7	3.6	3.6
6	Csongrád	3.0	2.5	2.7	2.6	2.2	1.8	1.7	1.4	1.4	1.3	1.2	1.2
7	Fejér	9.0	9.4	11.3	12.6	13.0	19.6	19.3	19.6	14.8	16.9	14.6	10.1
8	Győr-Moson-Sopron	5.8	7.7	6.8	6.3	8.1	10.3	15.5	19.4	17.3	16.8	16.6	16.9
9	Hajdű-Bihar	4.1	3.5	3.7	3.2	2.4	2.3	2.2	1.8	1.7	1.8	2.0	2.1
10	Heves	1.8	1.8	1.4	1.5	1.5	1.5	1.5	1.3	1.5	1.6	1.8	1.8
11	Komárom-Esztergom	1.5	1.6	1.8	2.1	3.9	3.7	3.2	2.6	5.5	7.9	8.1	10.4
12	Nógrád	1.4	1.4	1.6	1.4	1.3	1.0	0.9	1.1	1.3	1.0	1.0	1.0
13	Pest	2.6	3.3	3.8	3.8	4.2	4.7	6.1	6.3	9.0	4.3	4.7	7.7
14	Somogy	1.6	1.3	2.0	2.9	2.4	3.0	2.8	2.8	3.2	5.2	10.1	7.8
15	Szabolcs-Szatmár-Bereg	2.9	3.0	3.2	2.6	2.2	1.9	2.0	2.3	2.6	2.7	2.7	2.9
16	Jász-Nagykun-Szolnok	3.5	3.0	3.1	3.2	2.8	2.6	2.1	2.2	2.2	2.2	2.1	2.1
17	Tolna	2.9	2.0	2.0	1.9	1.6	1.2	1.1	1.1	0.9	0.8	0.8	0.6
18	Vas	4.2	4.9	5.2	5.6	12.9	9.9	10.4	10.3	7.7	7.1	5.8	6.0
19	Veszprém	3.2	3.0	3.7	4.3	2.9	2.5	2.2	2.2	2.3	2.2	2.2	2.6
20	Zala	2.1	2.4	2.1	2.0	1.6	1.2	1.1	1.1	1.0	0.9	0.8	0.8

Table A.16: Spatial distribution of import volume, share of NUTS-3 level entities, in %

	County	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	Budapest	34.6	32.6	28.8	27.4	23.5	20.8	17.0	15.3	18.6	18.4	16.7	17.4
2	Baranya	2.2	1.5	1.5	1.6	1.9	2.3	2.3	1.9	0.9	0.9	0.9	0.9
3	Bács-Kiskun	3.6	4.1	4.5	4.2	3.3	2.6	2.6	2.3	2.3	2.3	2.3	2.3
4	Békés	3.8	3.4	3.2	2.7	2.3	1.8	1.4	1.0	1.0	0.9	0.9	0.8
5	Borsod-Abaűj-Zemplén	4.9	6.5	6.6	7.1	4.9	4.4	3.6	3.2	3.7	3.7	3.6	3.6
6	Csongrád	3.0	2.5	2.7	2.6	2.2	1.8	1.7	1.4	1.4	1.3	1.2	1.2
7	Fejér	9.0	9.4	11.3	12.6	13.0	19.6	19.3	19.6	14.8	16.9	14.6	10.1
8	Győr-Moson-Sopron	5.8	7.7	6.8	6.3	8.1	10.3	15.5	19.4	17.3	16.8	16.6	16.9
9	Hajdű-Bihar	4.1	3.5	3.7	3.2	2.4	2.3	2.2	1.8	1.7	1.8	2.0	2.1
10	Heves	1.8	1.8	1.4	1.5	1.5	1.5	1.5	1.3	1.5	1.6	1.8	1.8
11	Komárom-Esztergom	1.5	1.6	1.8	2.1	3.9	3.7	3.2	2.6	5.5	7.9	8.1	10.4
12	Nógrád	1.4	1.4	1.6	1.4	1.3	1.0	0.9	1.1	1.3	1.0	1.0	1.0
13	Pest	2.6	3.3	3.8	3.8	4.2	4.7	6.1	6.3	9.0	4.3	4.7	7.7
14	Somogy	1.6	1.3	2.0	2.9	2.4	3.0	2.8	2.8	3.2	5.2	10.1	7.8
15	Szabolcs-Szatmár-Bereg	2.9	3.0	3.2	2.6	2.2	1.9	2.0	2.3	2.6	2.7	2.7	2.9
16	Jász-Nagykun-Szolnok	3.5	3.0	3.1	3.2	2.8	2.6	2.1	2.2	2.2	2.2	2.1	2.1
17	Tolna	2.9	2.0	2.0	1.9	1.6	1.2	1.1	1.1	0.9	0.8	0.8	0.6
18	Vas	4.2	4.9	5.2	5.6	12.9	9.9	10.4	10.3	7.7	7.1	5.8	6.0
19	Veszprém	3.2	3.0	3.7	4.3	2.9	2.5	2.2	2.2	2.3	2.2	2.2	2.6
20	Zala	2.1	2.4	2.1	2.0	1.6	1.2	1.1	1.1	1.0	0.9	0.8	0.8

Table A.17: Average number of export markets served and imports served by

Year	Average number of export markets served	Average Number of import market served by
1992	3.38	3.12
1993	3.36	3.27
1994	3.41	3.41
1995	3.45	3.63
1996	3.54	3.87
1997	3.58	4.34
1998	3.61	4.66
1999	3.65	4.85
2000	3.76	4.98
2001	3.79	5.04
2002	3.83	5.08
2003	3.98	5.25

unweighted average

Table A.18: Top 15 Export partners by volume of trade in 1992, 1999 and 2003

year	country	exports (Bn. HUF)	ship-ments	firms	products	share %
1992						
	Germany	154.3	10983	1974	2217	30.8
	Austria	55.4	5015	1326	1734	11.0
	Italy	44.4	2235	711	1028	8.8
	United States of America	19.7	1118	359	633	3.9
	France	19.3	1672	453	772	3.9
	Soviet Union	19.1	905	282	548	3.8
	Russian Federation	14.3	894	254	469	2.9
	United Kingdom	12.8	960	373	624	2.5
	Belgium and Luxembourg	11.6	810	291	516	2.3
	Czechoslovakia	11.5	2243	716	1111	2.3
	Netherlands	10.6	1277	431	713	2.1
	Switzerland	9.1	1374	470	747	1.8
	Turkey	8.9	243	106	200	1.8
	Spain	7.2	328	159	252	1.4
	Poland	6.7	729	297	469	1.3
1999						
	Germany	2157.7	25032	2942	2792	40.4
	Austria	480.6	10567	1917	2160	9.0
	United States of America	301.6	2126	577	977	5.6
	Italy	290.7	5783	1122	1662	5.4
	Netherlands	289.0	2696	694	1131	5.4
	United Kingdom	254.6	2720	631	1109	4.8
	France	250.3	4141	780	1275	4.7
	Belgium and Luxembourg	170.0	2143	493	977	3.2
	Poland	101.7	2631	720	1136	1.9
	Spain	88.6	955	343	536	1.7
	Romania	77.4	7532	1320	2116	1.4
	Czech Republic	75.3	2681	775	1163	1.4
	Russian Federation	66.1	1815	400	762	1.2
	Switzerland	61.4	2620	714	1081	1.2
	Ireland	58.7	294	122	218	1.1
2003						
	Germany	2972.2	27227	3291	2815	35.9
	Austria	567.5	11790	2080	2241	6.9
	France	493.6	5409	981	1427	6.0
	Italy	467.8	6614	1262	1772	5.6
	United Kingdom	396.6	4146	835	1289	4.8
	Netherlands	328.0	3510	840	1278	4.0
	Sweden	295.9	1981	557	853	3.6
	United States of America	274.7	3351	714	1197	3.3
	Spain	249.1	1729	467	789	3.0
	Belgium and Luxembourg	202.4	2644	612	1044	2.4
	Poland	188.0	2972	799	1250	2.3
	Czech Republic	165.3	3894	1038	1409	2.0
	Slovakia	161.8	5639	1409	1790	2.0
	Romania	161.4	11065	1657	2448	1.9
	Russian Federation	118.6	1976	416	870	1.4

Table A.19: Top 15 Import partners by volume of trade in 1992, 1999 and 2003

year	country	imports (Bn. HUF)	ship- ments	firms	products	share %
1992						
	Germany	93.8	45233	2759	3501	28.4
	Austria	47.4	25086	2092	2967	14.3
	Russian Federation	25.7	265	115	193	7.8
	Italy	24.3	9703	1287	2005	7.4
	Soviet Union	14.7	478	173	334	4.5
	Czechoslovakia	12.0	2452	780	1075	3.6
	France	10.8	5211	718	1595	3.3
	Netherlands	9.8	3818	590	1463	3.0
	Switzerland	9.3	5598	723	1663	2.8
	Belgium and Luxembourg	8.8	2577	407	1139	2.7
	United States of America	8.6	3191	545	1230	2.6
	United Kingdom	8.5	3377	677	1329	2.6
	Poland	6.3	396	179	278	1.9
	Sweden	4.8	2449	415	1014	1.4
	Ukraine	4.4	256	120	189	1.3
1999						
	Germany	1500.7	103134	4189	3822	34.4
	Austria	461.4	31590	2521	2872	10.6
	Italy	303.2	33467	2729	2932	7.0
	Russian Federation	249.9	746	257	467	5.7
	Japan	193.8	9086	1085	1514	4.4
	France	167.1	15408	1655	2491	3.8
	United States of America	127.8	16164	1638	2171	2.9
	Belgium and Luxembourg	105.3	7201	1022	1800	2.4
	United Kingdom	102.0	11871	1559	2083	2.3
	Netherlands	95.5	9343	1281	2036	2.2
	China	91.0	3769	773	1143	2.1
	Singapore	89.1	1120	205	352	2.0
	Taiwan	61.1	3214	697	826	1.4
	Switzerland	56.9	9785	1413	1827	1.3
	Korea	55.1	1529	417	603	1.3
2003						
	Germany	1846.1	105438	4945	3849	28.8
	China	485.2	8483	1345	1650	7.6
	Austria	422.2	30345	2749	2812	6.6
	Italy	405.9	36719	3247	3070	6.3
	Russian Federation	358.0	675	274	397	5.6
	Japan	339.0	11268	1242	1544	5.3
	France	265.0	16928	1962	2528	4.1
	United States of America	203.8	17534	1787	2106	3.2
	Korea	178.8	2603	568	889	2.8
	Poland	151.0	3959	1113	1303	2.4
	United Kingdom	135.9	12752	1706	2094	2.1
	Czech Republic	118.1	6198	1519	1626	1.8
	Malaysia	114.2	1790	351	424	1.8
	Taiwan	112.3	4891	968	951	1.8
	Netherlands	106.4	10115	1508	2036	1.7

