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INDIRECT EFFECTS OF INTERNATIONAL INVESTMENT AND TRADE

by

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Submitted in partial fulfillment of the requirements for
the degree of Doctor of Philosophy at
Central European University

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CENTRAL EUROPEAN UNIVERSITY
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DISCLOSURE OF CO-AUTHORS CONTRIBUTION

Title of paper: Learning to Import from Your Peers

Co-authors: Miklós Koren and Ádám Szeidl

The nature of the cooperation and 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 Miklós Koren and Ádám Szeidl. Ádám and Miklós invented the main question and the identification strategy of the paper. They worked out the structure and the logic of the paper, and Ádám also made contributions to the writing. My main contribution is in data management, programming, regression analysis and writing. I also reviewed the literature.

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Abstract

In my thesis I look at the indirect effects of international investment and trade. There are several well-known direct effects: foreign direct investment (FDI) creates new workplaces and increases tax revenue; trade increases both the market for domestic goods and the scope of goods available for local buyers. There is also evidence in the literature showing that exporting and importing firms become more productive. At the same time indirect effects are less trivial, though these can also be important. On one hand, indirect effects like knowledge spillovers or increased demand can benefit other local firms. On the other hand, competition for local inputs might also become higher.

The three chapters of my thesis examine some of these indirect effects, both looking at their magnitude and the mechanism behind. In all three chapters I do an empirical analysis, using Hungarian firm-level panel data. In the first chapter I look for vertical FDI spillovers. Taking the large-scale investment of Audi in Hungary I find that local firms operating in the supplier industry increased their sales and employment after the Audi entry, which is in line with a local demand effect, but there is no evidence for increased productivity. Moreover, the demand effect is driven by firms with foreign owners, which might be the result of the large productivity gap between the domestic firms and Audi. In the second chapter I estimate the local spillovers of FDI exits. I find that sales and employment of local firms decreased after the closure of a foreign-owned large plant located nearby. I also provide evidence showing that decreased competition for local labor, decreased local purchasing power of the laid-off, and lost demand for local suppliers are all important channels in the plant closure effect. The third chapter is a joint work with Ádám Szeidl and Miklós Koren. We estimate import spillovers, finding that peers with country-specific trade experience increase the probability of starting to import from a country. This effect is even stronger if the peer operates in the same industry or imported the same product before.

In my thesis I document several types of indirect effects of FDI and international trade.

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I show the existence of spillovers from an FDI to the supplier industry (chapter 1 and 2) and to the local service industry (chapter 2), and provide evidence for knowledge spillovers in imports (chapter 3). Additionally, I show that spillovers are specific to certain firm groups. All the three chapters suggest that spillovers are localized in space. Knowledge spillovers are especially concentrated in close neighborhoods. Spillovers are the strongest for firms in related industries: firms in the supplier industry of the foreign direct investment or same-industry peers of the importer firms. Finally, spillovers also depend on initial firm performance. Better firms tend to gain more after an FDI entry or learn more from experienced peers. Worse firms tend to lose more after an FDI exit.

Chapter 1: The Effect of FDI on Local Suppliers: Evidence from Audi in Hungary

In 1993 Audi opened a new plant in Hungary. This chapter examines the long-term effects of this large foreign direct investment on local firms operating in supplier industries. I use firm-level panel data with long time series. Using the method of triple difference-in-differences I compare outcomes of firms in supplier and control industries, close and far from the Audi plant, before and after the entry. My main findings are: (1) after the Audi entry the average annual growth rate of local firms increased by 3 percentage points for sales and 2 percentage points for employment. The effect is visible only five years after the entry of Audi. I find no positive effect on productivity. (2) Firms with foreign owners account for all the positive effect on sales and employment, suggesting a foreign-to-foreign complementarity in investments. Firms with higher productivity gained more. Consequently, the low initial productivity of domestic firms may explain the lack of an effect in this group. (3) New entrants in the supplier industry locating close to Audi are larger and grow faster, suggesting that Audi also had an effect on the extensive margin.

Chapter 2: The Effect of Foreign-owned Large Plant Closures on Nearby Firms

In the second chapter I estimate the impact of foreign-owned large plant closures on local firms. I identify 41 such events in Hungary and assign comparable control cities with foreign-owned large plants operating in the same industry and not closing. I use a firm-level panel database of Hungarian firms between 1992-2012. I do a difference-in-differences estimation comparing outcomes of firms in the treated and control areas, before and after

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the plant closure. I find that after the foreign-owned large plant closures sales of nearby firms decreased by 6 percentage points and employment decreased by 3 percentage points on average. Firms operating in local services were hurt even more, suggesting that reduced local purchasing power due to the layoffs is a significant channel of the local plant closure effect. Firms operating in the supplier industry of the closing plant also decreased employment more than average, suggesting that input-output linkages play an important role in the propagation of negative shocks. In contrast, firms in the industry of the closing plant increased their employment, suggesting that they could benefit from the increased local labor supply. I also find that low-productivity firms were hurt more by the plant closures than high-productivity firms.

Chapter 3: Learning to Import from Your Peers

(joint with Ádám Szeidl and Miklós Koren)

In the third chapter we estimate knowledge spillovers in importing. Using firm level data from Hungary we document that firms with peer firms—connected through close spatial or managerial networks—that have trade experience with a particular country are more likely to start importing from that country. Our empirical strategy is based on variation in partner countries, controlling for firm-year and country-year effects and for ownership links between the firm and the peer, thus eliminating several possible alternative explanations. We show that knowledge spillovers are highly localized in space, and that firms learn more from larger, more productive and same-industry peers which import the same product. Our results suggest that even in a very open economy information frictions form an important barrier to importing.

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Chapter 1

The Effect of FDI on Local Suppliers: Evidence from Audi in Hungary

1.1 Introduction

Attracting foreign direct investment (FDI) is high on the agenda of governments and municipalities all over the world.[1] One reason for this preference is that FDI is believed to play an important role in the development of the local economy. Besides the advantage that FDI creates new workplaces, the economic motivation for giving subsidies to FDI is the assumed existence of spillover effects to local firms. At the same time, empirical evidence on the existence of these benefits is ambiguous. First, it is difficult to properly identify FDI effects. Second, results largely depend on the characteristics of the local firms. As a result, some studies find a positive effect of FDI on domestic firms while others find no significant effect (see for example the meta-analysis of Bruno and Cipollina (2014)). It is still not properly understood to what extent and through which channels the FDI effect operates. This knowledge would also be crucial for evaluating policy decisions about how to subsidize FDI (see e.g. Haskel et al. (2007)). I contribute to this topic using rich data that helps the identification and allows for measuring particular mechanisms.

I look at a single investment, which limits the external validity of my findings. On the

[1] E.g. USA: https://www.whitehouse.gov/the-press-office/2013/10/31/president-obama-announce-first-ever-federal-effort-attract-job-creating-; USA, China and India: http://www.cbi.org.uk/media-centre/news-articles/2012/09/how-the-us-china-and-india-try-to-attract-external-investment/; India: http://articles.economictimes.indiatimes.com/2014-09-23/news/54239387_1_much-fdi-foreign-direct-investment-gdp-growth.

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other hand, it allows for a cleaner measurement of the FDI effect and its mechanism. The plant of Audi Hungaria Motor Kft in Győr is one of the largest foreign direct investments in Hungary (KSH (2011)). Based on Dusek et al. (2015), the direct contribution of Audi to the Hungarian GDP was around 1% in 2008. In this way it serves as a good case to investigate the effects of a large FDI in the setting of a middle-income country.

My identification strategy is similar to the approach of Greenstone et al. (2010). Using a firm-level panel data set of Hungarian firms[2] I do a triple difference-in-differences estimation. I assume that the effect of Audi is concentrated in firms operating in the supplier industries, especially when located close to Audi in Győr. I compare differences in the outcomes of firms located close to Audi in Győr versus in a control region, operating in supplier industries versus in control industries, before versus after the Audi entry in 1994. Following the strategy of Greenstone et al. (2010) I define the control region using the potential second best location choice of Audi. I determine this location combining two sources: the later location choice of Mercedes and a study of Empirica, a German research institute, which ranks the locations in the Central-Eastern European region based on attractiveness to foreign investment in 1992. As Javorcik (2004) showed for Lithuanian firms, a major channel for FDI spillovers is the link between the foreign firm and its local suppliers. Building on her findings, but using a different identification strategy, I focus on firms in the supplier industries of car manufacturing. I expect that benefits are the highest for these firms. I include both tier-1 and tier-2 supplier industries, which I determine based on 4-digit input-output table data. Firms in these industries are the most likely to interact with Audi or with its direct suppliers through business links or shared labor force. My identifying assumption is the following: without the presence of Audi inherent differences between close and far locations would have changed in the same way in supplier and control industries over time. I also account for yearly 2-digit industry-specific shocks.

I look at the net effect of Audi on various firm performance measures: sales, employment, productivity and trade of local firms operating in supplier industries. I choose these measures based on the potential effects of FDI. First, increased demand by Audi might positively affect sales, employment and productivity due to scale economies. Second, increased domestic demand might negatively affect exports. Third, knowledge spillovers might pos-

[2]The data sets I use: "APEH Balance Sheet" and "Customs Statistics" are created by the Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences (MTA KRTK) from the original data. The data sets are work in progress. Although the MTA KRTK made effort to clean the data, it cannot be held liable for any remaining error.

itively affect productivity and export capability. I have a firm-level panel data set with uniquely long time series, which allows me to look at long-term effects. I measure separately the average per firm effect using within-firm estimates (intensive margin) and the effect of Audi on new entrants and exiting firms (extensive margin). I further decompose the extensive-margin effect to differences in the number and composition of entrants and exiting firms, and also check the composition at entry and the subsequent growth of new entrants separately. Finally I capture the total effect using 4-digit industry level estimates, which also accounts for potential heterogeneity in the firm-level effects.

I find a significantly positive effect on the intensive margin for sales, domestic sales and employment. For firms located close to Győr and operating in the supplier industries the average annual growth rate of sales increased by 3 percentage points and the annual growth rate of employment increased by 2 percentage points after the Audi entry. This observation is in line with a positive demand effect. Yearly patterns show that the effect was not immediate, suggesting that local supplier-industry firms needed some time to be able to benefit from the foreign investment. At the same time, I do not find a positive effect on productivity or exports, except for a higher export value to the neighboring Austria. These results suggest that there were no sizable knowledge spillovers from Audi to local supplier-industry firms, or spillovers were only concentrated in a few directly linked supplier firms. The missing productivity effect is in line with the findings of Javorcik (2004) in case of greenfield investments, but the presence of a positive demand effect without any effect on productivity is surprising.

In order to solve this puzzle I look at the mechanism of the FDI effect. Allowing for heterogeneity of the effect across firm groups, I find that only firms with foreign owners could increase their sales and employment after the Audi entry. I also estimate a larger demand effect for firms with a higher initial productivity. As domestically-owned firms were less productive before the Audi entry than foreign-owned firms, the productivity gap might have prevented domestically-owned firms from enjoying the benefits of Audi's presence. This conclusion is also supported by other studies based on interviews with managers (e.g. Bödör (2007)), which claim that especially initially, domestically-owned local firms were not ready to qualify as suppliers of Audi. Additionally, highly productive firms with foreign owners might have had less room to learn from Audi, which could explain the missing productivity effect. Still, I cannot conclude that the presence of Audi was not beneficial for the local economy. My back of the envelope calculation suggests that the indirect contribution of Audi to the Hungarian GDP through the demand effect was about 50% of its direct contribution. At the same time, my results suggest that the complementarity of policies attracting FDI and promoting the improvement of local firms is crucial for being able to enjoy the potential benefits of FDI in the local economy.

My firm-level estimates do not capture the effect of Audi on new entrants. The literature on the location choice of FDI showed that foreign investors attract additional foreign investments in the same industry (Head et al. (1995)). For the identification of extensive-margin and total effects I assume that except the presence of Audi all other factors attracting firms to locate close to Győr are common in the supplier and control industries. Concerning the extensive margin, I find no significant effect on the the number of entrants and exiting firms, but firms entering into supplier industries close to Győr after the Audi entry were larger and also grew faster. Their sales in the second year after the entry was 35 percentage points higher than in the estimated counterfactual case without Audi, and their growth rate was 4.8 percentage points higher in sales, 3.4 percentage points higher in employment and 18.5 percentage points higher in exports. I capture the total effect of Audi on the local supplier industries by an industry-level analysis. I find that the average growth rate of 4-digit industry level sales weighted by the size of the industry increased by 8.3 percentage points and the growth rate of employment increased by 3.8 percentage points due to Audi. I also estimate a positive effect on industry-level exports, but there is no significant effect on average productivity.

1.1.1 Literature

Vertical FDI spillovers. The current study is related to the literature on spillovers from a foreign direct investment to local firms. There are many papers examining FDI spillovers, but findings on the scope and magnitude of these effects are mixed.[3] Starting with Javorcik (2004) a large strand of the literature focuses on vertical spillover effects: the effect of an FDI on local suppliers.[4] These papers measure FDI as the foreign ownership share in a given industry, neglecting the role of geographical closeness to FDI in spillover effects. My main contribution to this literature lies in my identification strategy, in which I use information on the distance of firms from the FDI. My approach is also supported by Girma and

[3] See Görg and Strobl (2001), Crespo and Fontoura (2007), Smeets (2008) and Meyer and Sinani (2009) for comprehensive analysis of the FDI spillover literature.

[4] Javorcik (2004) finds evidence of positive productivity spillovers to supplier-industry firms in Lithuania. As further examples, Kugler (2006) and Lin et al. (2009) report positive vertical spillover effects in Colombia and China.

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Wakelin (2007) who find only within-region vertical FDI spillovers in the UK electronics industry.

Agglomeration spillovers. This study can also be related to the agglomeration spillover literature. I build my identification on Greenstone et al. (2010) and Greenstone and Moretti (2004) who estimate the productivity improving and welfare increasing effect of new plants opening in the US. My study differs in both the scope and the setting. I focus on a foreign direct investment in a Central Eastern European country, looking at its effect on various firm-level outcomes. We could expect a higher scope for learning in a middle-income country, but my results suggest that the productivity gap hinders local firms to benefit from the FDI.

Heterogeneity of FDI spillovers. We know from the literature that characteristics of both the local firms and the FDI matter for the estimated size of the spillover effect. Sinani and Meyer (2004) find that horizontal spillovers in Estonia vary with size, ownership and export activity of the affected firm. I find a similar variation for vertical spillovers in Hungary. Javorcik and Spatareanu (2011) claim that FDI with a remote home country applies more local suppliers. Javorcik (2004) finds no vertical spillovers for fully foreign-owned foreign investment. Lin et al. (2009) show that the FDI spillover effect is weaker for export-oriented foreign entrants. As Audi Hungaria has a close home country: Germany, it is fully foreign-owned and export-oriented, we could expect no spillovers on local firms. On the other hand, spillovers might increase with the scale of the investment, and Audi Hungaria is one of the largest firms in Hungary. In spite of that, I don't find any evidence for significant knowledge spillovers from Audi.

FDI effect on exports. One of the outcomes I investigate is exports. As Kneller and Pisu (2007) state, there are surprisingly few studies on the export promoting effect of FDI, although FDI might help local firms to export by increasing their productivity and showing the foreign standards. Harding and Javorcik (2012) find that FDI increased the export quality of local firms. Greenaway et al. (2004) and Kneller and Pisu (2007) estimate a significantly positive effect on both the export probability and the exported value of local firms in the UK. Franco and Sasidharan (2009) find a heterogeneous effect for different types of FDI in India. I add to these papers by looking at the export promoting effect in a middle-income small open economy.

FDI spillovers in Hungary. There are some papers which estimate FDI spillovers using Hungarian data. Halpern and Muraközy (2007) find significant vertical spillovers in domestically-owned firms, also emphasizing the role of distance to FDI. Békés et al.

(2009) show that larger and more productive firms located in the same county can benefit more from the presence of a foreign multinational. As opposed to my event-study type identification strategy, both papers use an identification strategy following Javorcik (2004). Additionally, I use a finer, 4-digit industry classification to determine the supplier industries. Also Iwasaki et al. (2012) use 4-digit industry classifications, emphasizing the multi-layered nature of vertical links, but they look at horizontal spillovers.[5]

This study is structured as follows: Section 1.2 gives a brief overview of the motor vehicle manufacturing industry in Hungary and describes the data. Section 1.3 discusses the identification strategy. Section 1.4 presents the results and Section 1.5 concludes.

1.2 Background and data

1.2.1 Motor vehicle manufacturing industry in Hungary

Audi Hungaria Motor Kft. was established in 1993 by the German Audi AG. The new production plant built up in Győr started to operate in 1994. Its first activity was manufacturing of engines. Then from 1998 on cars were also assembled in Hungary, for which body elements were brought from Germany. Finally, from 2005 on tools manufacturing was also added to the line of activities. The plant has been continuously expanded over the years, the most recent large investment occurred in 2013. Currently, Audi is one of the largest employers of the country. The number of employees was about 11,300 in 2015 January. Audi is also one of the largest firms in Hungary in terms of sales. The net revenues of Audi Hungaria were €5588 million in 2013.[6] Consequently, Audi is a highly important FDI in Hungary.

Audi is not the only large player in the motor vehicle and engine manufacturing industry in Hungray. Figure 1.1 shows the location of the four large car manufacturers. Opel Szentgotthárd Kft., located in Szentgotthárd, and Magyar Suzuki Zrt, located in Esztergom, were both established in 1991, two years before the entry of Audi. Mercedes-Benz Manufacturing Hungary Kft, located in Kecskemét, was built only recently and started to

[5]Some recent papers use cross-country data for estimating vertical spillover effects. Alfaro and Chen (2013) emphasize the reallocation channel in the productivity effect of FDI. Fons-Rosen et al. (2013) find a very small but positive aggregate impact of FDI on country-level productivity growth. As I have a database from a single country, the external validity of my findings is more limited, but the rich information on firms can add to the identification where I also exploit spatial differences within the country.

[6]`http://evesjelentes2013.audiportal.hu/felelosseg/penzugyi_jelentes.pdf`

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operate in 2012. The Suzuki plant manufactures cars and the Opel plant manufactures engines. Opel also assembled cars initially, but this activity ended in 1996. The sales of Suzuki and Opel are about 1/3 of Audi's sales (see Figure A.1 of the Appendix). The different timing of the entry and the different location of the plants helps to separate the effect of Audi.

According to industrial experts, Audi initially had very few suppliers located in Hungary. Though the number of local suppliers increased over time, there are still only a few primary suppliers located in Hungary, and most of them are foreign owned. There are much more Hungarian firms among the secondary or tertiary suppliers (Bödör (2007)). Unfortunately, no full list of the Audi suppliers is available, neither for research purposes. I could still identify some suppliers mentioned in the press. Most of these known suppliers are located in Győr or nearby (see Figure A.2 of the Appendix). This observation supports my assumption that firms located close to Győr are more likely to benefit from the presence of Audi than firms located in other parts of the country.

1.2.2 Data

For the analysis I combine three firm-level panel data sources. The first is a data set from the Hungarian tax administration, which contains yearly balance sheet data for the universe of Hungarian firms between 1992-2011. The data set also includes 4-digit industry categorization corresponding to NACE Rev. 1.1 and the shares owned by foreign, local private and public agents. This allows me to create firm groups by industry and ownership. The second data set is the firm information database of CompLex Kiadó Kft. The CompLex database contains the precise address of the headquarters for all firms in Hungary between 1992-2012. Using this information I assign firms to groups by location. The third data source includes detailed customs data for all Hungarian firms between 1992-2003. It contains the yearly total value a firm exported to or imported from a country by 8-digit product category. This allows me to look at the export activity of firms by destination, which helps to identify potential country-specific spillover effects on exports.

I estimate the effect of Audi on various firm performance measures. I use sales, domestic sales and employment data from the balance sheet. I correct all the monetary values for inflation using two-digit sectoral price indices: producer price index (PPI) for sales and imports, export price index for exports, a weighted average of supplier sectors' PPI for material and a simple average PPI of five sectors manufacturing machinery and transport equipment for capital. I express all values in 1998 HUF. I measure productivity in two alternative ways, using labor productivity and total factor productivity. I calculate labor productivity as value added per capita, where value added is defined as sales minus material costs. For total factor productivity estimates I assume a Cobb-Douglas production function with coefficients varying by 2-digit industries. For firm i operating in industry j the production function in year t is:

$$Y_{ijt} = A_{ijt} L_{ijt}^{\alpha_j} K_{ijt}^{\beta_j} M_{ijt}^{\gamma_j}. \tag{1.1}$$

Y denotes sales, A is total factor productivity, L is labor measured by the number of employees, K is capital measured by the value of capital assets and M is material measured as material costs from the balance sheet. I estimate the log of the above equation:

$$log(Y_{ijt}) = log(A_{ijt}) + \alpha_j log(L_{ijt}) + \beta_j log(K_{ijt}) + \gamma_j log(M_{ijt}) + \varepsilon_{ijt}. \tag{1.2}$$

Using the method of Levinsohn and Petrin (2003) I estimate a separate production function for each 2-digit industry. Table A.1 of the Appendix presents the estimated coefficients in each industry.

1.3 Empirical strategy

In order to identify the effect of Audi on the local supplier industry I need a proper counterfactual. I use a triple difference-in-differences strategy, comparing outcomes of firms in supplier and control industries, near and far from Audi, before and after the entry of Audi. In the following, I refer to closely located firms operating in the supplier industry as the treated group.

1.3.1 Regional and industrial categorization

I define the region affected by the entry of Audi as a 80 km radius circle around Győr. Since I only have Hungarian data, I take the part of the circle which falls within the territory of Hungary as the treated region. I follow the strategy of Greenstone et al. (2010) and use the same circular area around the second best location choice of Audi as the control region. I regard Kecskemét as the potential second best location choice, where another auto manufacturer, Mercedes located two decades later. More importantly, the area around Kecskemét includes Csongrád, which was the second most attractive location

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Figure 1.1: Treated and control regions within Hungary, also indicating Pest and Csongrád counties and the location of the four motor vehicle plants

in the region for foreign investors, just after Győr. This ranking is based on a 1992 survey of Empirica, a German research institute from Bonn. Figure 1.1 shows the map of Hungary with the treated and control regions. I assign a firm to the treated or control region based on its location in 1993, the year before the Audi plant started to operate in Győr. For new entrants after 1993 I take the first location. I neglect location changes over time. This simplification does not cause a large distortion as 86% of the firms stayed in the same county over the years.

I classify firms to supplier and control industries based on their main four-digit NACE category. I consider only manufacturing firms. I look at both tier 1 (direct) and tier 2 (indirect) suppliers, as it is easier to become a secondary supplier, and these firms might also have enjoyed the benefits from the presence of Audi. I define supplier industries as those 4-digit manufacturing industries which provide a considerable share of inputs for car manufacturing or for its largest direct supplier industries. I use the 1997 US input-output table, which is detailed enough to differentiate between 4-digit industries. As automobile manufacturing has a similar technology all over the world, it is not necessary to use Hungarian input-output tables, which are only available at the 2-digit level. The Audi plant in Győr assembles cars and manufactures engines as well, so the industries of interest are

Automobile Manufacturing (NAICS 336111), *Motor Vehicle Body Manufacturing* (NAICS 336211) and *Gasoline Engine and Engine Parts Manufacturing* (NAICS 336312). I classify a 4-digit industry as a direct supplier if its output is used by any of these three industries and its contribution to total spending on manufacturing inputs by the given industry is at least 0.1%. These 4-digit NACE categories are the tier 1 supplier industries. I determine the tier 2 supplier industries in the same way, but using the aggregate spending of tier 1 suppliers instead of the three car manufacturing industry categories. The control industries are all those 4-digit manufacturing industries which do not sell any inputs to the three car manufacturing industries or to the tier 1 supplier industries. I assign firms to supplier and control industries based on their main activity. If a firm's activity changed over time I take the industry category with the longest duration. I present the full list of supplier and control industries in Table A.2-A.4 of the Appendix. Table A.5 of the Appendix shows the number of firms by 2-digit industry and their composition before the Audi entry in the four firm groups by industry and region.

1.3.2 Estimation

For the identification strategy I make three assumptions. First, I assume that the effect of Audi was locally concentrated. Many of the known suppliers are located close to Győr (see Figure A.2 of the Appendix), which supports this assumption. Second, I assume that Audi had no effect on firms operating in the control industries. Those firms can benefit from the presence of an FDI which operate in related industries. This assumption is also supported by Javorcik (2004), who finds that the major form of FDI spillovers are vertical spillovers between the investing firm and its local suppliers. If any of these assumptions is not true, my results still provide a lower bound of the true Audi effect. Third, I assume that after controlling for inherent and regional differences, firms operating in the supplier industries and located in the control region can provide a proper counterfactual. As comparable data are only available two years before the entry of Audi, I can only compare levels before the Audi entry but not pre-trends. Still, I choose the control region in such a way that it is comparable to the treated region. Table 1.1 shows that suppliers near and far are indeed similar in terms of various characteristics (column (3)). The only exception is the higher share of exporters in the treated region, which is closer to Austria. This difference becomes only marginally significant when I control for regional differences in control-industry firms. Column (7) shows the p-values of the interaction term coefficients from a difference-in-differences estimation in the period before the Audi entry. The similar

Table 1.1: Comparison of firm groups before the entry of Audi

Period: 1992-1993							
Industry group:	supplier			control			Diff-in-diff
Location:	near	far	p-value	near	far	p-value	p-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Number of firms	239	544		403	814		
Sales (MHUF)	196 (562)	192 (622)	0.929	489 (1482)	432 (1539)	0.419	0.568
Domestic sales (MHUF)	132 (398)	145 (514)	0.638	409 (1249)	328 (1089)	0.133	0.189
Employment (capita)	46 (136)	47 (117)	0.850	86 (218)	91 (256)	0.668	0.823
Log total factor productivity	4.66 (0.94)	4.74 (0.97)	0.176	5.09 (1.13)	5.21 (1.04)	0.022	0.649
Value added per worker (MHUF)	4.09 (6.79)	3.54 (7.37)	0.236	4.2 (8.72)	4.38 (13.58)	0.822	0.422
Export value (MHUF)	62 (270)	45 (186)	0.175	110 (469)	132 (660)	0.433	0.288
Export value to Germany (MHUF)	55 (175)	73 (219)	0.392	142 (453)	209 (728)	0.187	0.461
Export value to Austria (MHUF)	37 (159)	19 (71)	0.138	65 (221)	32 (92)	0.020	0.467
Import value (MHUF)	64 (266)	40 (215)	0.082	92 (336)	57 (306)	0.016	0.601
Share of exporters	0.4 (0.49)	0.33 (0.47)	0.012	0.39 (0.49)	0.32 (0.47)	0.003	0.875
Share of exporters to Germany	0.22 (0.42)	0.22 (0.41)	0.773	0.22 (0.42)	0.2 (0.40)	0.321	0.708
Share of exporters to Austria	0.19 (0.39)	0.11 (0.31)	0.000	0.16 (0.36)	0.12 (0.33)	0.023	0.084

Columns 1-2 and 4-5 show yearly average values of firms within a group in the period before the Audi entry. Standard deviations are in parentheses. Columns 3 and 6 show the p-value of comparing means within an industry group, where the alternative hypothesis is the difference of means. Column 7 shows the p-value of comparing the difference in industry-group means between the two regions. It is the p-value of the interaction term coefficient from a diff-in-diff regression with industry group and region as the two dimensions, using only pre-entry data, and the corresponding variable of the row on the left-hand side. Monetary values are given in million HUF, deflated to 1998 values. As a comparison, in 1998 December the exchange rate was around 1 USD = 219.03 HUF.

industry composition within the supplier industry group across regions also support the comparability of the treated and the control region. Table A.5 of the Appendix shows the 2-digit industry composition in the four firm groups before the entry of Audi. I consider further potential threats to the identification after showing the results.