Table A.20: Top 15 Export partners by number of trading firms in 1992, 1999 and 2003

year	country	exports (Bn. HUF)	ship-ments	firms	products	share %
1992						
	Germany	154.3	10983	1974	2217	30.8
	Austria	55.4	5015	1326	1734	11.0
	Czechoslovakia	11.5	2243	716	1111	2.3
	Italy	44.4	2235	711	1028	8.8
	Switzerland	9.1	1374	470	747	1.8
	France	19.3	1672	453	772	3.9
	Romania	6.4	1915	438	916	1.3
	Netherlands	10.6	1277	431	713	2.1
	Sweden	6.3	1008	386	582	1.3
	United Kingdom	12.8	960	373	624	2.5
	United States of America	19.7	1118	359	633	3.9
	Poland	6.7	729	297	469	1.3
	Belgium and Luxembourg	11.6	810	291	516	2.3
	Soviet Union	19.1	905	282	548	3.8
	Russian Federation	14.3	894	254	469	2.9
1999						
	Germany	2157.7	25032	2942	2792	40.4
	Austria	480.6	10567	1917	2160	9.0
	Romania	77.4	7532	1320	2116	1.4
	Italy	290.7	5783	1122	1662	5.4
	Slovakia	49.8	3552	1026	1413	0.9
	France	250.3	4141	780	1275	4.7
	Czech Republic	75.3	2681	775	1163	1.4
	Poland	101.7	2631	720	1136	1.9
	Switzerland	61.4	2620	714	1081	1.2
	Netherlands	289.0	2696	694	1131	5.4
	United Kingdom	254.6	2720	631	1109	4.8
	United States of America	301.6	2126	577	977	5.6
	Slovenia	39.8	1588	525	853	0.7
	Belgium and Luxembourg	170.0	2143	493	977	3.2
	Croatia	22.0	1755	493	959	0.4
2003						
	Germany	2972.2	27227	3291	2815	35.9
	Austria	567.5	11790	2080	2241	6.9
	Romania	161.4	11065	1657	2448	1.9
	Slovakia	161.8	5639	1409	1790	2.0
	Italy	467.8	6614	1262	1772	5.6
	Czech Republic	165.3	3894	1038	1409	2.0
	France	493.6	5409	981	1427	6.0
	Switzerland	101.2	3646	864	1306	1.2
	Netherlands	328.0	3510	840	1278	4.0
	United Kingdom	396.6	4146	835	1289	4.8
	Poland	188.0	2972	799	1250	2.3
	Serbia and Montenegro	45.3	3452	746	1543	0.5
	United States of America	274.7	3351	714	1197	3.3
	Croatia	63.6	2923	703	1315	0.8
	Belgium and Luxembourg	202.4	2644	612	1044	2.4

Table A.21: Top 15 Import partners by number of trading firms in 1992, 1999 and 2003

year	country	imports (Bn. HUF)	ship- ments	firms	products	share %
1992						
	Germany	93.8	45233	2759	3501	28.4
	Austria	47.4	25086	2092	2967	14.3
	Russian Federation	25.7	265	115	193	7.8
	Italy	24.3	9703	1287	2005	7.4
	Soviet Union	14.7	478	173	334	4.5
	Czechoslovakia	12.0	2452	780	1075	3.6
	France	10.8	5211	718	1595	3.3
	Netherlands	9.8	3818	590	1463	3.0
	Switzerland	9.3	5598	723	1663	2.8
	Belgium and Luxembourg	8.8	2577	407	1139	2.7
	United States of America	8.6	3191	545	1230	2.6
	United Kingdom	8.5	3377	677	1329	2.6
	Poland	6.3	396	179	278	1.9
	Sweden	4.8	2449	415	1014	1.4
	Ukraine	4.4	256	120	189	1.3
1999						
	Germany	1500.7	103134	4189	3822	34.4
	Italy	303.2	33467	2729	2932	7.0
	Austria	461.4	31590	2521	2872	10.6
	France	167.1	15408	1655	2491	3.8
	United States of America	127.8	16164	1638	2171	2.9
	United Kingdom	102.0	11871	1559	2083	2.3
	Switzerland	56.9	9785	1413	1827	1.3
	Netherlands	95.5	9343	1281	2036	2.2
	Czech Republic	48.4	4136	1225	1393	1.1
	Japan	193.8	9086	1085	1514	4.4
	Belgium and Luxembourg	105.3	7201	1022	1800	2.4
	Slovakia	52.8	2557	928	1005	1.2
	Spain	51.7	3719	854	1310	1.2
	China	91.0	3769	773	1143	2.1
	Poland	45.6	2210	754	985	1.0
2003						
	Germany	1846.1	105438	4945	3849	28.8
	Italy	405.9	36719	3247	3070	6.3
	Austria	422.2	30345	2749	2812	6.6
	France	265.0	16928	1962	2528	4.1
	United States of America	203.8	17534	1787	2106	3.2
	United Kingdom	135.9	12752	1706	2094	2.1
	Switzerland	77.7	10966	1591	1796	1.2
	Czech Republic	118.1	6198	1519	1626	1.8
	Netherlands	106.4	10115	1508	2036	1.7
	China	485.2	8483	1345	1650	7.6
	Japan	339.0	11268	1242	1544	5.3
	Belgium and Luxembourg	82.8	7283	1225	1725	1.3
	Slovakia	99.6	3540	1198	1169	1.6
	Spain	88.7	5225	1154	1557	1.4
	Poland	151.0	3959	1113	1303	2.4

Table A.22: Top 15 Export partners by volume with pre-transition geopolitical entities 1992, 1999 and 2003

year	country	exports (Bn. HUF)	ship-ments	firms	products	share %
1992						
	Germany	154.3	10983	1974	2217	30.8
	Austria	55.4	5015	1326	1734	11.0
	Italy	44.4	2235	711	1028	8.8
	"Soviet Union"	41.8	3213	520	1089	8.3
	United States of America	19.7	1118	359	633	3.9
	France	19.3	1672	453	772	3.9
	"Yugoslavia"	14.2	1479	388	699	2.8
	United Kingdom	12.8	960	373	624	2.5
	Belgium and Luxembourg	11.6	810	291	516	2.3
	"Czechoslovakia"	11.5	2243	716	1111	2.3
	Netherlands	10.6	1277	431	713	2.1
	Switzerland	9.1	1374	470	747	1.8
	Turkey	8.9	243	106	200	1.8
	Spain	7.2	328	159	252	1.4
	Poland	6.7	729	297	469	1.3
1999						
	Germany	2157.7	25032	2942	2792	40.4
	Austria	480.6	10567	1917	2160	9.0
	United States of America	301.6	2126	577	977	5.6
	Italy	290.7	5783	1122	1662	5.4
	Netherlands	289.0	2696	694	1131	5.4
	United Kingdom	254.6	2720	631	1109	4.8
	France	250.3	4141	780	1275	4.7
	Belgium and Luxembourg	170.0	2143	493	977	3.2
	"Soviet Union"	125.3	6249	766	1452	2.3
	"Czechoslovakia"	125.1	6233	1361	1762	2.3
	"Yugoslavia"	104.3	6594	1076	1842	2.0
	Poland	101.7	2631	720	1136	1.9
	Spain	88.6	955	343	536	1.7
	Romania	77.4	7532	1320	2116	1.4
	Switzerland	61.4	2620	714	1081	1.2
2003						
	Germany	2972.2	27227	3291	2815	35.9
	Austria	567.5	11790	2080	2241	6.9
	France	493.6	5409	981	1427	6.0
	Italy	467.8	6614	1262	1772	5.6
	United Kingdom	396.6	4146	835	1289	4.8
	Netherlands	328.0	3510	840	1278	4.0
	"Czechoslovakia"	327.1	9533	1863	2110	3.9
	Sweden	295.9	1981	557	853	3.6
	United States of America	274.7	3351	714	1197	3.3
	Spain	249.1	1729	467	789	3.0
	"Soviet Union"	222.7	7442	850	1666	2.7
	"Yugoslavia"	216.1	10125	1418	2252	2.6
	Belgium and Luxembourg	202.4	2644	612	1044	2.4
	Poland	188.0	2972	799	1250	2.3
	Romania	161.4	11065	1657	2448	1.9

Table A.23: Top 15 Import partners by volume with pre-transition geopolitical entities 1992, 1999 and 2003

year	country	imports (Bn. HUF)	ship-ments	firms	products	share %
1992						
	Germany	93.8	45233	2759	3501	28.4
	Austria	47.4	25086	2092	2967	14.3
	"Soviet Union"	45.7	1077	288	535	13.8
	Italy	24.3	9703	1287	2005	7.4
	"Czechoslovakia"	12.0	2452	780	1075	3.6
	France	10.8	5211	718	1595	3.3
	Netherlands	9.8	3818	590	1463	3.0
	Switzerland	9.3	5598	723	1663	2.8
	Belgium and Luxembourg	8.8	2577	407	1139	2.7
	United States of America	8.6	3191	545	1230	2.6
	United Kingdom	8.5	3377	677	1329	2.6
	Poland	6.3	396	179	278	1.9
	"Yugoslavia"	5.2	713	263	422	1.6
	Sweden	4.8	2449	415	1014	1.4
	Finland	4.2	776	240	415	1.3
1999						
	Germany	1500.7	103134	4189	3822	34.4
	Austria	461.4	31590	2521	2872	10.6
	Italy	303.2	33467	2729	2932	7.0
	"Soviet Union"	291.5	1617	529	760	6.7
	Japan	193.8	9086	1085	1514	4.4
	France	167.1	15408	1655	2491	3.8
	United States of America	127.8	16164	1638	2171	2.9
	Belgium and Luxembourg	105.3	7201	1022	1800	2.4
	United Kingdom	102.0	11871	1559	2083	2.3
	"Czechoslovakia"	101.3	6693	1729	1756	2.3
	Netherlands	95.5	9343	1281	2036	2.2
	China	91.0	3769	773	1143	2.1
	Singapore	89.1	1120	205	352	2.0
	Taiwan	61.1	3214	697	826	1.4
	Switzerland	56.9	9785	1413	1827	1.3
2003						
	Germany	1846.1	105438	4945	3849	28.8
	"Soviet Union"	503.0	2013	659	821	7.8
	China	485.2	8483	1345	1650	7.6
	Austria	422.2	30345	2749	2812	6.6
	Italy	405.9	36719	3247	3070	6.3
	Japan	339.0	11268	1242	1544	5.3
	France	265.0	16928	1962	2528	4.1
	"Czechoslovakia"	217.7	9738	2145	2000	3.4
	United States of America	203.8	17534	1787	2106	3.2
	Korea	178.8	2603	568	889	2.8
	Poland	151.0	3959	1113	1303	2.4
	United Kingdom	135.9	12752	1706	2094	2.1
	Malaysia	114.2	1790	351	424	1.8
	Taiwan	112.3	4891	968	951	1.8
	Netherlands	106.4	10115	1508	2036	1.7