I use the following econometric specification for the triple difference-in-differences estimation:

$$Y_{it} = \beta_0+\beta_1 D_t+\beta_2 D_t Supplier_{j(i)}+\beta_3 D_t Near_i+\beta_4 D_t Supplier_{j(i)} Near_i+a_i+s_{jt}+u_{it}, \quad (1.3)$$

where i stands for firm, j is industry and t is year. Y_{it} is an outcome variable, which can be the log of sales or employment, measures of productivity or export activity. $Supplier_{j(i)}$ is a dummy for firm i operating in industry j where j is a supplier industry. $Near_i$ is a dummy for firm i being located in the region close to the Audi plant in Győr. In the baseline specification D_t is an indicator for the period after the Audi entry, starting in 1994. In alternative specifications D_t either incorporates both a time dummy and a time trend after the Audi entry, or it denotes a full set of sub-period dummies or year dummies. Assuming no differences in pre-trends, the specification with the time dummy and the time trend allows me to separate the effect of Audi on the level and on the trend of the outcome variable. The gradual expansion of the Audi plant also suggests that the effect of Audi might have been increasing over time. I create sub-periods according to the different phases of investment in Audi. The specification with the full set of year dummies allows me to estimate the dynamics of the effect in the most flexible way. The coefficient on the triple interaction term β_4 - or the vector of β_4 coefficients in the alternative specifications - measures the average effect of Audi on a supplier-industry firm located close to Győr. a_i denotes firm-fixed effect, s_{jt} denotes industry-year-fixed effect and u_{it} is the error term. Firm-fixed effects ensure within-firm identification from firms already existing before the Audi entry and control for time-invariant composition differences across firm groups. I define industry-year-fixed effects using 2-digit industry categories, which are broader than the 4-digit industry classification I use to define the supplier and control industries. Industry-year-fixed effects correct for time-varying differences in industry composition across regions by controlling for yearly shocks common to a 2-digit industry. These industry-wide changes are not associated with the entry of Audi by assumption. Identification comes from those 2-digit industries which include both 4-digit treated and control industries. These industries contain about 3/4 of the supplier-industry firms (see Table A.5 of the Appendix). I cluster the standard errors by 4-digit industry and county groups.

The set of outcomes I choose to investigate is suggested by the potential effects of an FDI. First, an FDI might increase sales and employment of local firms through a direct demand effect. Second, an FDI can improve the productivity of local firms through knowledge spillovers. If there are increasing returns to scale in the industry, a higher demand also increases productivity. If local competition becomes higher, reallocation can also increase average productivity. Third, an FDI can affect the export activity of local firms. Increased productivity increases export capability. Additionally, an FDI might make local firms aware of the international standards or it can help connecting local firms to potential foreign business partners. On the other hand, increased local demand can crowd out exports if local firms have capacity constraints in production. From the policy point of view the outcomes of the main interest are the number of additional workplaces created and the contribution to GDP, either through increased sales or increased productivity. The other outcomes I use, i.e. domestic sales and exports help to understand the Audi effect in more depth. Domestic sales should increase if there is a demand effect. Increased exports to Germany, the home country of Audi, or to Austria, a close country with similar culture and language can be a sign of knowledge spillovers from Audi.

In the estimation sample I include only those manufacturing firms which can be classified as treated or controls based on their industry and location. I exclude firms with a median number of employees below 5, as these firms tend to provide less reliable balance sheet data. I also expect that very small firms cannot benefit from the presence of Audi. Additionally, I exclude outliers with the largest 0.1% of sales or zero reported sales. I use the remaining 5448 firms in the estimations. From these firms 1855 were present both in the pre- and post-Audi entry period (222 in the treated group) and 3449 were new entrants following the Audi entry (625 in the treated group). Table 1.1 shows descriptive statistics of the outcome variables by firm group for the period before the Audi entry.

1.4 Results

1.4.1 Suggestive evidence from aggregate data

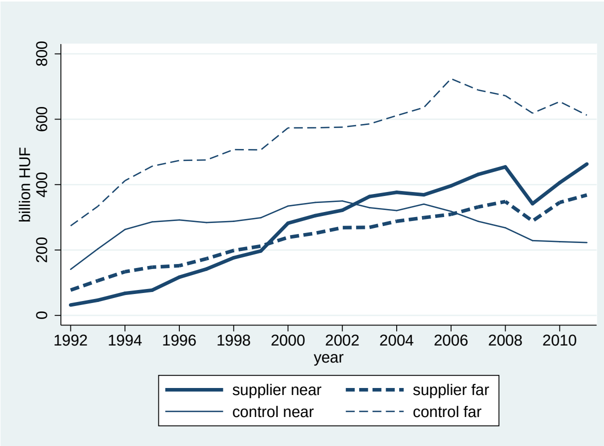
I start with showing suggestive evidence of a non-negligible effect of Audi on the local supplier industry. In Figure 1.2 I plot the yearly aggregate values of the three most important outcome variables: sales, employment and average productivity, separately for the four groups. The patterns are in line with the effect of Audi on aggregate sales and employment, but not on productivity. Before 1995 total sales increased in a parallel way across regions within the same industry group, and total employment increased in a parallel way across industry groups within the same region. In the period 1996-2001 both supplier-industry sales and employment increased more in the region close to Audi than in the control region. In the same period control industries evolved in a parallel fashion in the two regions. After 2001 total sales and employment stayed higher in the treated group and evolved in a parallel way with the control region. At the same time, sales in the control industry started to decline in the region close to Audi, but it was still growing in the control region, and employment declined in a parallel fashion in both regions. Throughout the whole period the average productivity, which I measure using the weighted average of firm-level labor productivity, was rather lower in the treated group compared to the controls. Figure A.3 of the Appendix shows similar plots for domestic sales and exports. Total exports in the treated group was growing clearly faster, but patterns are not so clear for domestic sales. Supplier industries evolved in a similar way in the two regions, but sales in the control industries declined in the region close to Audi compared to the control region. It can be a question how Audi could attract new entrants in the supplier industries if these firms sold so little to Audi, as the co-movement of aggregate domestic sales in the two regions suggests. First, it is possible that control industries capture regional shocks in a proper way and domestic sales in the supplier industry would have decreased in the treated region without the presence of Audi. Second, Audi could attract further FDI in related industries for reasons other than a direct supplier relationship. Agglomeration effects like sharing a common labor pool or other spillovers could also play a role in the location decisions of new entrants. Overall, these figures suggest that worsening of the control industry in the region close to Audi contributes to the estimated total effect of Audi, but does not move in itself the results.[7]

Next, I use my triple difference-in-differences strategy to show that the contribution of Audi to the growth of the local supplier industry seems to be considerable. I look at the five-year growth rate of sales and employment from 1993 to 1998, where the end point is the middle of the fast-growth period in the treated group. In the treated firm group the 5-year growth rate of total sales was 2.79 and it was 1.46 for employment. Using the growth rates in the other three groups and applying the triple difference-in-differences strategy I find that 73% of total sales growth and 79% of total employment growth can be attributed to Audi. Then I decompose the calculated total effect of Audi to the contribution of firms being present both in 1993 and 1998, exiting before 1998 and entering after 1993. Following Eaton et al. (2007) for each of the four industry-region groups I calculate

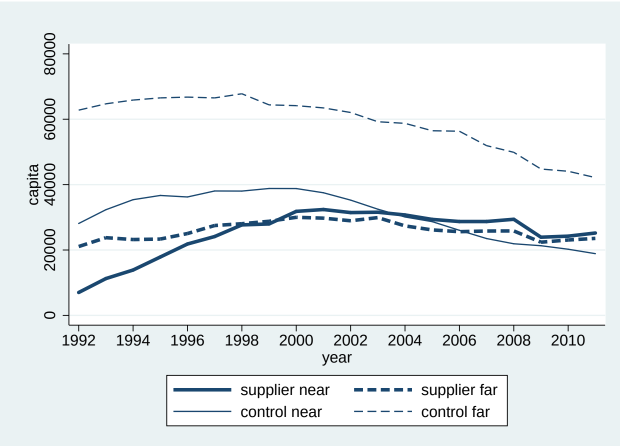
$$\frac{Y_{98}-Y_{93}}{Y_{93}} = \frac{\sum\limits_{i\in C}(y_{i,98}-y_{i,93})}{\sum\limits_{i\in C} y_{i,93}}\frac{\sum\limits_{i\in C} y_{i,93}}{Y_{93}} + \frac{NE\bar{y}_{93}}{Y_{93}} + \frac{\sum\limits_{i\in E}(y_{i,98}-\bar{y}_{93})}{Y_{93}} - \frac{NX\bar{y}_{93}}{Y_{93}} - \frac{\sum\limits_{i\in X}(y_{i,93}-\bar{y}_{93})}{Y_{93}}, \tag{1.4}$$

[7]Patterns are even clearer in Figure A.4 of the Appendix. Taking the log of the same measures, Figure A.4 shows the cross-region differences, normalized to zero just after the Audi entry.

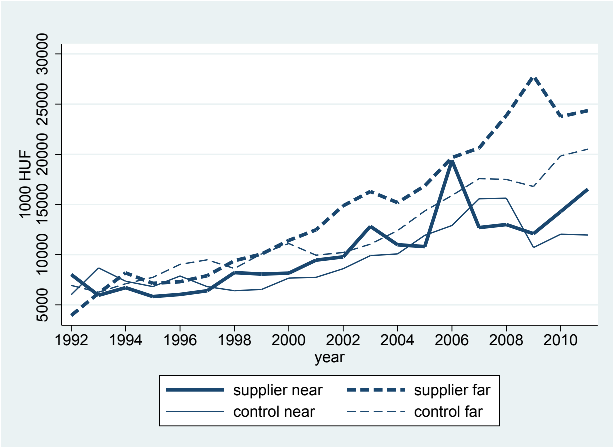
Figure 1.2: The evolution of total sales, total employment and average productivity in the different firm groups



(a) Sales



(b) Employment



(c) Average productivity

where Y_t is total sales or employment in year t, $y_{i,t}$ denotes firm-level sales or employment and $\bar{y}_t$ denotes average sales or employment in year t. C is the group of continuing firms being present both in 1993 and 1998, E is the group of new entrants from 1993 to 1998 and X is the group of exiting firms in the same period. N denotes the number of firms in a given group. The first term is the share of continuing firms, the second and fourth are the shares of entrants and exiting firms assuming no composition effect. The third and fifth terms measure the contribution of composition change coming from entrants and exiting firms. I do the triple difference-in-differences calculations for each of the five terms separately. With this back of the envelope calculation I find that the share of the continuing firms in the total effect of Audi is 18% for sales and 19% for employment. The share of entrants neglecting composition change is 21% for sales and 37% for employment. The share of composition change coming from entrants is 59% for sales and 41% for employment. The total share of exiting firms is negligible. This suggests that it is important to take into account both the incumbents and the new entrants when I want to capture the total effect of Audi. These calculations are only approximations, as I neglect potential composition differences across the firm groups. In the followings I provide more precise estimates using firm-level regressions.

In this section I first present estimates of the average firm-level effect and show heterogeneity by firm characteristics (intensive-margin effect). Next, I look at the number and the composition of new entrants and exiting firms (extensive-margin effect). I also check separately the characteristics of entrants by the time of entry and their growth afterwards. Finally, I provide industry-level estimates which incorporate the effect on both the intensive and extensive margin and also capture heterogeneity in the firm-level effects (total effect).

1.4.2 The effect of Audi on the intensive margin

Demand effect

My baseline firm-level estimates use the simplest version of equation 1.3, where I include a single indicator for the entire period after the Audi entry. The first three columns of Table 1.2 show the estimated effect of Audi on sales, domestic sales and employment. In the average firm located nearby and operating in a supplier industry, yearly sales and domestic sales increased by 35 percentage points and employment increased by 31 percentage points

Table 1.2: The effect of Audi on sales and employment

Dep. var.:	log sales (1)	log domestic sales (2)	log employment (3)	log sales (4)	log domestic sales (5)	log employment (6)
Triple interaction term with after dummy	0.347** (0.151)	0.346** (0.159)	0.309*** (0.105)	0.140 (0.139)	0.129 (0.152)	0.141 (0.099)
Triple interaction term with after trend				0.028** (0.011)	0.030** (0.012)	0.023*** (0.009)
Double interaction terms	YES	YES	YES	YES	YES	YES
After entry dummy	YES	YES	YES	YES	YES	YES
After entry trend	NO	NO	NO	YES	YES	YES
Industry-year-fixed effects	YES	YES	YES	YES	YES	YES
Firm-fixed effects	YES	YES	YES	YES	YES	YES
Observations	54,017	51,857	53,394	54,017	51,857	53,394
Number of firms	5,427	5,410	5,434	5,427	5,410	5,434

Triple interaction term: time dummy or time trend for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: time dummy or time trend for after Audi entry years interacted with close to Audi location dummy or with supplier-industry dummy. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét. Industry-year-fixed effects use 2-digit industry classifications.

after the entry of Audi. These results are in line with a demand effect of Audi.

Using the more flexible versions of equation 1.3 I check the dynamics of the estimated demand effect. Columns (4)-(6) of Table 1.2 present estimation results from the specification which allows a separate effect on the level and the trend of the outcome variables. Results suggest that most of the effect comes from a significantly positive break in the trend rather than a jump in the level. Assuming that growth rates across firm groups before the Audi entry were the same, I find that the average annual growth rate of sales and domestic sales increased by 2.8 and 3 percentage points and the growth rate of employment increased by 2.3 percentage points after the Audi entry. Estimating the effect of Audi by sub-periods suggests that this pattern is partly driven by the time lag between the entry of Audi and its effect on local firms. Table A.6 of the Appendix shows no significant effect on sales and only marginally significant effect on employment in the sub-period 1994-1997. Coefficient estimates by sub-periods increasing over time are in line with a positive effect on the growth rate of sales and employment. Table A.8 of the Appendix shows similarly increasing patterns from first, second, third and fifth difference estimation results.

I use the most flexible specification to see the full dynamics of the Audi effect. I estimate a version of equation 1.3 with a full set of year dummies and without industry-year-fixed effects. This allows me to plot the estimated pattern of log sales, log domestic sales and log employment in the four firm groups over time. In each firm group I normal-

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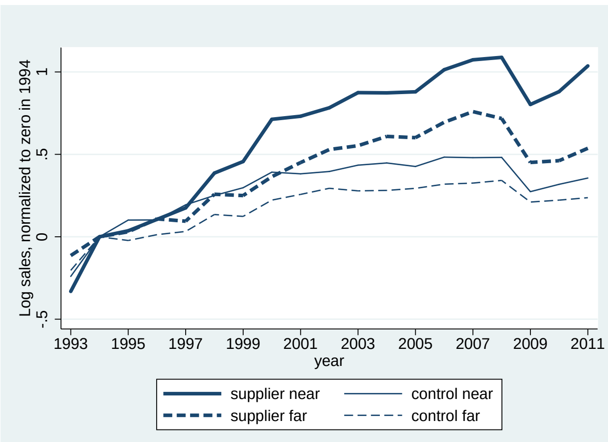
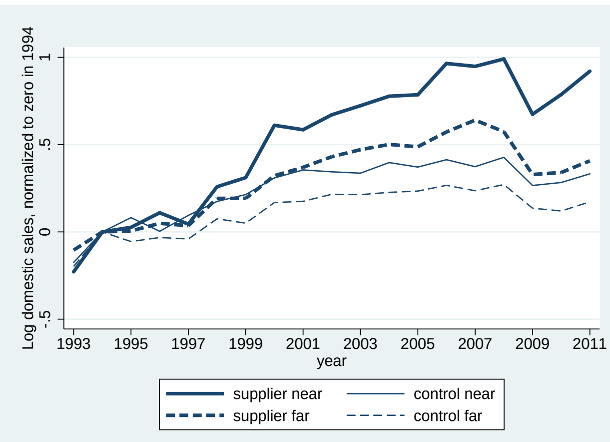
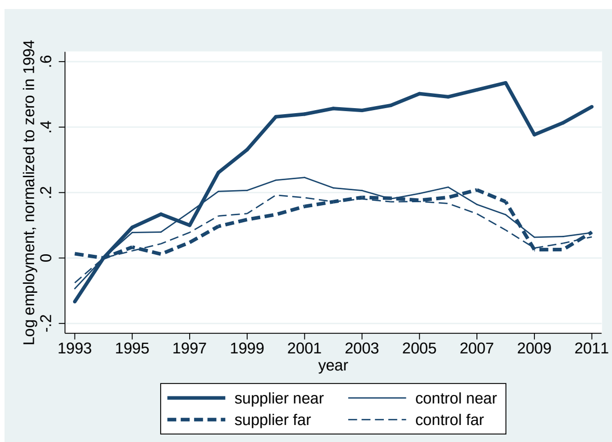
Figure 1.3: The evolution of average log sales, log domestic sales and log employment in the different firm groups, normalized to zero for all groups in 1994



(a) Sales



(b) Domestic sales



(c) Employment

ize the values to zero in 1994. Figure 1.3 presents the normalized value of the estimated coefficients on the year dummies in the corresponding firm group: β_1 for control-industry firms in the control region, $\beta_1 + \beta_3$ for control-industry firms in the treated region, $\beta_1 + \beta_2$ for supplier-industry firms in the control region and $\beta_1 + \beta_2 + \beta_3 + \beta_4$ for supplier-industry firms in the treated region. Figure 1.3 shows that sales, domestic sales and employment moved together in control-industry firms located near Audi and in the control region. Apart from a moderate shift in levels the figure shows no systematic difference between close and far regions. The average employment of supplier-industry firms in the control region also evolved in a similar way. Though average sales and domestic sales of supplier-industry firms increased more rapidly even in the control region, sales of supplier-industry firms increased in the treated region even more than that. Figure 1.3 suggests that the positive effect of Audi on local firms was not immediate. This pattern is in line with the information that Audi built up its local supplier links gradually. Most of the difference between treated and control firms comes from the larger growth rate of treated firms between 1998-2000. This period corresponds to the second phase of the Audi investment, when the sales of Audi also increased to a large extent (see Figure A.1 of the Appendix). After 2000 the difference in levels remained, but growth rates became similar for supplier-industry firms in the treated and control regions. Figure A.5 of the Appendix presents coefficient estimates on the triple interaction terms using the most flexible specification with 2-digit industry-year-fixed effects. With 1992-1993 as the reference period, Figure A.5 shows that the effect of Audi increased over time and became significant only in 1998 for employment and in 2000 for sales and domestic sales.

The effect on productivity and trade

The next set of firm-level outcomes I look at is productivity and exports. In Table 1.3 I present estimation results using the baseline specification with a single indicator for the whole period after the entry of Audi. The first two columns show that Audi did not increase significantly the productivity of local supplier-industry firms. Estimates using either productivity measures are negative and even marginally significant for total factor productivity. Estimates are noisy and significance is not robust to specification changes. I conclude that Audi had no significant effect on the productivity of closely located firms operating in the supplier industry. This result is in line with Javorcik (2004), who finds no significant productivity increasing effect of foreign greenfield investments. Still, a positive demand effect combined with no effect on productivity is a puzzle.

Table 1.3: The effect of Audi on productivity and trade

Dep. var.:	labor productivity	total factor productivity	log exported value: to all destinations	log exported value: to Germany	log exported value: to Austria	probability of starting to export	log imported value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Triple interaction term	-0.087	-0.114*	0.223	0.275	1.165**	0.049	-0.277
	(0.089)	(0.063)	(0.319)	(0.410)	(0.483)	(0.038)	(0.277)
Double interaction terms	YES	YES	YES	YES	YES	YES	YES
After entry dummy	YES	YES	YES	YES	YES	YES	YES
Industry-year-fixed effects	YES	YES	YES	YES	YES	YES	YES
Firm-fixed effects	YES	YES	YES	YES	YES	NO	YES
Observations	51,663	50,341	12,681	6,944	4,472	21,862	13,798
Number of firms	5,409	5,233	2,424	1,488	1,096		2,694

Triple interaction term: time dummy for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or with supplier-industry dummy. Labor productivity is value added per capita, total factor productivity is estimated from a Cobb-Douglas production function with coefficients varying by 2-digit industries. Both are measured in logs. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét. Industry-year-fixed effects use 2-digit industry classifications.

Columns (3)-(7) of Table 1.3 show the effect of the Audi entry on the extensive and intensive margin of exports and on imports. I measure the extensive margin effect by changes in the probability of starting to export, conditional on not exporting before. I use changes in the exported value to measure the effect on the intensive margin. For estimating the extensive margin I use a simple linear probability model without firm-fixed effects, where the left-hand side variable is a dummy being one if the firm starts to export in the given year. I include firms only in those years when they start to export or when they haven't started to export yet. I use the sample of firms which already existed before the entry of Audi. I also estimate intensive- and extensive-margin effects separately for Germany and Austria. Spillovers might be specific to these countries, as Germany is the home country of Audi and also the largest trade partner of Hungary, and Austria is the neighboring country of the county Győr with cultural links to Germany. Table 1.3 shows no significant impact of Audi on exports or imports. The only exception is a significantly positive effect on the exported value to Austria, which is the closest and easiest export destination for firms located close to Győr. This might suggest an export promoting effect of Audi specifically to Austria. Firms in the treated group might have used better marketing techniques or got better foreign contacts which helped them to sell their products abroad even without any productivity increase. Alternatively, country-specific export activity of firms in the treated and control industry differs to such an extent that the design I use cannot account for regional differences. Overall, I conclude that Audi did not have a clearly positive effect on trade. Table A.6 and A.7 of the Appendix show similar patterns separately by sub-periods.

Heterogeneity of the effect by firm groups

After estimating average firm-level effects, I allow for heterogeneous effects by different types of local firms. In this way I can learn more about the mechanism of the Audi effect. I check if the effect of Audi varies by ownership structure, size or initial productivity of the local firms. I differentiate firms with foreign owners and firms which have only domestic owners. I classify a firm as domestic if it never has a foreign owner in the period of 1992-2011. In this way I can separate firms with foreign owners, which might have had access to resources or knowledge directly through their foreign owners and not through their contacts with Audi.[8] I assign firms to size and productivity tertiles based on their employment and estimated total factor productivity in 1993, one year before the Audi entry. I create productivity tertiles for each 2-digit industry separately. For estimating heterogeneous effects I use a modified version of the baseline specification:

$$\begin{aligned} Y_{it} = \gamma_0 &+ \sum_k \gamma_1 D_t Group_{k,i} + \sum_k \gamma_2 D_t Supplier_{j(i)} Group_{k,i} + \sum_k \gamma_3 D_t Near_i Group_{k,i} \\ &+ \sum_k \gamma_4 D_t Supplier_{j(i)} Near_i Group_{k,i} + a_i + s_{jt} + u_{it}. \end{aligned} \tag{1.5}$$

As before, i stands for firm, j is industry group and t is year. $Group_{k,i}$ is a dummy variable being 1 if firm i belongs to group k. Group k can be a size or productivity tertile, or it can refer to domestic ownership. Coefficient vector γ_4 shows the estimated effect of Audi in the different subgroups. In the estimations by ownership group, γ_4 shows the additional effect on domestic firms compared to the reference group. As in equation 1.3, D_t is a time indicator, which can either be a single dummy for the period after the Audi entry, a dummy and a trend after the Audi entry, or a full set of year dummies. *Supplier* is an indicator of supplier-industry firms and *Near* is an indicator for firms located close to Audi.

Table 1.4 shows the estimated effects by ownership group. The coefficient on the triple interaction term $D_t Supplier_i Near_i$ measures the effect on firms having foreign owners at any point in time. Adding up this term and its interaction with the *Domestic* dummy gives the effect of Audi on domestic firms. The patterns are clear, employment, sales,

[8] The number of firms with foreign owners by firm group can be found in Table A.9 of the Appendix.

Table 1.4: The effect of Audi by ownership

Dep. var.:	log sales (1)	log domestic sales (2)	log employment (3)	labor productivity (4)	total factor productivity (5)	log exported value (6)	log imported value (7)
Triple interaction term	0.878***	1.014***	0.892***	-0.252	-0.155	1.041**	0.410
	(0.317)	(0.375)	(0.215)	(0.190)	(0.150)	(0.479)	(0.385)
Triple interaction term x	-0.775**	-0.923**	-0.843***	0.197	0.048	-1.456**	-1.458**
domestic dummy	(0.363)	(0.416)	(0.252)	(0.208)	(0.164)	(0.657)	(0.583)
Double interaction terms	YES	YES	YES	YES	YES	YES	YES
After entry dummy	YES	YES	YES	YES	YES	YES	YES
Industry-year-fixed effects	YES	YES	YES	YES	YES	YES	YES
Firm-fixed effects	YES	YES	YES	YES	YES	YES	YES
Observations	51,287	49,166	50,658	49,008	47,937	12,466	13,571

Triple interaction term: time dummy for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or with supplier industry dummy. All these are also interacted with domestic dummy being one in case of 100% domestic ownership in every year. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét. Labor productivity is value added per capita, total factor productivity is estimated from a Cobb-Douglas production function with coefficients varying by 2-digit industries. Both are measured in logs. Only domestic (always 100%) and foreign (minimum 20% foreign ownership at some point) owned firms are included. Industry-year fixed effects use 2-digit industry classifications.

domestic sales and exports became significantly higher in firms with foreign owners after the Audi entry. The same effects are close to zero for domestic firms and the estimated effect on imports is significantly negative. Imported inputs might have been substituted by the output of expanding local firms having foreign owners. Productivity estimates are negative but insignificant in both firm groups. The estimated positive demand effect of Audi is driven by firms with foreign owners which existed already before the entry of Audi. This finding is in line with the commonly held view that Audi had only few local suppliers and most of these were foreign-owned. Though the difference is not significant, Table A.10 of the Appendix suggests that the effect was even larger for those firms where the owners come from countries in which Germans have more trust according to the Eurobarometer survey. On average, domestic firms in the supplier industries could not benefit from the presence of Audi, even if I include tier-2 supplier industries in the estimation. At the same time, this finding suggests a foreign-to-foreign complementarity in investments. A new FDI can have a positive effect on other FDI-s being already present in the host country. This channel should be taken into account in evaluations of the FDI effect.