Table A.24: Description of the Wholesale and Resale sectors

NACE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
50	Sale, maintenance and repair of motor vehicles; retail sale of automotive fuel											
51	Wholesale trade and commission trade											
52	Retail trade, repair of personal and household goods											
Number of firms												
50	2036	2620	3296	3934	4393	5007	5337	5323	3233	3271	3587	3700
51	10927	13362	15774	17678	19150	21013	21854	21572	13025	12972	13434	13230
52	6197	7495	8803	10405	11769	13431	14627	14976	7236	7457	7592	7492
Share of exporters (%)												
50	16.1	13.4	11.1	12.3	11.1	10.5	10.7	9.5	15.6	18.4	16.5	17.5
51	27.3	24.4	23.2	22.6	20.2	19.4	19.8	19.2	33.6	39.8	37.8	38.1
52	11.2	9.3	8.6	8.2	7.3	6.5	6.8	6.3	14.0	16.4	15.1	14.0
Share of total export volume (%)												
50	1.4	1.7	1.6	1.4	0.5	0.3	0.3	0.3	0.3	0.3	0.2	0.2
51	15.2	13.7	11.7	12.6	8.2	7.7	6.6	5.5	5.6	5.5	5.1	4.8
52	1.1	2.2	1.2	0.6	0.5	0.3	0.3	0.3	0.4	0.4	0.4	0.4
Average number of Destinations												
50	1.7	1.8	2.2	2.3	2.3	2.2	2.3	2.2	2.2	2.3	2.3	2.3
51	2.4	2.4	2.3	2.3	2.4	2.4	2.4	2.5	2.5	2.5	2.6	2.6
52	2.0	2.0	1.9	1.8	1.9	1.9	1.9	2.0	2.0	2.0	2.0	1.9
Average number of product categories exported												
50	6.8	7.4	10.2	9.5	11.2	13.1	15.1	15.7	16.2	15.3	17.3	14.0
51	6.1	5.9	6.1	5.9	6.1	6.1	6.6	6.8	7.0	7.3	7.4	7.2
52	5.3	4.6	5.0	4.8	6.0	6.4	6.5	6.4	6.8	6.7	8.2	7.8
Share of importers (%)												
50	45.0	41.4	37.4	30.2	24.2	21.4	20.6	20.4	36.3	44.3	45.7	47.6
51	46.3	44.3	41.7	37.9	35.1	33.3	33.9	34.1	58.0	61.3	62.9	66.0
52	28.8	25.3	23.0	19.4	16.9	15.9	15.6	15.6	32.6	34.5	35.7	37.3
Share of total import volume (%)												
50	5.4	7.4	7.0	5.6	4.5	5.0	5.3	5.4	4.9	5.3	6.2	6.5
51	27.6	30.5	29.8	25.8	23.9	22.8	21.3	19.4	18.9	19.3	20.4	21.3
52	4.3	4.4	4.0	3.3	2.5	2.5	2.6	2.4	2.2	2.2	2.4	2.3
Average number of origins												
50	3.0	2.8	3.0	3.3	3.6	4.5	4.7	4.7	5.0	5.0	5.0	5.2
51	3.1	3.2	3.2	3.4	3.7	4.1	4.4	4.6	4.7	4.8	4.9	5.0
52	2.5	2.7	2.7	3.1	3.3	3.7	4.0	4.2	4.5	4.5	4.5	4.5
Average number of product categories imported												
50	24.7	23.7	26.4	25.7	27.1	31.2	32.4	31.6	31.6	26.9	25.3	26.1
51	14.7	14.2	14.6	14.4	15.5	16.7	18.1	19.3	19.3	19.5	20.1	20.1
52	12.8	13.3	13.2	13.1	14.4	15.6	17.0	17.9	18.7	18.4	19.1	19.2

Appendix B

Appendix for Chapter 2

2.1 Appendix

2.1.1 Number of firms in the region

So far, we have used employment density as our main explanatory variable, proposing that employment is a good proxy for how likely it is that people can meet and exchange ideas. However, as Henderson (2003) argues, firm count may better grasp another aspect of firm-to-firm interactions: commerce and exchange of ideas by management rather than workers. To incorporate this idea, we introduce number of firms as additional controls.

Table B.1: Estimates using number of firms - separate samples FE

	firms trading					
Dep.Var.: TFP	never	always	never	always	never	always
num. firms	0.181**	0.275***				
	[0.0722]	[0.0907]				
num. firms (≥10)			0.0594	0.218**	0.0255	0.123*
			[0.0712]	[0.0838]	[0.0644]	[0.0696]
agglomeration					0.0501	0.145**
					[0.0340]	[0.0558]
size	0.0700***	0.168***	0.0690***	0.168***	0.0693***	0.161***
	[0.0201]	[0.0367]	[0.0203]	[0.0365]	[0.0202]	[0.0356]
foreign ownership	0.0203	0.0756***	0.0202	0.0787***	0.0204	0.0766***
	[0.0165]	[0.0183]	[0.0165]	[0.0182]	[0.0164]	[0.0181]
dummy: year	yes	yes	yes	yes	yes	yes
constant	yes	yes	yes	yes	yes	yes
firm FE	yes	yes	yes	yes	yes	yes
Observations	21958	23063	21950	23062	21950	23062
R-squared	0.022	0.089	0.021	0.089	0.022	0.09
Number of id	5638	3775	5638	3775	5638	3775

Standard errors in parentheses. All use Moulton errors.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Each column shows results from separate regressions. The first and third column use the sample of never trading firms, while the second and fourth that of always traders.

In order to investigate the importance of defining agglomeration in this manner, in Table B.1 we use the number of firms instead of employment density. Here, as past density would not properly instrument number of firms, we rely on fixed effects specification. As a first step, we only include the number of firms (in the first two columns). When using the number of firms as an agglomeration measure, we find that non-trading firms also show higher productivity in more dense environments, though the difference as a consequence of the high standard errors is not significant.

There may be several reasons why these two measures would yield different results. First, one could argue that employment density is more directly related to the thickness of the labor market and hence proxies spillovers taking place among employees. Instead, the number of firms approach grasps more the idea of technology spillovers among units of enterprizes. Another difference might stem from the fact that density variable is more sensitive to the presence of large firms than a variable that counts the number of firms. Firm count more closely measures the centrifugal force of competition which is especially true for smaller firms. However, for traders, local market competition should be less important as they partially compete on foreign markets. Competition on factor markets (such as labor and raw materials) remain an issue for all firms. In terms of the empirical investigation, there may be lot of very small firms with very imprecisely measured activity owing to a larger role of the grey economy. Hence, we also estimate separated sample fixed effects regressions for firms with employment size over 10. See column 3 and 4 of Table B.1. Results for the regression on the whole sample show a smaller difference between elasticities of traders and non-traders. Focusing on firms with at least 10 employees we found quite different elasticities. This is true when keeping both count and employment in the last two columns.[1]

2.1.2 The impact of large or multi-site firms

There may be several problems related to large firms possibly operating several sites or at least a separate HQ.

To see the size of the potential bias when other plants are not within the same micro-region, we can rely on another dataset. This data source comes from the annual labor survey (LFS) that covers all firms with at least 20 employees and a randomly selected set of small firms. In firms with at least 20 employees, one in ten employees is surveyed and the exact location of their workplace is duly noted. We look at this data for all years in our sample. We know from this sample that only 7-8 percent of firms have multiple sites, most multi-plant firms have two plants. On average, firms have 1.15 plants - so this is the maximum size of our bias. As for firms with more than one plant, the largest plant (which, in 80 percent of the cases, is also the site of the firm's headquarters) has 67 percent of the employees.

Table B.2: *Within firm share of identified location in matched LFS sample for 2002*

Number of location per firm in LFS	frequency in LFS sample	employment share of the location we identified in our sample / location
1	93%	100%
2	5%	88%
3	1%	78%
4	0.50%	59%
5 or more (avg. values)	0.50%	50%

Location refers to a micro-region

In Table C.1 we check the share of employment of a firm in the micro-region that we use as the identifier on the LFS sample. On a 2100 firm sample of 2002, it shows that 93 percent of the firms are within one micro-region. In the case when a firm is

[1] We also carried out several robustness checks on these results using trimmed samples generated by our previously described matching procedure and explicitly leaving out large and small firms. Results remained unchanged.

located in more than one micro-region, the one that we are able to identify holds 70-90 percent of the firm's employment. Finally, note that these figures mostly refer to firms with above 20 employees, and thus whole economy figures are much smaller, since the majority of firms are small and medium sized enterprizes. This suggests that our biases due to multi-plant firms are probably small: the bias is not larger than 5 percent. This reinforces the notion that headquarters in the case of manufacturing co-locate with the place of production with a higher probability.

2.1.3 Spatial lag estimation detailed

To control for this possible bias, spatial lag variables of employment and productivity are constructed in the following way. We take the manufacturing population and value added measures summed over the immediate neighboring micro-region and express the total log of total employment in the proximity and productivity as log of total VA per the total employment. Thus each micro-region's immediate neighborhood is accounted for.

$$\text{SL-agglomeration}_{rt} = ln \sum_{it} \mathbf{I} \text{ employment}_{it} \tag{B.1}$$

$$\text{SL-productivity}_{rt} = ln \frac{\sum_{it} \mathbf{I} \text{ va}_{it}}{\sum_{i} \mathbf{I} \text{ employment}_{it}} \tag{B.2}$$

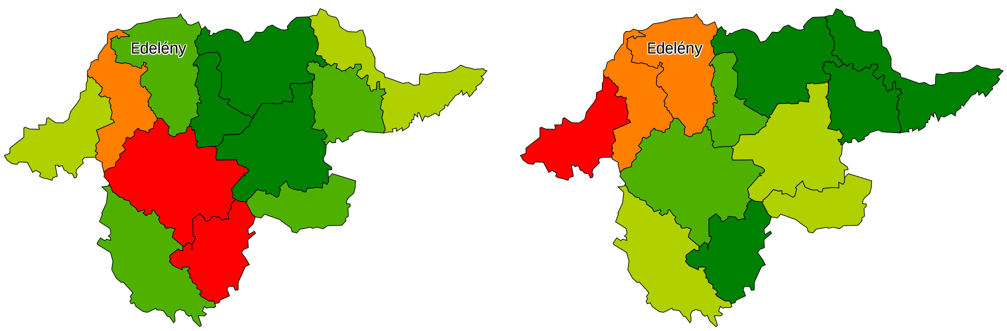
where, va is firm level value added and $\mathbf{I}$ is an indicator function, which takes up value one if a firm is located in the micro-region next to r and SL prefix is used for spatial lag. Adding spatial dependence variables, the specification to be estimated by fixed effects becomes:

$$\begin{aligned} lnTFP_{it} &= \alpha_1 \text{agglomeration}_{rt} + \alpha_{ctrls} \text{controls}_{it} \\ &+ \alpha_{SLA} \text{ SL-agglomeration}_{rt} + \alpha_{SLP} \text{ SL-productivity}_{rt} \\ &+ v_r + \nu_i + \tau_t + \epsilon_{it} \end{aligned} \tag{B.3}$$

Figure B.1 provides an illustration of the spatial autocorrelation problem and also helps to understand the creation of spatial lag variables (we use SL prefix for spatial lag). On the left side of the figure, one can see the 9 micro-regions of Borsod county colored according to the distribution of manufacturing employment in 1999. Borsod is in the north-east of Hungary, all borderlines to the north are also the national borders with Slovakia. We pick a micro-region, Edelény, as all its neighbors are within Borsod county. As pointed out by the arrow on the left side of the graph, Edelény is surrounded by two very dense regions in the west and south-west. Thus Edelény, though itself not that populated, can actually be considered as part of a broader agglomerated region.

On the right side of Figure B.1, the micro-regions of Borsod county are shaded according to the density of their neighbors, the SL variables. Edelény is now more heavily shaded, indicating its proximity to densely populated regions.

Figure B.1: Creating SL variables: Example Borsod county densities 1999



(a) agglomeration (b) SL-agglomeration

Panel a) shows the spatial distribution of manufacturing employment (in logs) in Borsod county. Panel b) shows the distribution of manufacturing employment of the neighboring micro-regions calculated for each region (in logs). The darker shades imply higher agglomeration.

Table B.3: Agglomeration elasticities by trading activity - separate samples

Dep. Var.: TFP	firms trading	
	never	always
agglomeration	0.0199	0.111***
	[0.0204]	[0.0390]
SL - agglomeration	0.0443	0.0374
	[0.0304]	[0.0406]
SL - productivity	0.00871	0.021
	[0.0197]	[0.0362]
foreign own.	-0.0163	0.411***
	[0.0233]	[0.0307]
instrument:		
ln Pop dens 1880	yes	yes
dummy: sector	yes	yes
dummy: nuts 3	yes	yes
dummy: year	yes	yes
First stage: F-stat	45.92	39.13
First stage: R-sq.	0.8644	0.8723
Cragg-Donald Stat.	7291.11	6003.51
Kleibergen-Paap stat.	45.92	39.13
Stock-Wright LM S stat.	0.87	9.59***
F-stat.	129.33	105.94
Observations	25588	23409
R-squared	0.145	0.246

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Moulton corr. standard errors in parentheses

Each column show the results from regression eq.2.7 on two separate samples of firms: never traders and always traders.