The effect of Audi also differs by the initial productivity of the local firms. Table 1.5 shows that the estimated effect on sales, domestic sales and employment is smaller and insignificant in the lowest productivity tertile. Medium- and high-productivity firms

Table 1.5: The effect of Audi by productivity

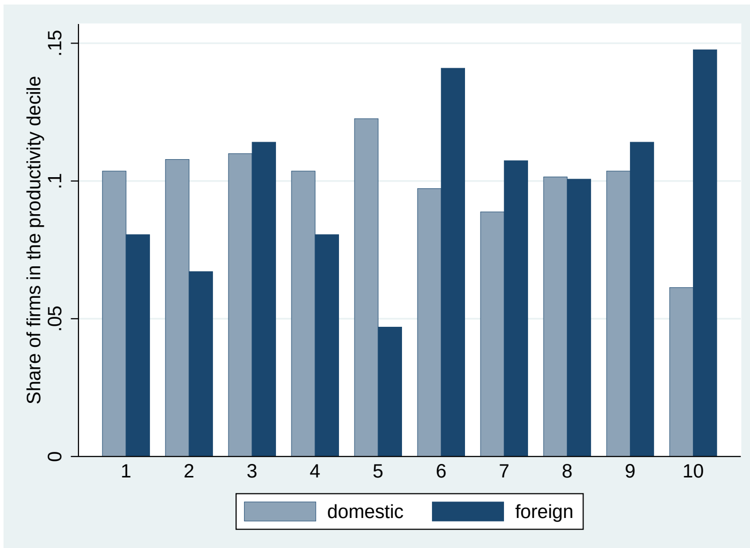
Dep. var.:		log sales	log domestic sales	log employment	labor productivity	total factor productivity	log exported value	log imported value
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Triple interaction term X productivity tertiles	1st tertile	0.127	0.054	0.203	-0.225	-0.142	-0.746	-0.233
		(0.307)	(0.301)	(0.182)	(0.159)	(0.111)	(0.587)	(0.620)
	2nd tertile	0.459**	0.573**	0.363**	-0.034	-0.155*	0.831	-0.705
		(0.218)	(0.256)	(0.163)	(0.128)	(0.082)	(0.560)	(0.492)
	3rd tertile	0.464**	0.411	0.370**	-0.050	-0.098	-0.067	-0.298
		(0.222)	(0.267)	(0.185)	(0.166)	(0.136)	(0.512)	(0.401)
Double interaction terms		YES	YES	YES	YES	YES	YES	YES
After entry period dummy		YES	YES	YES	YES	YES	YES	YES
Industry-year-fixed effects		YES	YES	YES	YES	YES	YES	YES
Firm-fixed effects		YES	YES	YES	YES	YES	YES	YES
Observations		21,456	20,796	21,203	20,735	20,527	7,053	7,622

Triple interaction term: time dummy for after Audi entry, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or with supplier industry dummy. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included Control region: 80 km around Kecskemét. Labor productivity is value added per capita, total factor productivity is estimated from a Cobb-Douglas production function with coefficients varying by 2-digit industries. Both are measured in logs. Productivity tertiles determined based on before Audi performance, within each 2-digit industry. Industry-year fixed effects use 2-digit industry categories.

can benefit from a demand effect to the same extent. Productivity estimates are always negative but insignificant, and only marginally significant for medium-productivity firms. Exports and imports are not affected in any productivity group either. Table A.11 of the Appendix shows that not the largest firms move the results. The employment and sales effects are even larger for small or medium-size firms, and the effect on domestic sales is similar across size groups. Effects on sales and domestic sales are not significant any more, presumably due to the lower sample size within a group. The main patterns suggest that rather smaller and more productive firms could benefit from the presence of Audi. Looking at the joint effect of different firm characteristics, Table A.12 of the Appendix shows that the Audi effect is mainly driven by firms with foreign owners. The estimated effect on firms with foreign owners is higher in all size and productivity groups, though the difference is not always significant. Table A.13 of the Appendix shows that the additional effect of higher productivity is not uniform across size groups. Overall, medium-size and medium-productivity firms gained the most.

Combining the results by ownership and productivity suggests a possible explanation for the puzzle of having a demand effect without any effect on productivity. Figure 1.4 presents the productivity distribution of local firms by ownership one year before the entry of Audi. Compared to those firms which ever have a foreign owner, the productivity distri-

Figure 1.4: The histogram of estimated total factor productivity for domestic and foreign firms in 1993



bution of domestic firms is shifted to the left. There are relatively more low-productivity firms among the domestic firms. This productivity gap might have prevented domestic firms from enjoying the benefits of Audi's presence. On the other hand, firms with foreign-owners might have had less room to increase their productivity.

Robustness checks

The main concern with my identification strategy is whether firms in the treated group had a higher growth potential and would have grown more even without the entry of Audi. The treated region can be special in attracting investments into machinery and electronics due to its economic traditions. Unfortunately, as the Audi entry is close to the political transition in Hungary, I have only two years of pre-period data. This timing makes it impossible to compare pre-trends reliably. Still, there is some evidence that not pre-trend differences move my results. First, industry composition is similar in the two regions before the Audi entry (see Table A.5 of the Appendix). Second, I can use an alternative approach to control for potential differences in pre-trends, exploiting the observation that I estimate an insignificant effect for the period 1994-1997. I extend the pre-entry period to 1992-1997, assuming that Audi had an effect on the local supplier-industry firms only after the second phase of the investment, which started in 1998. This assumption is in line with my previous estimates (see Figure A.5 of the Appendix). Similarly to Figure 1.3,

Figure A.6 of the Appendix shows the evolution of sales, domestic sales and employment in the four firm groups separately, but with a different normalization, setting the values to zero in 1997. The plots suggest that sales evolved in a parallel fashion within the same region until 1997. The evolution of domestic sales is also similar within the supplier industry up to 1997. Pre-trend differences in employment are larger. Still, the evolution of employment within the treated region is fairly similar in the period 1992-1997 compared to the large differences after 1997. Additionally, employment evolved in a similar way within the control region even after 1997. Third, as a robustness check I use an alternative control region: Pest county and Budapest (also showed in Figure 1.1). This location is more similar to the treated region than the baseline control area in terms of economic development measured in GDP per capita. On the other hand, it is more different from the treated region in other aspects, like industrial composition. The last two columns of Table A.15 in the Appendix show that the estimates for sales and employment are robust to changing the control region.

A second concern is the presence of Opel and Suzuki on the edge of the treated region. As a result, the measured effect might not be attributed to Audi only. On one hand, Opel and Suzuki are smaller than Audi (see Figure A.1 of the Appendix). On the other hand, they are known to have more local suppliers. I cannot fully exclude the possibility that part of the measured effect comes from the presence of Opel or Suzuki, but the timing of my analysis makes this problem less relevant. Opel and Suzuki were already present before the entry of Audi, so pre-post analysis should control for their presence. Additionally, the dynamics of the measured effect correspond to the the dynamics of the Audi investment.

Third, if the presence of Audi had a negative effect on control firms, I might overestimate the effect of Audi. High-quality labor might have moved away into the treated region or moved from the control industry into the supplier industry within the treated region. This movement could lead to the worsening performance of firms in the control region or in the control industries. As a result, part of the estimated difference between treated and controls would come from the crowding-out effect on control firms. I cannot completely rule out this possibility, but patterns of increasing average firm-level sales in all the four firm groups seem to contradict a negative effect on controls (see Figure 1.3a).

Finally, some of the foreign-owned firms already existing before the entry of Audi might have located close to Győr because of Audi, if they were already aware of the location choice of Audi. For these firms the entry of Audi was not an exogenous shock, and I might overestimate the effect of Audi if these firms had a high growth potential even without Audi. At the same time, these foreign-owned firms would not have come to Hungary if Audi had not located in Győr. Still, it is not part of the intensive-margin effect. A robustness check where I only include firms which were already present in 1992 gives similar results to my baseline estimates. This rules out the possibility that foreign firms entering in 1993 drive my results. As a related concern, I also rule out the possibility that different age composition across the four firm groups is the main driver of my estimates. If the growth rate of young firms is higher and there are more young firms in the treated group, my estimates might only reflect a different age structure. Yet, my results are robust to controlling for firm age. See both robustness checks in Table A.14 of the Appendix.

As further robustness checks I compare estimates using the baseline specification with and without fixed effects. When I exclude firm-fixed effects I use the sub-sample of firms which were already present before the Audi entry. In this way I identify the effect from the same set of firms. Table A.15 shows that the estimated coefficients are robust to these specification changes.

Magnitude of the estimated demand effect

The specification including both a dummy and a trend for the period after the Audi entry suggests that the presence of Audi increased the average annual growth rate of sales and domestic sales by 2.8 and 3 percentage points and the annual growth rate of employment increased by 2.3 percentage points (see Table 1.2). For these estimates I assume that the pre-trends were the same in all the four firm groups. Although I cannot test this assumption, I can calculate the effect on the annual growth rates in an alternative way. For this calculation I use 1992-1997 as the pre-entry period, since I only estimate a significant Audi effect from 1998 on, when the second phase of the investment started. I also exclude the crisis years and use 1998-2008 as the period after the Audi entry. I use estimates from the flexible version of equation 1.3 with a full set of year dummies. I calculate the effect on the yearly growth rate as:

$$\frac{\beta_4^{2008} - \beta_4^{1997}}{11} - \frac{\beta_4^{1997} - \beta_4^{1993}}{4}, \tag{1.6}$$

where β_4^t refers to the estimated coefficient on the triple interaction term of *Supplier* and *Near* dummies with a dummy for year t.[9] As a result I get 0.3 percentage point increase in

[9] More precise calculations using the formula $e^{\beta} - 1$ for the estimated growth rate and calculating the average growth rate separately for all the four firm groups give very similar numbers.

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sales, 3 percentage points in domestic sales and the change is close to zero for employment. The estimated patterns using the flexible specification suggest that most of the change in trends comes from the period 1998-2000. When I repeat my calculations using 1998-2000 as the post-entry period I get 6 percentage points increase in sales and employment and 9 percentage points in domestic sales. My previous estimates assuming no differences in pre-entry trends across firms groups are larger than the calculated effect on growth rates for the period 1998-2008. As in the calculations I assume that Audi had no effect up to 1998, the true effects are likely to be in between the two results.

In order to provide a benchmark for my estimates I compare them to other estimates in the literature measuring the effect of different interventions. Specifically, I use the effect of exporting on sales and employment as a comparison. Bernard and Jensen (1999) find that the annual growth rate of employment is 2-2.5 percentage points higher for exporters in the short run and 0.4-1.7 percentage points higher in the longer-run. After a firm starts to export, the average annual growth rate becomes higher by 5.6 percentage points. Girma et al. (2004) find that right after the export entry the growth rate of employment increases by 2-3.6 percentage points and the growth rate of sales increases by 1.3-2.8 percentage points. The estimated effect of export on sales and employment has a magnitude similar to my findings.

1.4.3 Extensive-margin effects

After estimating the intensive-margin effect on incumbent firms, I look at the extensive margin. I check separately the potential effect of Audi on the number and the composition of the entrant and exiting firms. I further divide the effect on the composition of new entrants to differences in size at entry and differences in subsequent growth. When I look at the effect on new entrants, I need an additional identifying assumption. As the presence of Audi is not an exogenous shock for firms entering after the Audi entry, I have to assume that the difference-in-differences strategy controls for any locating factors other than Audi which are specific for the region close to Audi.

The number of entries and exits

I find no significant effect on the number of entries and exits. Figure A.7 of the Appendix shows how the number of firms evolved over time in the four firm groups, separately by ownership. I use the same classification for firms with domestic or foreign owners as before.

The number of firms in full domestic ownership evolved in a parallel way within the treated region and in the two supplier-industry groups. The number of firms with foreign owners started to decline later and declined less in the treated group than in the control industry group or in the control region. This pattern is in line with Audi attracting other FDI in related industries. At the same time, the yearly number of new entries is not significantly higher in the treated group.

Looking at exits, I use a modified version of equation 1.3. I use a dummy for exit in the next period as a dependent variable, and I estimate the baseline specification without firm-fixed effects. I also include time-varying firm-level controls: age, employment, productivity and exporter status. I present the estimation results in Table A.18 of the Appendix. Estimates show no significant effect of Audi on the exit probability of firms. I conclude that Audi had no significant effect on the number of exits either.