2.1.4 Productivity estimation

This section describes the productivity estimation approached we used. To address econometric problems arising from selection, input endogeneity and that of trade status we used a modified version of the estimation method proposed by Olley and Pakes (1996), (OP). We start the following Cobb-Douglas production function using indices i for the firm and t for time.

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \omega_{it} + \epsilon_{it} \tag{B.4}$$

where y_{it}, k_{it}, l_{it}, m_{it} denote the natural logarithm of value-added, capital, labour. Productivity is denoted by ω_{it} and ϵ_{it} stands for the measurement error in output. Productivity is assumed to follow a first order Markov process:

$$\omega_{i,t+1} = E[\omega_{i,t+1}|\omega_{i,t}] + \eta_{i,t+1} \tag{B.5}$$

with η_{it} being an exogenous shock process.

Estimating equation [B.4] by OLS entails several problems. First, due to the annual periodicity of the data, it is safe to assume, that firms get a fair perception of productivity process for the period at beginning of the year and are able to change their decision on input choices accordingly. That is, k_{it}, l_{it} are correlated with ω_{it}, which makes estimation biased and inconsistent.

Secondly, every year firms whose productivity falls below a certain threshold will be forced to shut down. This implies, that next year productivity distribution will be of a selected sample of the surviving firms. Ignoring the selection problems will again bias the estimation of the input coefficients. Thirdly, as internalisation plays primary role in our analysis we need to consider the possibility that investment and exit behaviour of the firm is correlated with its export and import status. Furthermore, trading firms, especially importers face different input prices. Exchange rate changes over the examined period might induce a measurement error in the prices used in the estimation. This problem raised by e.g. Amiti and Konings (2007).

To account for these issues we used two modifications to the standard OP procedure. On the one hand, when calculating value added, imported input values account for the changes in real exchange rate. On the other hand the OP procedure investment processes involves firms export and import status. Consequently, we also include trade variables in the investment decision. X will denote export status dummies, taking up one when the firms show activity of trade. The dummy for import activity was split to indicate trade from low and from high wage countries, ML_{it} and MH_{it} respectively. Modifications rewrite the standard OP estimation procedure in the following way.

The first stage of the OP method becomes:

$$y_{it} = \beta_l l_{it} + \beta_m m_{it} + \phi_{it}(i_{it}, k_{it}, X_{it}, ML_{it}, MH_{it}) + \epsilon_{it} \tag{B.6}$$

This regression gives consistent estimates of β_l and β_m. Since the functional form of $\phi(\cdot)$ is unknown, we use a linear model that includes full interaction term polynomials of the arguments. The estimation provides $\hat{\phi}$.

The second stage of the estimation, that control for the selection bias caused by low productivity firms exiting the sample gives the estimates of the remaining coefficients. The probability that a firm survives to t (s_t) can be expressed as being above a certain productivity threshold $\underline{\omega}_t$. The survival probability (P_t) can be estimated by probit regression as a polynomial function of capital and investment and trade status crossterms.

$$Pr(s_t = 1|\underline{\omega}_t(k_t)) = \varphi(i_{t-1}, k_{t-1}, X_{t-1}, ML_{t-1}, MH_{t-1}) \tag{B.7}$$

Rearranging B.4 and taking expectations given that the firm survived, we have:

$$E(y_{it} - \beta_l l_{it} - \beta_m m_{it}|k_{it}, s_t = 1) = \beta_0 + \beta_k k_{it} + E(\omega_{it}|\omega_{i,t-1}, s_t = 1) \tag{B.8}$$

Using the Markov property of productivity, and the notion that once survival and past productivity is realised k_{it} is known.

$$\begin{aligned} y_{it} - \beta_l l_{it} - \beta_m m_{it} &= \beta_k k_{it} + E(\omega_{it}|\omega_{i,t-1}, s_t = 1) + \\ &+ \omega_{i,t+1} - E[\omega_{i,t+1}|\omega_{i,t}] - \eta_{i,t+1} \\ &= \beta_k k_{it} + E(\omega_{it}|\omega_{i,t-1}, s_t = 1) + \xi_{it} - \eta_{i,t+1} \end{aligned} \tag{B.9}$$

where ξ_{it} is the surprise efficiency for surviving firms, which does not effect last period exit or investment choice. The remaining unknown $E(\omega_{it}|\omega_{i,t-1}, s_t = 1)$ is a function of past unobserved productivity and surviving probability. Olley and Pakes (1996) suggest to proxy these variables with the estimated survival probability and the lagged value of investment function estimated in the first stage:

$$y_{it} - \beta_l l_{it} - \beta_m m_{it} = \beta_k k_{it} + \theta(P_{t-1}, \phi_{i,t-1} - \beta_k k_{it}) + \nu_{it} + \epsilon_{i,t-1} \tag{B.10}$$

Using the estimated values of P_{t-1}, $\phi_{i,t-1}$ and of β_l, β_m from previous stages, expressing θ as polynomial of its components, one can estimate remaining coefficients running equation B.10. Using all estimated coefficients the log of TFP, as residual of the production function can be calculated:

$$tfp_{it} = y_{it} - \hat{\beta}_k k_{it} + \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it} \quad \text{(B.11)}$$

We carry out the estimation at 2 digit sector (TEAOR classification) level for the Hungarian manufacturing firms. The results from the modified OP estimation are shown in Table B.4.

Table B.4: *Production function coefficients*

		Labour	s.e.	Capital	s.e
15	Food products and beverages	0.8845	0.0107	0.3104	0.0734
16	Tobacco products	0.8845	0.0107	0.3104	0.0734
17	Textiles	0.7321	0.0215	0.3095	0.0857
18	Apparel	0.8650	0.0174	0.4240	0.1305
19	Leather	0.8924	0.0264	0.0948	0.0327
20	Wood	0.8481	0.0189	0.5433	0.1214
21	Pulp, paper	0.7069	0.0357	0.1003	0.0766
22	Publishing, printing	0.8454	0.0203	0.1837	0.0415
24	Chemicals	0.8446	0.0274	0.1180	0.0155
25	Rubber and plastic products	0.8466	0.0169	0.2484	0.0323
26	Non-metallic mineral products	0.8744	0.0214	0.4488	0.1087
27	Basic metals	0.9456	0.0348	0.1643	0.0270
28	Fabricated metal products	0.8997	0.0109	0.2946	0.0483
29	Machinery	0.8879	0.0121	0.2690	0.0549
30	Office machinery and computers	0.7875	0.0722	0.4669	0.0877
31	Electrical machinery	0.8412	0.0191	0.5793	0.0916
32	Radio, TV and communication	0.8734	0.0272	0.2439	0.0243
33	Medical, precision, optical	0.9406	0.0244	0.1098	0.0345
34	Motor vehicles	0.9975	0.0257	0.1010	0.0299
35	Other transport equipment	0.8359	0.0459	0.0638	0.0251
36	Furniture	0.8811	0.0199	0.4062	0.1066
37	Recycling	0.9002	0.0657	0.5169	0.3141

2.1.5 Additional Regression results

Table B.5: First stage regressions of Table 2.4

Dep.Var.: agglomeration	never	occasionally	always
iv 1880	2.071***	2.0256***	1.9194***
	[0.3099]	[0.3089]	[0.3088]
foreign ow.	-0.0694*	-0.0628**	0.0244***
	[0.0350]	[0.0285]	[0.0260]
dummy: region	yes	yes	yes
dummy: year	yes	yes	yes
F-stat of excluded IVs	44.65***	42.98**	38.62
F-stat	116.14***	90.34***	100.35***
R-squared	0.869	0.8698	0.866
Num. Obs.	25588	56686	23409

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Robust standard errors in parentheses

Table B.6: Localization vs urbanization by trading activity - separate samples FE

Dep. Var.: TFP	firms that trade in their time present		
	never	occasionally	always
localization	0.011	0.0354**	0.0370**
	[0.748]	[2.001]	[2.341]
urbanization	0.0345	0.0517	0.0930**
	[1.230]	[1.644]	[2.126]
for	-0.0222	0.00193	0.0727***
	[-1.097]	[0.0874]	[4.690]
dummy: year	yes	yes	yes
constant	yes	yes	yes
Observations	20125	47566	22384
R-squared	0.084	0.092	0.19
Number of id	5288	8110	3671

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Moulton corr. standard errors in parentheses

Each column show the results from regression eq.2.8 on three separate samples of firms: never traders, sometimes or occasionally traders and always traders.

Table B.7: Number of observations

year	all firms	traders
1992	6170	3429
1993	7043	3872
1994	7610	4209
1995	8084	4400
1996	8815	4868
1997	10031	5516
1998	10856	6014
1999	11295	6176
2000	10294	6614
2001	10230	6857
2002	10212	6830
2003	9977	6710

Table B.8: *Number of observation by year and trading activity*

year	num.	firms is trading		
	obs	never	sometimes	always
1992	6367	2174	2201	1991
1993	7287	2406	2993	1888
1994	7868	2559	3468	1841
1995	8365	2692	3827	1846
1996	9110	2958	4229	1923
1997	10362	3435	4880	2047
1998	11197	3808	5226	2163
1999	11654	3986	5445	2223
2000	10660	2374	5895	2391
2001	10587	2432	5823	2332
2002	10574	2508	5661	2405
2003	10337	2487	5402	2448

Table B.9: *Share of foreign firms by year and trading activity (%)*

year	firms is trading		
	never	sometimes	always
1992	41	51	74
1993	24	42	64
1994	17	38	60
1995	14	35	59
1996	12	33	55
1997	17	34	53
1998	14	31	52
1999	14	31	50
2000	9	26	46
2001	9	25	46
2002	9	24	44
2003	9	23	42

Foreign ownership is defined with over 0.5 percent of capital

Table B.10: Descriptive statistics of main variables.

Variable	Mean	s.d.	s.d. within firm	Min	Max
agglomeration	9.575	1.95	0.11	2.40	12.36
iv1880	0.285	1.24		-1.66	2.04
labor	62.594	293.46	97.17	4.00	13658
capital (ln)	5.096	2.35	0.27	-5.27	16.95
capital / labor	1.798	0.80	0.27	-2.94	9.61
TFP (Levinsohn Petrin)	-0.395	1.23	0.37	-11.51	4.83
TFP (Modified OP)	-1.375	1.54	0.37	-10.28	5.38

Table B.11: *Basic Geographical Description*

County	Area (km^2)	Population (mean)	Num.Districts
Budapest	525	1865321	1
Baranya	4430	406600	8
Bács-kiskun	8445	540004	10
Békés	5631	398598	6
Borsod-Abaúj-Zemplén	7247	741667	11
Csongrád	4263	426202	7
Fejér	4359	424703	7
Györ-Moson-Sopron	4208	432209	6
Hajdú-Bihar	6211	547807	7
Heves	3637	326300	6
Komárom-Esztergom	2265	313982	7
Nógrád	2544	220236	6
Pest	6393	1021686	14
Somogy	6036	335456	9
Szabolcs-Szatmár-Bereg	5937	574007	10
Jász-Nagykun-Szolnok	5582	416675	6
Tolna	3701	247895	5
Vas	3336	269367	9
Veszprém	4493	371070	9
Zala	3784	298131	6
	4651	508896	7.5

Figure B.2: The 150 micro-regions of Hungary and number of firms in 1999

Table B.12: *Firm size and frequency distribution over micro-region: pooled sample*

region	Number of firms			Employ.		region	Num. of firms			Employ.	
	median	min	max	me-dian	max		median	min	max	me-dian	max
Ajka	62	37	71	29	2313	Mezőkovácsháza	10	8	11	35	139
Aszód	28	15	34	12	1529	Mezőkövesd	28	16	31	17	783
Baja	68	43	81	13	1777	Miskolc	226	105	264	13	22851
Baktalórántháza	10	5	11	40	152	Mohács	56	24	63	18	673
Balassagyarmat	32	18	38	16	703	Monor	16	9	23	12	75
Balatonalmádi	29	13	33	17	2966	Mosonmagyaróvár	93	50	107	23	1476
Balatonfüred	11	6	13	8	87	Mátészalka	26	10	30	27	1136
Balmazújváros	11	3	13	26	282	Mór	28	11	31	33	3508
Barcs	19	12	20	14	508	Mórahalom	4	1	5	5	57
Berettyóújfalu	30	19	39	20	954	Nagyatád	15	4	17	12	269
Bicske	20	9	24	14.5	436	Nagykanizsa	59	23	65	25	1318
Bonyhád	26	15	29	20	1433	Nagykálló	15	10	19	30	337
Budapest	3138	2377	3716	12	22091	Nagykáta	42	15	45	15	885
Budaörs	170	97	203	11	960	Nyírbátor	13	7	16	19	403
Bácsalmás	6	6	7	40.5	248	Nyíregyháza	197	122	204	16	3447
Bátonyterenye	21	12	25	30	441	Orosháza	60	34	63	22	1701
Békéscsaba	146	95	156	18	1524	Oroszlány	15	5	19	13	4360
Cegléd	85	57	98	15	435	Paks	38	16	46	25.5	7761
Celldömölk	23	14	26	54.5	1463	Piliscsaba	106	69	132	13	1470
Csenger	6	2	8	21	560	Polgár	7	3	9	12.5	52
Csepreg	9	4	11	19.5	124	Pápa	62	25	67	22	1048
Csongrád	16	10	18	27	785	Pásztó	20	17	30	15.5	207
Csorna	22	7	27	25	448	Pécs	226	137	273	15	1313
Csurgó	8	4	10	32.75	349	Pécsvárad	9	4	11	22.5	55
Dabas	50	26	53	14	214	Pétervására	10	5	13	13	232
Debrecen	259	141	281	16	3254	Püspökladány	26	11	28	20.5	242
Dombóvár	35	11	38	16	820	Ráckeve	145	95	180	12	934
Dorog	31	23	35	23	1198	Rétság	22	16	25	25	886
Dunakeszi	63	46	74	12	1421	Salgótarján	65	47	77	15	1709
Dunaújváros	80	46	101	21	4769	Sarkad	5	3	7	26	129
Edelény	13	11	15	24	239	Sellye	5	2	6	15	171
Eger	108	45	115	15	1874	Siklós	15	5	20	15	751
Encs	5	4	6	22	369	Siófok	21	14	27	12	577
Enying	6	1	7	18	92	Sopron	108	57	119	16.5	5125
Esztergom	85	50	98	15	2185	Szarvas	38	23	44	30	1091
Fehérgyarmat	11	3	15	33	438	Szeged	217	138	245	15	1613
Fonyód	20	17	23	11	995	Szeghalom	18	10	22	23	615
Füzesabony	16	9	18	23	639	Szekszárd	77	44	84	18	676
Gyál	93	40	96	12	1082	Szentendre	87	73	114	12	375
Győr	234	100	263	15	9545	Szentes	24	15	28	35	1078
Gyöngyös	69	30	76	20	766	Szentgotthárd	22	4	25	46	1141
Gárdony	16	5	19	15	173	Szerencs	26	17	30	19	209
Gödöllő	119	66	133	14	4522	Szigetvár	16	8	21	29	527
Hajdúböszörmény	50	34	56	29.5	969	Szikszó	2	1	2	19	44
Hajdúszoboszló	26	10	28	11	182	Szob	11	6	12	20	373
Hatvan	38	24	42	22	837	Szolnok	128	68	151	18	4005
Heves	14	6	17	29	329	Szombathely	142	82	155	20	2997
Hódmezővásárhely	87	52	103	17	1489	Szécsény	18	10	20	18	1649
Jánoshalma	13	6	15	16	270	Székesfehérvár	232	97	251	16	8153
Jászberény	74	44	79	20	4121	Sárbogárd	3	2	4	39.5	1229
Kalocsa	45	20	50	18	355	Sárospatak	32	11	37	23	335
Kaposvár	86	46	94	16	953	Sárvár	27	11	33	24	2503
Kapuvár	25	13	26	27	692	Sásd	15	6	21	16	176
Karcag	75	41	84	28	990	Sátoraljaújhely	25	18	29	35	1478
Kazincbarcika	31	22	35	34	4527	Sümeg	15	7	17	16	224
Kecskemét	241	139	250	18	1129	Tab	11	9	15	47	10578
Keszthely	24	13	32	14.5	2215	Tamási	26	14	29	21	720
Kisbér	16	9	22	11	463	Tapolca	19	11	24	20	252
Kiskunfélegyháza	48	34	51	27	676	Tata	55	35	63	14	496
Kiskunhalas	44	30	51	15	338	Tatabánya	117	77	124	14	689
Kiskunmajsa	17	11	19	27	487	Tiszafüred	11	7	14	27	595
Kiskőrös	56	18	67	14	450	Tiszavasvári	9	7	12	32	2158
Kistelek	6	5	9	8	37	Tiszaújváros	46	14	50	21	7736
Kisvárda	12	10	13	49	815	Tét	13	8	14	12	1046
Komló	46	22	49	19	1071	Törökszentmiklós	28	14	31	27	421
Komárom	41	18	47	16	1810	Vasvár	8.5	5	11	31.5	275
Kunszentmiklós	18	14	21	30	215	Veszprém	119	57	131	14	2482
Kunszentmárton	18	7	20	20.5	400	Vác	74	42	82	15	2250
Kőszeg	14	7	17	34	1722	Várpalota	25	16	27	36.5	1634
Körmend	14	6	17	24	626	Vásárosnamény	10	3	12	39	304
Lengyeltóti	7	4	7	14	74	Zalaegerszeg	138	53	147	20	1884
Lenti	27	9	30	30	302	Zalaszentgrót	20	10	23	22	447
Letenye	10	4	14	21.5	235	Zirc	12	7	14	19	184
Makó	28	17	30	34	621	ózd	50	24	55	26	1087
Marcali	20	12	21	25	1082	őriszentpéter	9	6	10	26	261

Table B.13: Transition matrix for districts agglomeration decile position (1992-2002)

	Starting decile in 1993									
ending decile	1	2	3	4	5	6	7	8	9	10
1	80%	0%	7%	7%	7%					
2	13%	53%	27%		7%					
3	7%	20%	27%	33%		13%				
4		27%	20%	40%	13%					
5			13%	7%	47%	27%	7%			
6				13%	27%	47%	13%			
7			7%			13%	40%	33%	7%	
8							33%	60%	7%	
9							7%	7%	73%	13%
10								0%	13%	87%

Figure B.3: Over time st. deviation of agglomeration by density in 1992 in microregions

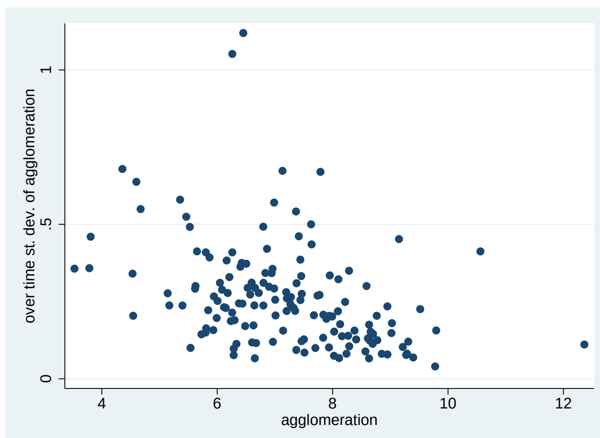
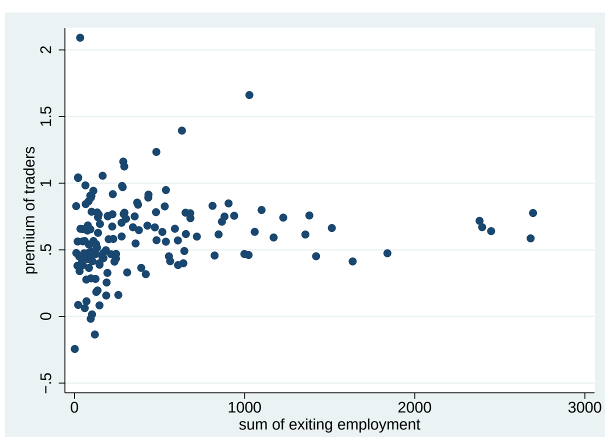


Figure B.4: Exiting employment vs. avg. traders premium in microregions



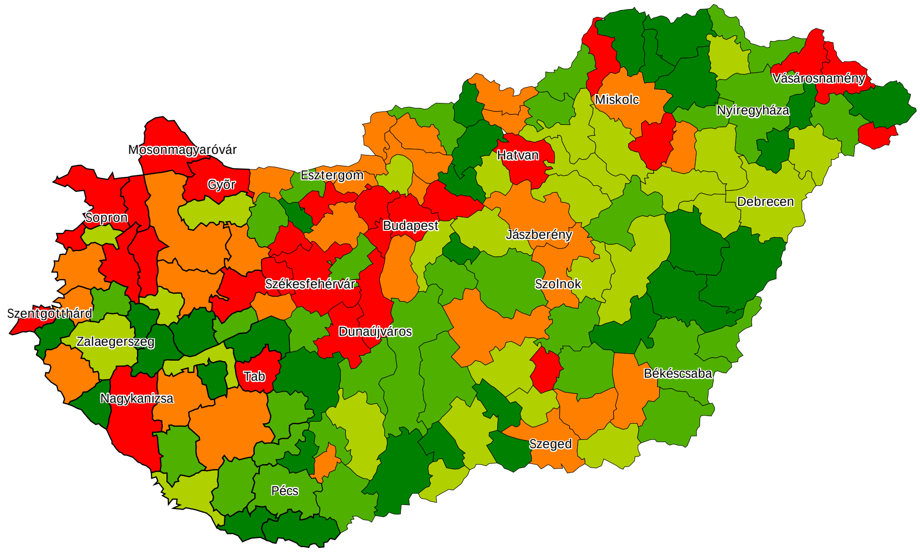


Figure B.5: Spatial distribution of Manufacturing Productivity 1999

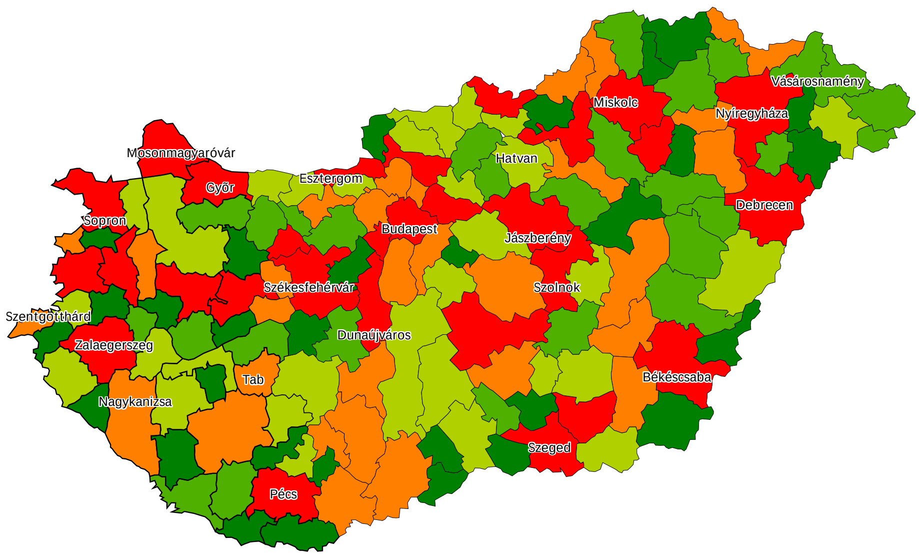


Figure B.6: Spatial distribution of Manufacturing Density 1999

Appendix C

Appendix for Chapter 3

3.1 Appendix

3.1.1 The impact of large or multi-site firms

There may be several problems related to large firms possibly operating several sites or at least a separate HQ.