The composition of new entrants and exiting firms

Next, I check potential differences in the characteristics of the new entrants and the exiting firms. I start with those firms which enter after Audi. I look at their characteristics two years after they first appear in the balance sheet data. This time lag after the entry is necessary, as I would like to exclude any transitory period before full operation starts in the new firms. In this way I cannot do a comparison before and after the Audi entry, and I only estimate a simple difference-in-differences specification. Table 1.6 presents the estimation results. The interaction term coefficients show that new entrants operating in the supplier-industry and locating close to Audi are significantly larger, having 36 percentage points higher sales. The estimated difference in employment, productivity or exports is also positive but estimates are noisy and insignificant. Table A.19 of the Appendix shows a similar comparison for exiting firms in their last year of existence. The estimates might suggest that exiting firms in the treated group are less productive and trade less, but the coefficients are not significant or only marginally significant.

I look at the effect of Audi on the growth of the new firms separately. I estimate similar regressions as in Table 1.6, with first differences of the log of firm characteristics on the left-hand side as the measure of growth, and also controlling for yearly 2-digit industry-level shocks. Table 1.7 shows that new entrants' growth in sales, employment, productivity and exports is significantly higher when they are located close to Audi and operate in a supplier industry. The estimates suggest, that the composition of the new entrants is different in the treated firm group, the firms are larger and grow faster compared to the

Table 1.6: The characteristics of new firms by firm group

Dep. var.:	log sales (1)	log domestic sales (2)	log employment (3)	labor productivity (4)	total factor productivity (5)	log exported value (6)	log imported value (7)
Interaction term	0.355**	-0.010	0.151	0.143	0.058	0.611	-0.115
	(0.172)	(0.170)	(0.121)	(0.117)	(0.135)	(0.471)	(0.492)
Industry and region dummies	YES	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES
Observations	2,978	2,822	2,965	2,893	2,797	751	804

Sample: new firms entering after the Audi entry in their third year of operation. Interaction term: region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees considered. Control region: 80 km around Kecskemét. Labor productivity is value added per capita, total factor productivity is estimated from a Cobb-Douglas production function with coefficients varying by 2-digit industries. Both are measured in logs.

Table 1.7: The growth of new firms by firm group

Sample: new firms entering from 1994 on

Dep. var.:	sales growth (1)	domestic sales growth (2)	employment growth (3)	labor productivity growth (4)	total factor productivity growth (5)	export growth (6)	import growth (7)
Interaction term	0.048*	0.043	0.034**	0.024*	0.020*	0.185**	0.080
	(0.025)	(0.026)	(0.017)	(0.015)	(0.010)	(0.084)	(0.101)
Near, supplier dummies	YES	YES	YES	YES	YES	YES	YES
Year-industry-fixed effect	YES	YES	YES	YES	YES	YES	YES
Observations	25,644	23,837	25,446	24,174	23,600	3,271	3,546

Sample: new firms entering after the Audi entry. Dependent variables are first differences of log values of firm characteristics. Interaction term: region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees considered. Control region: 80 km around Kecskemét. Labor productivity is value added per capita, total factor productivity is estimated from a Cobb-Douglas production function with coefficients varying by 2-digit industries. Both are measured in logs. Year-industry-fixed effects use 2-digit industry classifications.

controls. Concerning growth, I cannot distinguish two potential channels: this pattern might either be the direct effect of Audi on firm growth (intensive-margin effect on the new firms), or the effect of Audi on the composition of new entrants, i.e. firms with larger growth potential locate close to Audi.

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1.4.4 The total effect of Audi

Industry-level effects

So far I showed that Audi had a significant effect on the treated firm group both on the intensive and on the extensive margin. In this section I capture the total effect of Audi on the local supplier industry. As the firm-level effect is heterogeneous by different firm characteristics, the total effect is likely to differ from a simple aggregation of the average firm-level estimates on the intensive and extensive margin. To capture the total effect, I estimate a modified version of equation 1.3, where the unit of observation is a 4-digit industry in one of the two regions. As before, I include 2-digit industry-year-fixed effects. I cluster the standard errors by 2-digit industry within a supplier group and region. As a dependent variable I include the log of total sales, employment, domestic sales or exported value, at the industry-level. I use industry-level averages of the productivity measures. The share of exporters on the left-hand side captures the effect on export entry. I estimate weighted regressions, where the weight is the employment share of a 4-digit industry one year before the Audi entry. I expect that the estimated weighted average effect corresponds to the total effect of Audi. For the identification I assume that regional characteristics other than the presence of Audi (e.g. closeness to Austria) are similarly attractive for new entrants in supplier and control industries. Then the estimated coefficient on the triple interaction term captures the total effect of Audi on the aggregate performance of all the supplier industries in the treated region.

Table 1.8 and 1.9 show the results of industry-level estimates. As in the firm-level estimates, the effect on sales, domestic sales and employment is significantly positive. Estimated coefficients are about 3-times higher than before, which suggests that Audi had a sizable effect on new firms entering after 1993. There is no significant effect on average productivity, but the effect on industry-level exports is positive. As I expect, the exported value to Austria or Germany increased even more than average exports. The share of exporters to Germany is also significantly higher in the treated group after the Audi entry. As firm-level estimates show no significant effect on exports, new entrants exporting to Austria and Germany might move the industry-level estimates.

In order to look at the dynamics of the effect I use a more flexible specification including both a dummy and a trend for the period after the Audi entry. Table A.16 and A.17 of the Appendix show the results. The annual growth rate of total sales and total domestic sales increased by 8 and 6 percentage points. There is both a jump in the level and a shift

Table 1.8: The effect of Audi across 4-digit industries: sales, employment and productivity

Unit of obs.: NACE 4 industry by region

Dep. var.:	log sales (1)	log domestic sales (2)	log employment (3)	labor productivity (4)	total factor productivity (5)
Triple interaction term	0.981***	0.966***	0.744***	-0.177	-0.050
	(0.269)	(0.312)	(0.175)	(0.180)	(0.101)
Double interaction terms	YES	YES	YES	YES	YES
After entry dummy	YES	YES	YES	YES	YES
Industry-year-fixed effects	YES	YES	YES	YES	YES
Observations	6,387	6,322	6,283	6,212	6,109

Triple interaction term: time dummy for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or with supplier industry dummy. Control region: 80 km around Kecskemét. Labor productivity and total factor productivity are calculated as yearly 4-digit industry averages. Idustry-year fixed effects use 2-digit industry classification. Weighted regressions, using total employment by NACE4 in 1993 as weights. Standard errors are clustered by 2-digit industry-supplier group-region.

Table 1.9: The effect of Audi across 4-digit industries: trade

Unit of obs.: NACE 4 industry by region

Dep. var.:	log exported value			share of exporters			log imported value
	to all destinations	to Germany	to Austria	to all destinations	to Germany	to Austria	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Triple interaction term	1.021*	1.479***	1.455**	-0.004	0.045**	0.014	0.432
	(0.532)	(0.503)	(0.691)	(0.042)	(0.021)	(0.024)	(0.457)
Double interaction terms	YES	YES	YES	YES	YES	YES	YES
After entry dummy	YES	YES	YES	YES	YES	YES	YES
Industry-year-fixed effects	YES	YES	YES	YES	YES	YES	YES
Observations	3,068	2,300	1,984	3,882	3,882	3,882	3,200

Triple interaction term: time dummy for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or with supplier industry dummy. Control region: 80 km around Kecskemét. Industry-year-fixed effects use 2-digit industry classification. Weighted regressions, using total employment by NACE4 in 1993 as weights. Standard errors are clustered by 2-digit industry-supplier group-region.

in the trend for employment, increasing the annual growth rate by 4 percentage points. There is a large increase in exports, the annual growth rate of total exports to Germany and Austria is 22 and 13 percentage points higher after the Audi entry. Results for the share of exporters to Germany suggest that new exporters arrived within a short period.

Magnitude and composition of the total effect

Finally, I do some back of the envelope calculations to capture the magnitude of the total Audi effect. First I calculate the yearly contribution of Audi to total sales and total employment in the supplier industry. For the calculations I use the results from the industry-level estimations, and assume that the effect of Audi was homogeneous across years. As $E(log(y)) \neq log(E(y))$, I need to account for potential heteroskedasticity and make further adjustments to get the effect on the level of aggregate sales and employment. I follow the solution proposed by Silva and Silva and Tenreyro (2006) and I estimate the multiplicative model of the form $E(y_i|X_i) = e^{\beta X_i}$ using Poisson regressions, where y is either industry-level sales or employment and X includes supplier industry, close to Audi region and after Audi entry indicators, their interactions and the fixed effects as in Table 1.8. Then I calculate the yearly total effect of Audi in the following way:

$$TotalEffect_t = \sum_{j=1}^{n}(y_{jrt} - \frac{\hat{y_{jrt}}}{e^{\beta_4}})|_{Supplier_j=1,Near_r=1,After_t=1}, \tag{1.7}$$

where j is industry, r is region, t is year, y can be employment or sales, $\hat{y}$ is the predicted value from the Poisson regression and β_4 is the estimated coefficient on the triple interaction term. In the calculations I include only supplier industries located near Audi in the period after the Audi entry. Figure 1.5 shows the calculated yearly total effect of Audi on sales and employment with the 95% confidence interval calculated by bootstrap.

I also check the economic significance of my estimates, comparing the estimated effect and the direct contribution of Audi to the Hungarian GDP. For this calculation I use the industry-level estimates presented in Figure 1.5. I also consider that firms in the treated group might use inputs coming partly from control firms. Using the input-output table, I calculate the share of inputs supplier industries import or purchase from supplier industries. This is about 65% in the treated firm group. I deduct this share from the estimated value of additional total sales due to Audi, and consider the remaining as the additional value added due to Audi. As a result I find, that in an average year the calculated additional value added of local firms due to Audi was 0.5% of the Hungarian GDP. As the

Figure 1.5: The estimated total amount of additional sales and employment due to Audi

(a) Sales

(b) Employment

direct contribution of Audi to the Hungarian GDP was around 1% in 2008 (Dusek et al. (2015)), the total indirect contribution of Audi to the Hungarian GDP was about half of its direct contribution. Based on my estimates the number of additional workplaces due to Audi is about 14,500, which is four times higher than the number of people directly employed by Audi. The difference between the ratio of direct and indirect contribution to value added and employment is driven by the high value added per capita in Audi.

As a final exercise I calculate the relative importance of the intensive-margin effect on the incumbents and the effect on the size and growth of the new entrants within the total effect of Audi on sales and employment. I focus on the period 1996-2001, with the largest growth difference between supplier-industry firms located close to Audi and in the control region (see Figure 1.2). I do the following decomposition:

$$Y_t^w - Y_t^{wo} = \sum_{i \in BOTH} y_{i,t}^w + \sum_{i \in ONLY\_W} y_{i,t}^w - \sum_{i \in BOTH} y_{i,t}^{wo} - \sum_{i \in ONLY\_WO} y_{i,t}^{wo}, \tag{1.8}$$

where Y_t is total sales or employment in the treated firm group in year t and $y_{i,t}$ is a firm-level measure. w refers to the observed case with Audi and wo refers to the counterfactual situation without Audi. $BOTH$ refers to firms being present both with and without Audi, $ONLY\_W$ refers to firms which wouldn't have been present without Audi and $ONLY\_WO$ refers to firms which would have been there without Audi but exited or didn't enter with Audi. As I find no significant difference in the number of new entrants or exiting firms, I can neglect the second and the fourth term. I decompose the total effect further to the contribution of firms already existing before the Audi entry (OLD) and entering after Audi (NEW):

$$Y_t^w - Y_t^{wo} = \sum_{i \in BOTH} y_{i,t}^w - \sum_{i \in BOTH} y_{i,t}^{wo} = \sum_{i \in OLD} y_{i,t}^w + \sum_{i \in NEW} y_{i,t}^w - \sum_{i \in OLD} y_{i,t}^{wo} - \sum_{i \in NEW} y_{i,t}^{wo} \quad (1.9)$$

Then I decompose the contribution of new firms coming from their larger size at entry and the larger growth afterwards:

$$Y_t^w - Y_t^{wo} = \left(\sum_{i \in OLD} y_{i,t}^w - \sum_{i \in OLD} y_{i,t}^{wo} \right) + \sum_{i \in NEW} \left(y_{i,t_{i0}}^w - y_{i,t_{i0}}^{wo} \right) g_{i,t_{i0},t}^w + \sum_{i \in NEW} y_{i,t_{i0}}^{wo} \left(g_{i,t_{i0},t}^w - g_{i,t_{i0},t}^{wo} \right) \quad (1.10)$$

I write yearly sales and employment as the product of initial values at entry in $t_{i,0}$ and the growth afterwards, denoted by $g_{i,t_{i0},t} = y_{i,t}/y_{i,t_{i0}}$. The first term of equation 1.10 is the intensive-margin effect on the incumbent firms which were already present before the Audi entry. The second term is the part of the Audi effect coming from the size composition of new entrants, given the observed growth of firms. The third term is the effect on the growth of new entrants, conditional on no effect on their size at entry.

I calculate the first term with a firm-level Poisson regression where I constrain the sample to firms being already present before the entry of Audi. For ease of computation I do not include firm-fixed effects[10], but allow the effect to differ by size quartiles. For calculating the second term I use Poisson estimates to get the size differences of new entrants across firm groups. I measure the size of entrants in the second year after their entry, which helps me to account for a potential transitory period. Firm-level growth rates are observed in the data. I calculate the third term as a residual, taking the results from the industry-level Poisson regressions showed in Figure 1.5 as the total effect. I find that approximately 20% of the estimated total sales increase comes from the intensive-margin effect on pre-existing firms, 20% is the contribution of the larger size of new entrants and the remaining 60% comes from the larger growth of new firms. The composition is very similar for employment: 22% of the total effect comes from the pre-existing firms, 20% comes from the larger size of the entrants and 58% comes from the larger growth of the

[10]OLS estimates give similar results with or without firm-fixed effects when I include only those firms in the estimation which already existed before the Audi entry.