To see the size of the potential bias when other plants are not within the same location, one can rely on another dataset. This data source comes from the annual labor survey (LFS) that covers all firms with at least 20 employees and a randomly selected set of small firms. In firms with at least 20 employees, one in ten employees is surveyed and the exact location of their workplace is duly noted.

I look at this data for all years in our sample. From this sample on learns that only 7-8 percent of firms have multiple sites, most multi-plant firms have two plants. On average, firms have 1.15 plants - so this is the maximum size of our bias. As for firms with more than one plant, the largest plant (which, in 80 percent of the cases, is also the site of the firm's headquarters) has 67 percent of the employees.

Table C.1: *Within firm share of identified location in matched LFS sample for 2002*

Number of location per firm in LFS	freq. if location is NUTS5	freq. if location is NUTS4
1	90.8%	91.1%
2	5.3%	5.3%
3	2.0%	1.7%
4	0.50%	0.6%
5 or more (avg. values)	0.2%	0.1%

In Table C.1 the share of employment of a firm in the settlement is checked and in the micro-region that I use as the identifier on the LFS sample. On a 2230 firm sample of 2002, it shows that 91 percent of the firms are within the same municipality and also in the same micro-region. In the case when a firm is located in more than one municipality the one that I am able to identify holds 65-70 percent of the firm's employment. Finally, note that these figures mostly refer to firms with above 20 employees, and thus whole economy figures are much smaller, since the majority of firms are small and medium sized enterprizes. This suggests that our biases due to multi-plant firms are probably small.

3.1.2 Additional tables and figures

Figure C.1: Percentage share of total export value in NUTS5 locations in 2000

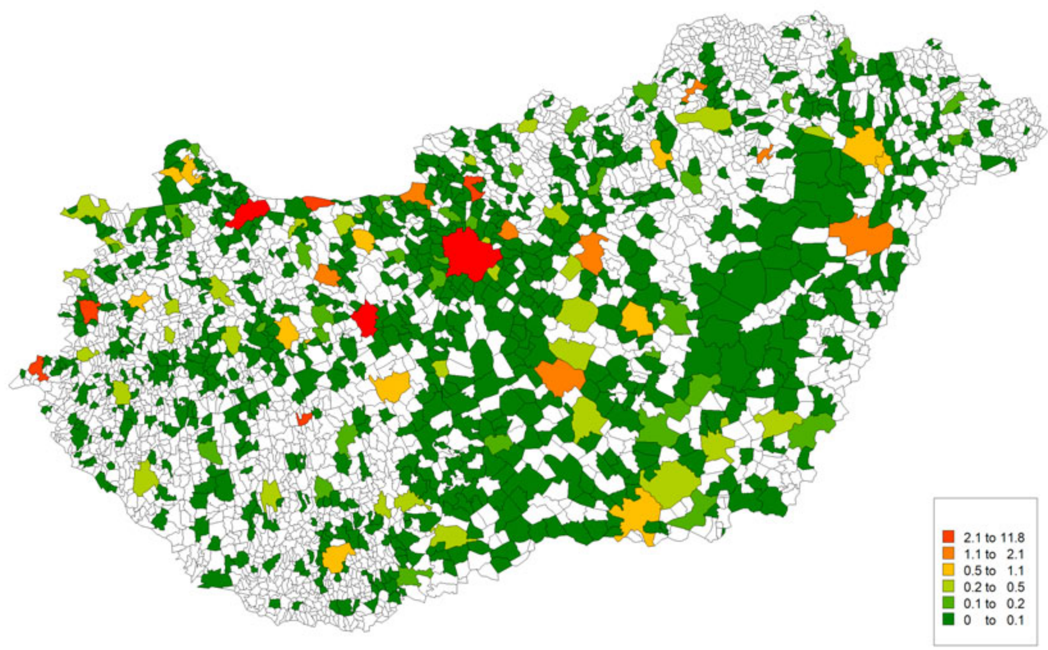


Figure C.2: Number of exporting firms in NUTS5 locations in 2000

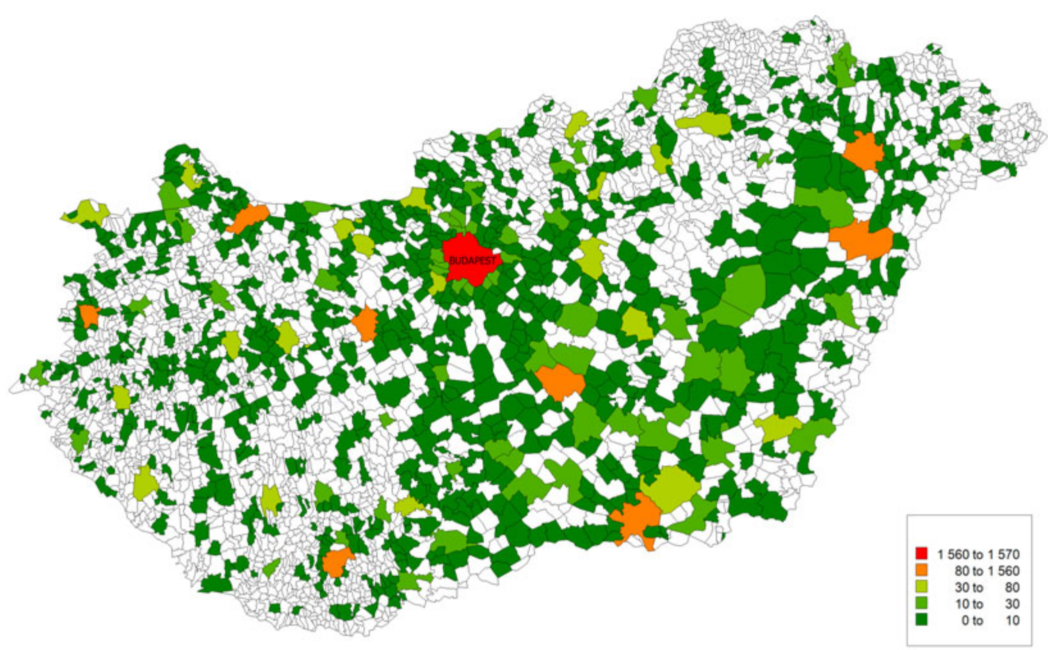


Table C.2: Collected estimates when spillover variables are included separately

Dep. Var.: Export entry	[1]	[2]	[3]	[4]	[5]
# of local firms exporting to					
another country and good	0.0068***				-0.0091***
	[0.0019]				[0.0024]
another country, same good		0.582***			0.420***
		[0.0864]			[0.0814]
same country, other good			0.0414***		0.0230***
			[0.00918]		[0.00758]
same country and product				5.236***	4.811***
				[0.420]	[0.439]

Moulton corr. standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
The Table collects results from 5 separate regressions. The left columns contain results from four logistic regressions with firm-country-product fixed effects when only one (indicated) spillover variable is included.

Table C.3: Estimations including value spillovers at the country - product level

Dep. Var.: Export entry	[1]	[2]
NUMBER of local firms exporting		
another country and good		-0.0198***
		[0.00660]
another country, same good		0.380***
		[0.0676]
same country, another good		0.0165
		[0.0131]
same country and good		4.383***
		[0.301]
VALUE of local firms' export		
another country and good	-0.00227*	-0.00144
	[0.00128]	[0.00153]
another country and good	0.00209**	0.00173*
	[0.000863]	[0.000973]
same country, another good	0.00273*	0.00284*
	[0.00154]	[0.00150]
same country and good	0.00383***	0.000904
	[0.000877]	[0.000816]
controls	yes	yes
dummy: year	yes	yes
dummy: product-country-firm	yes	yes
Observations	608,960	608,960
R-squared	0.028	0.028
Number of ID	133118	133118

Moulton corr. standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The Table collects results from 2 separate regressions. Both regressions include eight spillover variables: the four measuring the number of peers and four measuring the sum of traded value in logs. Controls include firm size, ownership and productivity, partner country GDP, year dummies and firm country product fixed effects.

Table C.4: Coefficients of same country, same product spillover

Dep. Var.: Export entry	[1]
1994-1997	5.900***
	[0.708]
1995-1998	7.431***
	[0.428]
1996-1999	7.370***
	[0.385]
1997-2000	5.661***
	[0.330]
1998-2001	5.710***
	[0.649]
1999-2002	8.447***
	[0.569]

Moulton corr. standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

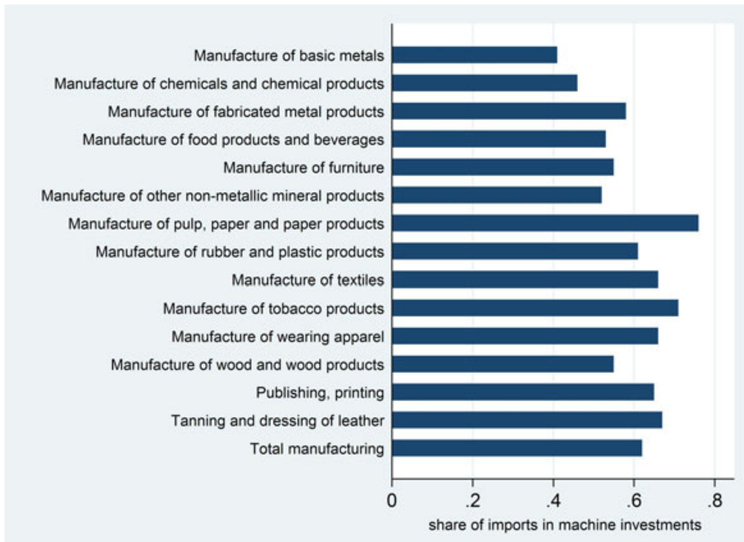
The Table collects results from 6 separate regressions for export entry. It reports only the coefficient on same country, same product spillovers. The specifications are equivalent to those of the last columns in Tables 3.6 only the time span is restricted to the indicated intervals.

Appendix D

Appendix for Chapter 4

4.1 Appendix

Figure D.1: The share of imports in the volume of machine investments, (1992-2003 average)



Source: Central Statistical Office, Hungary

Figure D.2: Number of imported machines by location

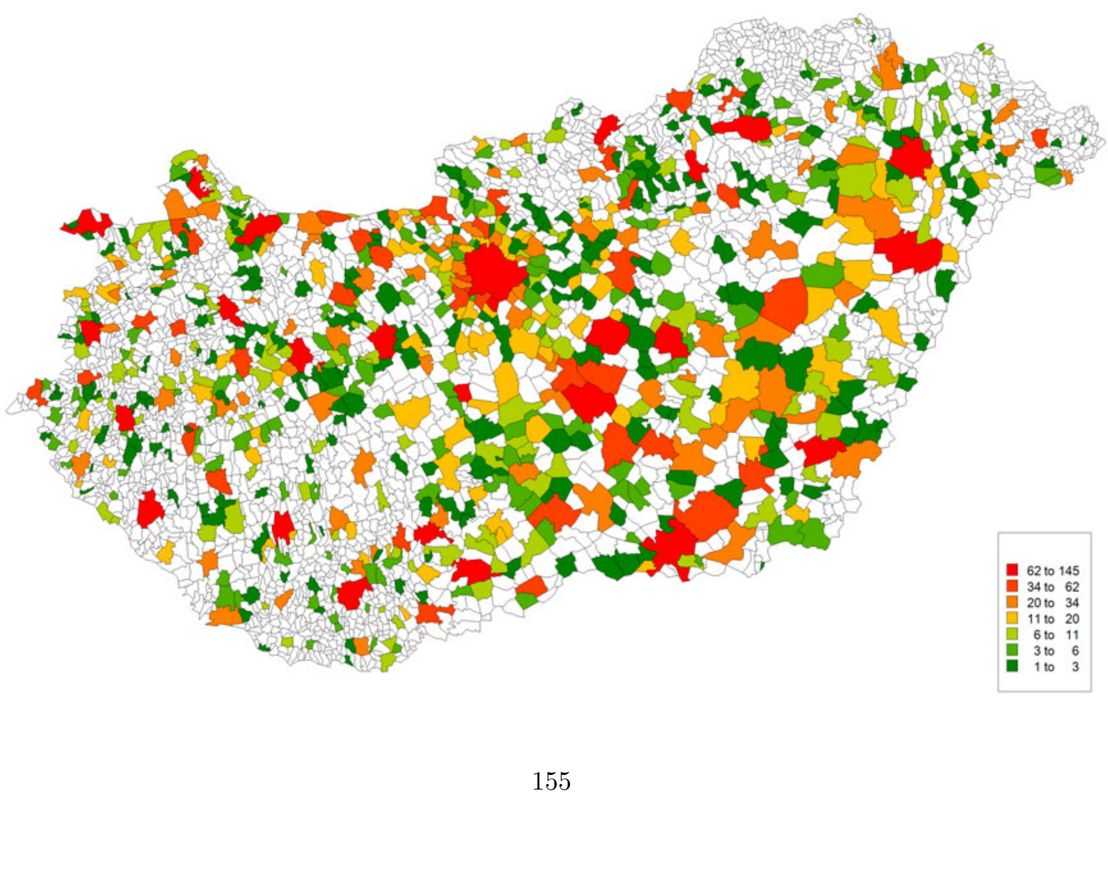


Table D.1: Countries investigated

Country	# of machines	country	# of machines
Austria	137		
Belgium	71	Croatia	2
Bulgaria	1	Luxembourg	1
Canada	4	Netherlands, the	74
Switzerland	113	Norway	1
China	17	New Zealand	1
Czech Republic	67	Poland	13
Germany	148	Portugal	2
Denmark	46	Romania	11
Spain	31	Russia	3
Finland	15	Sweden	58
France	123	Slovenia	5
Grat Britain	114	Slovakia	26
Ireland	1	Thailand	1
Israel	1	Turkey	3
India	1	Taiwan	23
Italy	143	Ukraine	1
Japan	76	United States	124

Table D.2: Machine import spillover estimation: Budapest excluded

dep. Var: import dummy	[1]	[2]	[3]	[4]
num. of prior importers of the same machine				
same NUTS4	3.593***	2.030***	1.925***	1.744***
	[0.309]	[0.293]	[0.285]	[0.285]
same NUTS3, other NUTS4	1.827***	1.844***	1.915***	1.908***
	[0.180]	[0.136]	[0.133]	[0.133]
controls	yes	yes	yes	yes
constant:	yes	yes	yes	yes
dummy: year	yes	yes	yes	yes
Observations	1714005	1278853	1278853	1267975
R-sqrd	0.003	0.009	0.01	0.01

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Moulton corrected s.e. in parentheses

Each columns contain results from three separate linear probability regressions as defined in eq. 4.2. Spillover variable is divided by 1000, all other control variables are lagged by one year. The control variables correspond to the controls of the same columns in Table 4.7

Table D.3: Regressions on machine spillover with various N definitions

dep. Var: import dummy N is:	2	3	4	∞
num. of prior importers of the same machine				
same NUTS4	1.621***	1.148***	0.859***	0.409***
	[0.0372]	[0.0310]	[0.0321]	[0.0150]
same NUTS3, other NUTS4	3.219***	2.527***	2.049***	1.076***
	[0.179]	[0.137]	[0.133]	[0.0664]
controls	yes	yes	yes	yes
dummy: year	yes	yes	yes	yes
Observations	1278777	1278777	1278777	1278777
R-squared	0.01	0.01	0.01	0.009

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Moulton corrected s.e. in parentheses

Each column represents a separate regression as in last column of Table 4.7. The columns only show the spillover coefficients. Spillover variable is divided by 1000, all other control variables are lagged by one year. The control variables correspond to the controls of the same columns in Table 4.7.

Table D.4: Machine spillover regressions: controls for location selection

dep. Var: import dummy established before	any date	1992	1990	1988
num. of domestic prior importers of the same machine in the				
same NUTS4	0.893***	1.198***	1.426***	1.305***
	[0.0287]	[0.127]	[0.171]	[0.151]
NUTS3, other NUTS4	2.074***	2.597***	2.388***	2.668***
	[0.113]	[0.210]	[0.509]	[0.730]
controls	yes	yes	yes	yes
dummy:year	yes	yes	yes	yes
Observations	1278777	274830	63889	22885
R-squared	0.01	0.007	0.007	0.012

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Moulton corrected t-statistics in parentheses

Each column show results from separate regressions. Controls: size, foreign ownership, TFP, local agglomeration, number of firms in NUTS4, all lagged. The first regression is identical to last regression of Table 4.7, the others have the same specification but exclude firms established later than indicated in the uppermost row.

Table D.5: Regressions on countries choices location-selection

dep. Var: import dummy established before	any date	1992	1990	1988
spillover variables:				
same NUTS4, same country	48.26***	36.87***	29.43***	38.74***
	[12.62]	[11.12]	[10.04]	[10.87]
same NUTS4, other country	-28.93***	-22.06***	-16.22**	-24.44***
	[7.563]	[7.662]	[7.481]	[8.387]
same NUTS3, same country	19.93***	17.52***	19.77***	7.277**
	[1.525]	[1.705]	[3.480]	[3.498]
same NUTS3, other country	2.758	3.123	2.133	10.63**
	[2.191]	[1.961]	[3.720]	[4.109]
Observations	6247918	2575051	593527	203752
R-squared	0.021	0.016	0.015	0.018

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Moulton corrected s.e. in parentheses

Each column contains a results from a separate regression. Controls: size, foreign ownership, TFP, local agglomeration, number of firms in NUTS5 and dummies for past export and import activities, all lagged. The first column replicates the last column of Table 4.9, while the other columns are the same specification estimated on samples defined by the birth date of the firm.

Table D.6: Regressions on countries choices by number of partner countries (C)

dep. Var: import dummy	[1]	[2]	[3]	[4]
sample	all firms	C≥3 & C≤5	C>5 & C≤10	C>10
spillover variables:				
same NUTS4, same country	48.13***	58.83**	48.54***	47.31***
	[12.58]	[23.41]	[16.26]	[10.18]
same NUTS4, other country	-28.99***	-18.95	-29.36**	-28.33***
	[7.673]	[12.02]	[11.57]	[5.728]
Number of Countries	-0.00940***			
	[0.00174]			
NUTS3 spillovers	yes	yes	yes	yes
controls:	yes	yes	yes	yes
dummy: year	yes	yes	yes	yes
Observations	6247918	40618	2251187	3956113
R-squared	0.021	0.034	0.022	0.021

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Moulton corrected s.e. in parentheses

Each column contains a results from a separate regression. Controls: size, foreign ownership, TFP, local agglomeration, number of firms in NUTS4, financial controls and dummies for past export and import activities, all lagged.

Table D.7: Regressions with countries and various fixed effects

Dep. Var.: import dummy	[1]	[2]	[3]	[4]
prior importers of the same machine				
same NUTS4, same country	48.24***	48.26***	47.74***	48.13***
	[12.76]	[12.62]	[12.84]	[12.75]
same NUTS4, other country	-28.67***	-29.20***	-28.62***	-28.51***
	[7.455]	[7.600]	[7.741]	[7.387]
same NUTS3, same country	20.09***	19.88***	19.18***	20.21***
	[1.693]	[1.689]	[1.674]	[1.706]
same NUTS3, other country	2.783	2.492	3.197	2.682
	[2.292]	[2.203]	[2.262]	[2.300]
FIXED EFFECTS	NUTS5	machine	country	firm
Controls	yes	yes	yes	yes
year dummies	yes	yes	yes	yes
Observations	6680137	6680137	6680137	6680137
R-squared	0.023	0.023	0.022	0.026
Estimation	LSDV	LSDV	LSDV	Within

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Moulton corrected t-statistics in parentheses.

Controls: size, foreign ownership, TFP, local agglomeration, number of firms in NUTS5 and dummies indicating past export of import experience with the given country.

Table D.8: Fixed effect models

Table	Col.	Model
Table 4.8		
	(1)	$y_{i(l)mt} = \beta^{‘} X_{i(l)m(t-1)} + \alpha_t + \alpha_l + \varepsilon_{imt}$
	(2)	$y_{i(l)mt} = \beta^{‘} X_{i(l)m(t-1)} + \alpha_t + \alpha_{ls} + \varepsilon_{imt}$
	(3)	$y_{i(l)mt} = \beta^{‘} X_{i(l)m(t-1)} + \alpha_t + \alpha_{lt} + \varepsilon_{imt}$
	(4)	$y_{i(l)mt} = \beta^{‘} X_{i(l)m(t-1)} + \alpha_{it} + \varepsilon_{imt}$
Table 4.10		
	(1)	$y_{i(l)cmt} = \beta^{‘} X_{i(l)cm(t-1)} + \alpha_t + \alpha_l + \varepsilon_{icmt}$
	(2)	$y_{i(l)cmt} = \beta^{‘} X_{i(l)cm(t-1)} + \alpha_t + \alpha_{ls} + \varepsilon_{icmt}$
	(3)	$y_{i(l)cmt} = \beta^{‘} X_{i(l)cm(t-1)} + \alpha_t + \alpha_{lc} + \varepsilon_{icmt}$
	(4)	$y_{i(l)cmt} = \beta^{‘} X_{i(l)cm(t-1)} + \alpha_t + \alpha_{lc} + \alpha_{ls} + \varepsilon_{icmt}$
Table 4.11		
	(1)	$y_{i(l)cmt} = \beta^{‘} X_{i(l)cm(t-1)} + \alpha_{lt} + \varepsilon_{icmt}$
	(2)	$y_{i(l)cmt} = \beta^{‘} X_{i(l)cm(t-1)} + \alpha_l + \alpha_{ts} + \varepsilon_{icmt}$
	(3)	$y_{i(l)cmt} = \beta^{‘} X_{i(l)cm(t-1)} + \alpha_l + \alpha_{tc} + \varepsilon_{icmt}$

Table D.9: List of machines 1.