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firms entering after Audi.

1.5 Conclusion

In this study I estimate the effect of Audi, a large FDI entering Hungary in 1993, on the local firms operating in supplier industries. I focus on two potential channels: the demand effect increasing sales and employment, and the knowledge spillovers increasing productivity and promoting exports. I identify supplier firms based on their industry and location. I use a triple difference-in-differences approach, where I compare the outcomes of firms in supplier and control industries, located close to Audi and in a control region, before and after the entry of Audi. I use the second best potential location choice of Audi as a control region. My results support the hypothesis that Audi had a demand effect on closely located firms operating in the supplier industries. I find a positive effect on average firm-level sales and employment, but I don't find a positive effect on productivity. The estimated effect is not immediate and also differs by firm characteristics. Firms in full domestic ownership could not benefit from the presence of Audi, and demand effect estimates are higher for more productive firms. As firms having only domestic owners had a lower initial productivity than firms with foreign owners, it seems that domestic firms could not learn from Audi due to the productivity gap. At the same time, firms with foreign owners might have had less room to learn from Audi. I do industry-level estimates to incorporate additional effects coming from new entrants, finding a positive effect on sales, employment and exports. Supplier-industry firms entering the treated region after the Audi entry are significantly larger and also grow faster. Simple calculations show that the indirect effect of Audi through the supplier industry is approximately half of its direct contribution to the Hungarian GDP. For a deeper analysis of the Audi effect it would be necessary to have data on business links, which were not available for the current study. A systematic identification of the firms supplying Audi could shed even more light on the precise mechanism and timing of the Audi effect.

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Chapter 2

The Effect of Foreign-owned Large Plant Closures on Nearby Firms

2.1 Introduction

Local spillover effects of foreign direct investment (FDI) is a widely researched topic.[1] Attracting FDI is an important goal of economic policy in many countries all over the world.[2] Some of these investments is, however, reverted within a few years, resulting in the relocation of production and plant closures. We know that mass layoffs and plant closures happen rather frequently.[3] Moreover, foreign-owned firms and especially multinationals tend to be more footloose than domestic firms.[4] In this paper I look at a much less investigated aspect of the FDI effect: the impact on the local economy when FDI leaves. As attracting or keeping existing FDI needs different policy measures, findings about the effect of FDI exits are also relevant from a policy perspective.

My contribution is threefold: first, existing papers related to this topic either investigate the consequences of mass layoffs on individuals losing their jobs (e.g. Browning

[1]See for example Javorcik (2004), Kneller and Pisu (2007), Crespo and Fontoura (2007), Smeets (2008), Meyer and Sinani (2009).

[2]e.g. http://www.cbi.org.uk/media-centre/news-articles/2012/09/how-the-us-china-and-india-try-to-attract-external-investment/.

[3]According to the US Bureau of Labor Statistics, in the first quarter of 2013 there were 914 mass layoff events in the US with about 154 thousand people being laid off (http://www.bls.gov/mls/). Before the crisis, in the period of 2000-2007 there were around 123,000 mass layoff events with altogether more than 13.7 million people being laid off (http://www.bls.gov/mls/mlspnfmle.htm).

[4]See for example Alvarez and Görg (2009), Bernard and Sjöholm (2003), Bernard and Jensen (2007), Kneller et al. (2012) and Van Beveren (2007).

and Heinesen (2012) and Eliason and Storrie (2006)), or look at the effects of large plant closures and mass layoffs on the local labor market (e.g. Gathmann et al. (2015), Jofre-Monseny et al. (2015) and Foote et al. (2015)) or on subsequent exits (e.g. Ferragina et al. (2012) and Resende et al. (2015)). In this paper I look at the effect of foreign-owned large plant closures on various aspects of local firms' performance, including sales, employment, productivity and survival. Second, by looking at the heterogeneity of the effect across firms, I provide some evidence about the various channels through which foreign-owned large plant closures affect local firms: increased labor supply, decreased demand due to lower purchasing power of unemployed local consumers and lost input-output linkages. Third, the main focus of the existing literature is either the USA and Western Europe (e.g. Gathmann et al. (2015)) or the developing world (e.g. Bernard and Sjöholm (2003)). Using Hungarian data, this paper looks at a different setting in a middle-income country.

I use press announcements from the period 1998-2009 to identify 41 cases in Hungary where a foreign-owned large plant closed and did not reopen. These are typically subsidiaries of a multinational enterprise, and can either be greenfield investments or previous foreign acquisitions. I identify nearby firms using a panel database[5] of firms operating in Hungary between 1992-2012. With a difference-in-differences strategy I compare the performance of local firms within 10 km agglomeration of the closing plant and in a comparable control area, before and after the plant closure. I assign control locations using propensity score matching. I choose the controls from those cities which had a large foreign-owned plant operating in the same 2-digit industry as the closing plant and the plant in the potential control city was still active three years after the closure event.

The identification assumption I use is the exogeneity of the observed plant closures, such that plants did not close because of worsening local conditions. The assumption is supported by three types of evidence: first, the literature finds that foreign multinationals are more likely to relocate independently of local conditions or plant performance than domestic firms (e.g. Bernard and Sjöholm (2003), Bernard and Jensen (2007), Alvarez and Görg (2009), Ferragina et al. (2012) and Engel et al. (2013)). Second, the press announcements about the reason for the plant closure either mentioned global reasons (e.g. decreasing demand) or country-specific reasons (e.g. high labor costs). Using control loca-

[5]The data set I use: "APEH Balance Sheet" is created by the Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences (MTA KRTK) from the original data. The data set is work in progress. Although the MTA KRTK made effort to clean the data, it cannot be held liable for any remaining error.

tions in the identification accounts for any country-wide or global changes. Third, I find that on average outcomes of firms in treated and control locations are not significantly different before the plant closure. Additionally, my main findings are robust to controlling for potential differences in pre-closure trends of the two firm groups.

Considering closures of foreign-owned plants has the advantage that local conditions are less likely to affect the decision to close than for domestic plants. Still, my results might not be specific to foreign-owned large closures. In the current paper I do not deal with the question of external validity to domestic plant closures. As the decision about exit might be less correlated with location-specific conditions than the location decision at entry, my results can also be used to give a lower-bound estimate for the effect of an FDI entry. Nevertheless, I expect the true effect of entry to be higher, as transferred knowledge or new infrastructure remains still after the FDI exit.

Looking at a three-year period after a plant closure, I find that the sales of firms within the 10 km agglomeration of a closing plant decreased by 6 percentage points, and their employment decreased by 3 percentage points on average. I still find significantly lower sales and employment 4-5 years after the closures. At the same time, there is no significant effect on productivity, average wage or exit probability. Results are robust to specification changes in which I account for potential differences in the pre-closure trend of firms in treated and control locations. The estimated effects are heterogeneous across firms. Foreign-owned and large firms seem to benefit, and small and low-productivity firms lose more than average in terms of sales or employment. Effects are also heterogeneous by the characteristics of the local economy. Local firms are more affected in smaller cities and in regions with a high unemployment rate.

I also show some evidence suggesting the importance of three different channels in the plant closure effect. First, local labor supply increases for the remaining local firms after a plant closure, exerting a downward pressure on wages. Former employees of the foreign firm might also transfer valuable knowledge to their new firm.[6] Especially those firms can benefit, which employ people with similar education and skills as the closing plant. Indeed, I find that firms operating in the same industry as the closing plant increased their employment and had a lower exit probability after the closure. Second, when the laid-off people stay unemployed or can only find jobs paying less, their consumption will decrease due to the lost income, hurting firms which sell to local consumers. In line with Mian and Sufi

[6] Stoyanov and Zubanov (2012) find that a new employee coming from a more productive firm increases the employer firm's productivity, also when looking at medium-skilled workers.

(2012), I find that firms providing non-tradable local services decreased their employment more than average after the closure. Third, lost input-output linkages can hurt local buyers or suppliers, as it can be costly to find new business partners and transport cost might also increase. I find that firms operating in the local supplier industry of the closing plant decreased their employment more than average after the closure. Buyers were not affected significantly, which can be the result of closing plants having not many local buyers. This explanation is also supported by the large export share of the closing plants.

2.1.1 Related literature

This topic is closely related to the literature on how plant closures affect other firms in the agglomeration or in the same industry. Resende et al. (2015) claim that exits induce more exits but also entries. Bernard and Jensen (2007) point out the importance of plant closures in forming industry productivity and employment. Here I focus on foreign-owned large plants, which makes the identification strategy more reliable due to the exogenous exit assumption. Additionally, magnitude of the effects might be different compared to a domestic plant closure, due to potentially higher knowledge spillovers.

There are two recent papers highly related to this paper, but focusing on local labor market effects. Both papers use a similar approach to mine, doing a difference-in-differences analysis around the large layoffs with matched control settlements. Gathmann et al. (2015) investigate the spillover effect of domestic and foreign plant closures and mass layoffs in the local labor market. Using German data, they find that the overall negative employment effect within the region is larger than the size of the initial layoff, but as opposed to my results, especially same-sector firms are hurt. They also find that people moving across locations decrease the effect of a plant closure on individual employment. On the contrary, I see no increases in the aggregate move-out rates after a plant closure. This might be the result of the lower mobility in Hungary compared to Germany. Jofre-Monseny et al. (2015) use the same identifying assumption as this paper. They investigate the effect of large plant closures by looking at plants relocating abroad. Using Spanish data they find that a considerable share of the laid-off gets employed by incumbents operating in the same industry as the relocating plant, decreasing the actual labor losses of plant closures. This is in line with my finding on same-industry firms increasing their employment after the closure. As opposed to my results on local service or supplier-industry firms, they find no employment effect in other industries. In contrast with both papers, I look at firm-level outcomes instead of aggregate industry measures. I also look at performance measures other than employment, like sales, productivity and exit probability. Finally, as an additional contribution, I use variation by industry to provide some suggestive evidence for the existence of different channels through which a foreign-owned large plant closure has an effect on the local economy.

My analysis on the differential effect of plant closures in related industries can be linked to the literature investigating the propagation of idiosyncratic shocks in production networks. Allcott et al. (2016) investigate how shortages in electricity supply affect Indian manufacturing firms using electricity. They find significant reductions in revenues but not in productivity. Instead of looking at a single supplier-buyer relation, Acemoglu et al. (2015) consider the full input-output network. They find that both the input-output network and the geographic network play an important role in the propagation of industry-level shocks. There are two papers using data on exact buyer-supplier relations between firms. Carvalho et al. (2014) take the Great East Japan Earthquake as an exogenous shock and investigate how its effect propagates through inter-firm transactions to areas unaffected by the tsunami. Looking at the exiting firms in the tsunami-hit areas, they find a significantly negative effect on sales growth for both the suppliers and buyers of these firms. Similarly, Barrot and Sauvagnat (2014) investigate firm-level idiosyncratic shocks by looking at natural disasters. They find a negative effect on the customers of the affected firms, which spills over to their other suppliers, originally not affected by the shock. In line with these findings, in this paper I show that firms in the supplier industry of the closing plant are hurt more than average after the plant closure. If foreign-owned large plant closures can be regarded as exogenous shocks in the local economy, my findings can serve as a further evidence for the role of input-output linkages in the propagation of local shocks.

The study is structured as follows: Section 2.2 gives a brief outline of the history of FDI entry and exit in Hungary, and Section 2.3 presents the data. Section 2.4 describes the cases of exit and the process of matching controls and Section 2.5 presents the empirical strategy. Section 2.6 shows the results, and finally Section 2.7 concludes.

2.2 FDI in Hungary

Antalóczy et al. (2011) and Antalóczy and Sass (2005) give a nice overview of the evolution of foreign direct investment in Hungary. This country was the first in the region opening up for FDI. After the transition foreign investments played a crucial role in the

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economic development, and they remained important ever since. Beyond greenfield investments almost all of the large Hungarian firms were privatized. At the same time, FDI is still not embedded enough into the domestic economy. Foreign firms have relatively few local buyers or suppliers. Foreign investment is spatially concentrated. The most popular locations are the central part of the country, especially Budapest and its agglomeration, and Central and Northern Transdanubia. Pintér (2008) notes that Budapest was mostly chosen by the tertiary sector, and manufacturing firms located their plants in other parts of the country. FDI is also concentrated in specific industries: electronics, vehicle manufacturing and oil extraction and processing were the most popular ones in the 90s. At the same time, there were also many cases when foreign investments exited Hungary (e.g. Kukely (2008)). Especially the county of Vas was affected, but foreign-owned large plant closures occurred all over the country. Many of these happened around the EU accession, since the easily accessible borders reduced cross-country transport costs. As a result, companies could optimize production costs by concentrating their activity in fewer sites within the region. Food, textile and the electronic industry were affected the most. Demand fluctuations, the attractiveness of cheaper labor in Asia and global reorganizations within the company were the main driving forces behind plant closures in the electronics industry. All in all, the high number of FDI entries and exits in the 90's and in the 2000's ensure that Hungary is a good setting for investigating the effects of foreign-owned large plant closures.