sector	SITC code	Description
15	72123	Harvesting and threshing machinery; mowers
	72126	Machines for cleaning, sorting or grading eggs, fruit or other agricultural produce
	72127	Machines for cleaning, sorting or grading seed, grain or dried leguminous vegetables
	72129	Parts of the machines of headings 721.21 through 721.26
	72138	Dairy machinery
	72139	Parts for milking machines and dairy machinery
	72191	Presses, crushers used in the manufacture of wine, cider, fruit juices or similar beverages
	72196	Agricultural, horticultural, forestry or bee-keeping machinery
	72721	Machinery for the extraction or preparation of animal or fixed vegetable fats and oils
	72722	Machinery, n.e.s., for the industrial preparation or manufacture of food or drink
	72729	Parts for the food-processing machinery
	72849	Machinery having individual functions, n.e.s.
	74137	Bakery ovens (including biscuit ovens), non-electric
	74138	Other non-electric furnaces and ovens (including incinerators)
	74139	Parts for the furnaces and ovens of headings
	74143	Indsutrial use refrigerating or freezing chests , cabinets, display counters, showcases
	74145	Other refrigerating or freezing equipment; heat pumps
	74149	Parts of refrigerators, freezers and other refrigerating or freezing equipment (electric or other)
	74186	Driers, n.e.s.
	74187	Machinery for making hot drinks or for cooking or heating food
	74271	Pumps for liquids, n.e.s.
	74291	Parts for pumps
	74311	Vacuum pumps
	74359	Other centrifuges
	74361	Machinery for filtering or purifying water
	74362	Machinery for filtering or purifying beverages other than water
	74367	Machinery for liquids, n.e.s.
	74391	Parts of centrifuges (including centrifugal driers)
	74471	Pneumatic elevators and conveyers
	74473	Other continuous-action elevators and conveyors, bucket-type
	74474	Other continuous-action elevators and conveyors, belt-type
	74479	Continuous-action elevators and conveyers for goods or materials, n.e.s.
	74527	Other packing or wrapping machinery
	74529	Parts of Dishwashing machinery
	74531	Weighing machinery, including weight-operated counting and checking machines
	74565	Other appliances for projecting, dispersing or spraying liquids or powders
16	72843	Machinery for preparing or making up tobacco, n.e.s.
	72853	Parts for the machinery for preparing or making up tobacco
	74527	Other packing or wrapping machinery
17	72435	Other sewing-machines
	72442	Machines for preparing textile fibres
	72443	Textile-spinning, doubling or twisting machines; textile-winding (including weft-winding) or reeling machines
	72449	Machines for extruding, drawing, texturing (parts)
	72451	Weaving machines (looms)
	72452	Knitting-machines and stitch-bonding machines
	72453	Machines for making gimped yarn, tulle, lace, embroidery, trimmings, braid or net and machines for tufting
	72454	Machines for preparing textile yarns for weaving machines, knitting-machines, stitch-bonding
	72455	Machinery for the manufacture or finishing of felt or non-wovens
		.....

Table D.10: List of machines 2.

sector	SITC code	Description
17	72461	Auxiliary machinery for machines of Machines for extruding, drawing, texturing and weaving
	72467	Accessories of weaving machines (looms)
	72468	Accessories of machines for gimped yarn, tulle, lace
	72474	Indsutrial machinery for washing , cleaning, wringing, pressing etc.
18	72435	Other sewing-machines
	72439	Sewing-machine needles; furniture, bases and covers specially designed for sewing-machines
	72452	Knitting-machines and stitch-bonding machines
	72453	Machines for making gimped yarn, tulle, lace, embroidery, trimmings, braid or net and machines for tufting
	72468	Accessories of machines for gimped yarn, tulle, lace
	72473	Drying machines, each of dry linen capacity exceeding 10 kg
	72474	Indsutrial machinery for washing , cleaning, wringing, pressing, bleaching, dyeing etc.
	72485	Machinery for making or repairing articles of hides, skins or leather, other than footwear
19	72435	Other sewing-machines
	72481	Machinery for preparing, tanning or working hides, skins or leather
	72483	Machinery for making or repairing footwear
	72485	Machinery for making or repairing articles of hides, skins or leather, other than footwear
	72488	Machinery for preparing, tanning, or working hides, skins or leather
20	72812	Machine tools for working wood, cork, bone, hard rubber, hard plastics
	72819	Accessories suitable for machines of working stone, ceramics, bone, rubber and plastics
	72844	Presses for the manufacture of particle board or fibre building board of wood
	72849	Machinery having individual functions, n.e.s.
	72852	Parts for the machinery for working rubber or plastics
	73166	Other sharpening (tool- or cutter-grinding) machines
	73177	Sawing or cutting-off machines
21	72512	Machinery for making or finishing paper or paperboard
	72521	Cutting machines
	72523	Machines for making bags, sacks or envelopes
	72525	Machines for making cartons, boxes, cases, tubes, drums or similar containers
	72527	Machines for moulding articles in paper pulp, paper or paperboard
	72591	Machinery for making pulp of fibrous cellulosic material
	72599	Machinery for making up paper pulp, paper or paperboard
	72631	Machinery, apparatus and equipment for typesetting, for making printing blocks
	72635	Printing type, blocks, plates, cylinders and other printing components, etc.
	72659	Offset printing machinery (other than reel or sheet)
	72668	Machines for uses ancillary to printing
	72681	Bookbinding machinery (including book-sewing machines)
	72699	Parts for offset typing
	74527	Other packing or wrapping machinery
	74529	Parts of Dishwashing machinery
22	72529	Paper mill and pulp mill machinery
	72599	Machinery for making up paper pulp, paper or paperboard
	72631	Machinery, apparatus and equipment for typesetting, for making printing blocks
	72635	Printing type, blocks, plates, cylinders and other printing components, etc.
	72651	Reel-fed offset printing machinery
	72655	Sheet-fed, office-type (sheet size not exceeding 22 x 36 cm) offset printing machinery
	72659	Offset printing machinery (other than reel or sheet)
	72667	Other printing machinery
	72668	Machines for uses ancillary to printing
		.....

Table D.11: List of machines 3.

sector	SITC code	Description
22	72681	Bookbinding machinery (including book-sewing machines)
	72689	Parts for bookbinding machinery
	72691	Parts for type-founding or typesetting
	72699	Parts for offset typing
24	72449	Machines for extruding, drawing, texturing (parts)
	72832	Machinery for crushing or grinding earth, stone, ores etc.
	72833	Machinery for mixing and kneading earth, stone, ores etc.
	72839	Accessories for sorting, screening, separating, washing, crushing earth, stone etc.
	72842	Machinery for working rubber or plastics or for products from these materials, n.e.s.
	72846	Machinery for treating metal (including electric wire coil-winders), n.e.s.
	72849	Machinery having individual functions, n.e.s.
	72852	Parts for the machinery for working rubber or plastics
	72855	Parts, n.e.s., for the machines of headings 72348, 72721, 72844, 72846 and 72849
	74173	Distilling or rectifying plant
	74174	Heat-exchange units
	74183	Medical, surgical or laboratory sterilizers
	74186	Driers, n.e.s.
	74527	Other packing or wrapping machinery
25	72812	Machine tools for working wood, cork, bone, hard rubber, hard plastics
	72819	Accessories suitable for machines of working stone, ceramics, bone, rubber and plastics
	72832	Machinery for crushing or grinding earth, stone, ores, etc. substances in solid form
	72842	Machinery for working rubber or plastics or for products from these materials, n.e.s.
26	72831	Machinery for sorting, screening, separating or washing earth, stone, ores or other mineral
	72832	Machinery for crushing or grinding earth, stone, ores, etc. in solid form
	72833	Machinery for mixing and kneading earth, stone, ores , etc. in solid form
	72834	Machinery for agglomerating, shaping or moulding solid mineral fuels, ceramic paste etc.
	72839	Accessories for sorting, screening, separating, washing, crushing, kneading earth, stone etc.
	72841	Machines for assembling electric or electronic lamps, tubes or valves or flash bulbs, in glass envelopes
	72842	Machinery for working rubber or plastics or for products from these materials, n.e.s.
	72849	Machinery having individual functions, n.e.s.
	72851	Parts for the machines for assembling electric or electronic lamps
	72855	Parts, n.e.s., for the machines of headings 72348, 72721, 72844, 72846 and 72849
27	72849	Machinery having individual functions, n.e.s.
	73177	Sawing or cutting-off machines
	73311	Forging or die-stamping machines (including presses) and hammers
	73312	Bending, folding, straightening or flattening machines (inc. presses), numerically controlled
	73313	Non-numerically controlled bending, folding, straightening or flattening machines (inc. presses)
	73391	Draw benches for bars, tubes, profiles, wire or the like
	73399	Machine tools for working metal, sintered metal carbides or cermets, without removing material, n.e.s.
	73513	Work holders
	73515	Dividing heads and other special attachments for machine tools
	73595	Parts for machine for metal, sintered metal carbides or cermets
	73712	Casting machines
	73719	Parts for converters, ladles, ingot moulds
	73729	Rolls and other parts for metal-rolling mills
	73737	Other metalworking machines for electric , laser or other light or photon beam machine group
	73739	Parts for metalworking machines (Electric, laser, photon, ultrasonic..)
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Table D.12: List of machines 4.

sector	SITC code	Description
28	72846	Machinery for treating metal (including electric wire coil-winders), n.e.s.
	72849	Machinery having individual functions, n.e.s.
	72852	Parts for the machinery for working rubber or plastics
	73131	Horizontal lathes, numerically controlled
	73135	Other lathes, numerically controlled
	73137	Other horizontal lathes
	73143	Drilling machines, n.e.s.
	73145	Boring-milling machines, n.e.s.
	73154	Milling machines, n.e.s.
	73157	Other threading or tapping machines
	73162	Non-numerically controlled flat-surface grinding machines, in which accuracy is of at least 0.01 mm (any axis)
	73163	CNC grinding machines in which accuracy is of at least 0.01 mm (any axis)
	73164	Grinding machines, n.e.s., in which accuracy is of at least 0.01 mm (any axis)
	73177	Sawing or cutting-off machines
	73311	Forging or die-stamping machines (inc. presses) and hammers
	73312	Bending, folding, straightening or flattening machines (inc. presses), numerically controlled
	73313	Non-numerically controlled bending, folding, straightening or flattening machines (inc.presses)
	73315	Non-numerically controlled shearing machines (inc. presses)
	73316	Numerically controlled punching or notching machines (inc. presses)
	73317	Punching or notching machines, n.e.s.
	73318	Presses for working metal or metal carbides, n.e.s.
	73393	Thread-rolling machines
	73395	Machines for working wire
	73399	Machine tools for working metal, sintered metal carbides or cermets, without removing material, n.e.s.
	73511	Tool holders and self-opening die-heads
	73515	Dividing heads and other special attachments for machine tools
	73591	Parts for machine tools working by removing metal
	73595	Parts for machine for metal, sintered metal carbides or cermets
	73721	Metal-rolling mills
	73733	Machines and apparatus for resistance welding of metal, fully or partly automatic
	73735	Machines and apparatus for arc (inc. plasma-arc) welding of metal, fully or partly automatic
	73736	Other metalworking machines for arc welding of metal
	73737	Other metalworking machines for electric , laser or other light or photon beam machine group
	73742	Other gas-operated metalworking machinery and apparatus
	73743	Other machinery for soldering, brazing or welding
	73749	Parts for the machinery for soldering, brazing or welding
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Table D.13: List of machines 5.

sector	SITC code	Description
36	72435	Other sewing-machines
	72439	Sewing-machine needles; furniture, bases and covers specially designed for sewing-machines
	72812	Machine tools for working wood, cork, bone, hard rubber, hard plastics
	72819	Accessories suitable for machines of working stone, ceramics, bone, rubber and plastics
	72842	Machinery for working rubber or plastics or for the manufacture of products from these materials, n.e.s.
	72844	Presses for the manufacture of particle board or fibre building board of wood or other ligneous material
	72849	Machinery having individual functions, n.e.s.
	72852	Parts for the machinery for working rubber or plastics
	73162	Non-numerically controlled flat-surface grinding machines, in which an accuracy of at least 0.01 mm (any axis)
	73167	Honing or lapping machines
	73177	Sawing or cutting-off machines
	73178	Planing machines, metalworking
	73311	Forging or die-stamping machines (including presses) and hammers
	73312	Bending, folding, straightening or flattening machines (including presses), numerically controlled
	73595	Parts for machine for metal, sintered metal carbides or cermets
	73749	Parts for the machinery for soldering, brazing or welding
	74527	Other packing or wrapping machinery