2.3 Data

In this paper I use four types of data sources: press announcements to find closing plants, city-level data to match control locations, industry-level data to determine industry linkages, and firm-level data to investigate the effect of foreign-owned large plant closures on local firms. I find the press announcements on closures by searching the web. The city-level data I use are from the freely accessible T-Star database of the Hungarian Central Statistical Office.[7] I use data on working-age population, unemployment and people moving out of the city. I measure working-age population as the number of inhabitants aged 18-59. In order to make the other measures comparable across locations, I always normalize with the number of working-age population. City-level data are available for the period

[7]The data are accessible at the webpage `http://statinfo.ksh.hu/Statinfo/themeSelector.jsp?page=2&szst=T`.

2000-2013. For the propensity score matching I need to proxy missing data before 2000. For population, I use the earliest available data from 2000. For unemployment rate, I use NUTS-2 unemployment rate data, which are also available for the 90's. I also have the GPS coordinates of all the Hungarian settlements and use this information to determine the distance of settlement pairs.

For the main analysis I use a firm-level panel dataset from the Hungarian Tax Authority (NAV), covering the period 1992-2013. The dataset contains all double book-keeping firms in Hungary with yearly information on balance sheet data, industry, foreign ownership share and location of the headquarter. I adjust all the balance sheet data expressed in monetary values for inflation.[8] Industry categories are provided following the 2-digit NACE Rev 1.1 categorization. I determine industry links using the Hungarian input-output table from 2005, which uses a 2-digit NACE Rev 1.1 classification. I define supplier and buyer industries in the following way: industry j is a supplier industry of industry i if j is different from i, and j provides at least 5% of all the industrial inputs used by i. Industry k is a buyer industry of i if k is different from i, and i provides at least 5% of all the industrial inputs used by k. For the calculations I use all industries and not just manufacturing. The list of buyer and supplier industries, separately for each 2-digit industry in which I have a closing plant can be found in Table B.6-B.9 of the Appendix.

I calculate two productivity measures from the balance sheet data. The first measure is labor productivity, defined as value added over the number of employees. I calculate value added by deducting material cost from the sum of sales and the capitalized value of self-manufactured assets. The second measure is total factor productivity (TFP), which I estimate assuming a Cobb-Douglas production function with coefficients varying by two-digit industries. For firm i in industry j in year t the production function is

$$Y_{ijt} = A_{ijt} L_{ijt}^{\alpha_j} K_{ijt}^{\beta_j} M_{ijt}^{\gamma_j}, \tag{2.1}$$

where Y denotes sales, A is total factor productivity, L is labor measured by the number of employees, K is capital and M is material. I use the method of Levinsohn and Petrin

[8]For sales and value added I use the producer price index (PPI) of the 2-digit industry. For export sales I use the export price index of the 2-digit industry. For capital I use a capital deflator created as the average PPI of industries producing capital goods: NACE Rev 1.1 sectors 29, 30, 31, 34 and 35. For materials I use a material price index calculated separately for each 2-digit industry: the weighted average PPI of all input-providing sectors with input shares as weights. For the wage I use a wage index, calculated from the national average of per capita earnings.

(2003) for estimating TFP.

Finally, I use an additional firm-level database from Complex to calculate the age of a firm in a given year. I provide descriptive statistics of the variables I use in Table B.11 of the Appendix.

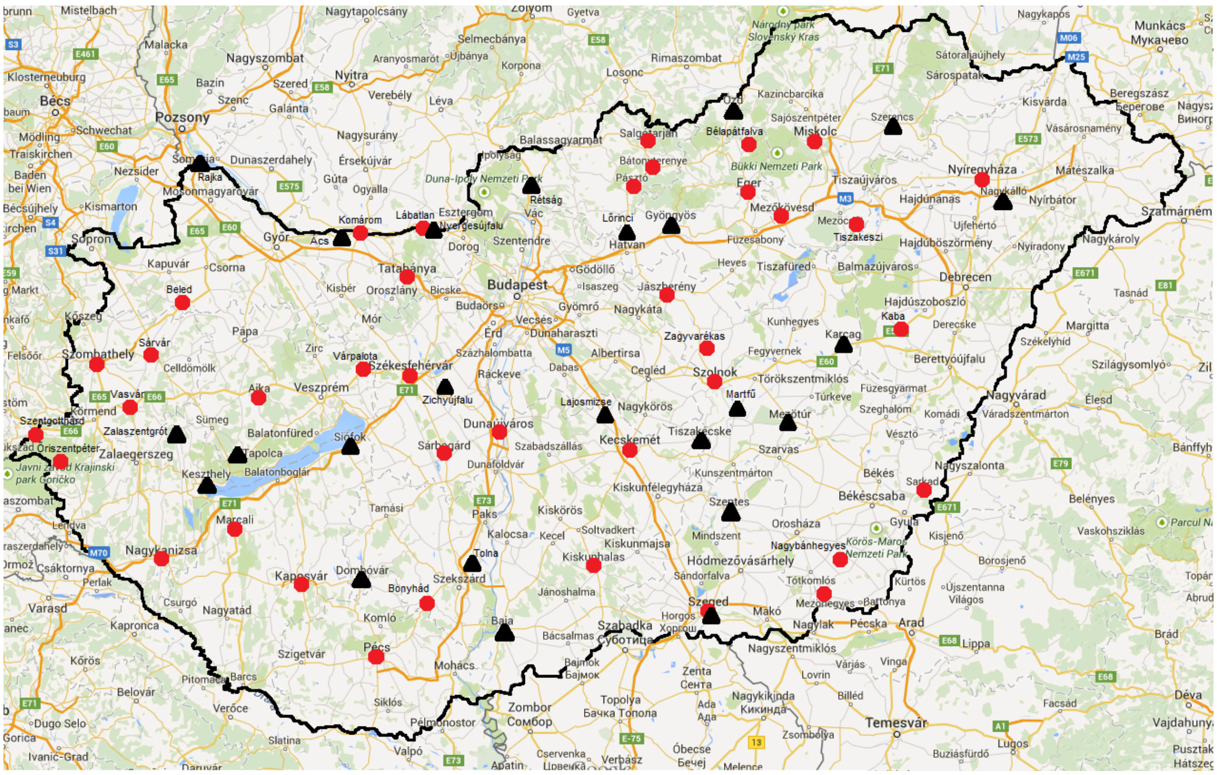
2.4 The closure events and the matched controls

2.4.1 The cases of foreign-owned plant closures

In the current analysis I identify foreign-owned large plant closures using press announcements. Focusing on manufacturing plants I collect 49 such events which fulfill the following criteria: 1. the closing plant should have majority foreign ownership. 2. It has to be large enough, i.e. having more than 150 employees at the site in the last year of operation. This ensures that the presence of the plant was important enough for the local economy. 3. The site should not be in Budapest. I expect that the impact of a closure cannot be so strong in the capital city as elsewhere with less employment opportunities. 4. Closure should fall within the period of 1995-2009, as I have data on firms from 1992 to 2012. In this way I can look at pre- and post-event periods of at least three years. 5. I also check that exits were permanent, and the plant was not reopened in the next three years, either by the same owner or a new one. At the same time, I allow for new entries in other industries. I will refer to the locations with a plant closure as ”treated”. It is important to emphasize, that the information I collect on closures is at the plant-level, but the data sets which I use for the matching and in the main analysis are at the firm-level.

I verify the information collected from the press using firm-level administrative data, containing ownership and balance sheet information. I check ownership, compare decreases in the number of employment to the announced number of people being laid off from the plant and also check exit from the database in case of single-plant firms. The full list of plant closures, including the name of the firm, the city of the plant, plant size, industry, city population and the time of closure can be found in Table B.1 and B.2 of the Appendix. Most of the closures happened around the EU accession or in the crisis year 2009, but there are closures from all years of the period 1998-2009. The majority of the observed plant closures happened in the food industry, the wearing apparel industry and the footwear manufacturing industry. There are closures in other industries as well, like manufacturing of electrical machinery, manufacturing of communication equipment or manufacturing of paper. The number of employees laid off are typically below 250, but there are closing

Figure 2.1: The location of treated and control settlements



plants with more than 1000 employees as well. The closing plants are important employers in the local economy. Their average share in total employment within 10 km of the city is about 10%. Figure 2.1 shows the treated settlements marked by red dots. The figure shows that treated settlements are located all over Hungary with no significant spatial concentration.

2.4.2 Assignment of controls

I assign control locations to treated locations using propensity score matching. I do cross-location comparisons to account for countrywide or global trends which could drive the results. Matching based on pre-closure location characteristics helps me to choose comparable locations as controls. Additionally, if exits were not entirely independent of location-specific characteristics, propensity score matching also helps choosing controls being similarly at risk of a closure.

Candidates for controls are such cities in Hungary where an established foreign-owned large firm operated in the year of a plant closure. Accordingly, I do propensity score matching on this subsample of city-year observations, also including the previously collected events of closure. As there are two cases in which two plant closures happened in the same city and in the same year, I have 47 treated city-year observations. I will refer to a treated city-year observation as a case. I define a firm as established if it already existed three years before the given year. In this way I exclude those cases where the outcomes in the control location would be driven by a large new entry. I define a firm as foreign-owned if it had a majority foreign ownership in the previous year or ever before, and disregard changes back to domestic ownership. Doing this I assume that the experience of foreign ownership has long-lasting effects. Additionally, the local economy can benefit from the presence of these firms still after the ownership change.[9] I define a firm as large if the median number of employees is at least 100 and there is a year when there are at least 150 employees. I assign these firms to cities based on the headquarters of the firms, as I have a database with information on all firms only at the firm-level. I identify closures on the plant-level using extra information from press announcements, but I can only identify controls using firm-level information. This is a limitation, as with multi-plant firms I lose potential control cities. Still, it doesn't worsen the comparability of controls, provided that headquarters are not separated from production facilities. This is a reasonable assumption except for Budapest, which I exclude from the pool of potential controls. I also exclude treated cities from the set of potential controls in the three-year period before the plant closure, but they are included earlier. In the estimation I use only those city-year observations which had at least one firm operating in the industry of a treated plant closing that year, and at some point there was a closure in the same NUTS2 region. In this way I end up with 168 potential control cities.

For the propensity score matching I estimate the following equation, using a probit model:

$$\begin{aligned} y_{ct} = \Phi(&\beta_0 + \beta_1 lPop_{ct-1} + \beta_2 lPopA_{ct-1} + \beta_3 Unemp_{ct-1} + \beta_4 UnempA_{ct-1} + \beta_5 dUnemp_{ct-1} \\ &+ \beta_6 dUnempA_{ct-1} + \beta_7 Supp_{ct-1} + \beta_8 Buy_{ct-1} + \beta_9 Sales_{ct-1} + \beta_{10} dSales_{ct-1} \\ &+ \beta_{11} I_{ct} + \beta_{12} D_t + \beta_{13} R_c + \epsilon_{ct}), \end{aligned} \tag{2.2}$$

[9]Only 17% of the firms classified as foreign ever switch back to majority domestic ownership. This share is only 6% when I aggregate up the measure to city-industry-year level.

where c denotes city and t denotes year. y is an indicator of plant closure, being one for the 49 plant closure events and zero otherwise. $lPop$ is working-age population in the city, which I measure as the number of people being 18-59 years old, and $lPopA$ is working-age population in the 30 km agglomeration, both measured in logs. $Unemp$ and $UnempA$ are the unemployment rate in the city and in the 30 km agglomeration respectively. I measure the unemployment rate as the number of unemployed divided by the size of working-age population. $dUnemp$ refers to changes in the unemployment rate from two years before, measured in percentage points. $Supp$ is the share of the large foreign firm's supplier industry in total employment within the 30 km agglomeration of the city. Similarly, Buy is the share of the large foreign firm's buyer industry in total employment within the 30 km agglomeration of the city.[10] $Sales$ is total sales measured in logs and $dSales$ is the average growth rate of per firm sales, both measured in the 30 km agglomeration of the city.[11] I is a set of industry dummies, being one if there was a foreign-owned large plant in the given city and year operating in the given industry.[12] D_t is a set of year dummies, R_c is a set of NUTS-2-level region dummies, and ϵ_{ct} is the error term.

I use the estimated propensity scores for choosing the final set of controls. First, I ensure overlap between treated and controls by dropping treated with a propensity score more than 20% higher than the highest propensity score among the controls. I also drop those controls where the lowest treated propensity score is more than 20% higher than the estimated propensity score of the control. As I cannot find any comparable controls for 6 treated, I end up with 41 cases. I also drop those potential controls which were treated in the previous two years. Then I create industry-year brackets and look for comparable controls within each bracket. I look for control cities with a plant operating in the same industry as the closing plant, because I am especially interested in the performance of

[10] I define the buyer industry differently for the matching than for the estimation of the plant closure effect by industry group. Here I classify industry k as a buyer industry of industry i if k is different from i, and k uses at least 5% of all the output produced by i and used by an industry. In about 1/3 of the observations there are foreign-owned large plants operating in multiple industries. In these cases there is no single supplier or buyer share to be used. Since I am interested in the probability of having a closing plant, I use the lowest buyer share, as I estimate a negative relationship between the buyer share and the plant closure probability. As the estimated relationship between supplier share and plant closure is positive, I include the highest supplier share in the regression for matching.

[11] When I calculate $Sales$ and $dSales$ I include only those firms which have a median level of employment of at least 5. I also exclude the firms of the closing plants and all the large foreign firms operating in the potential control cities. I also get rid of outliers in sales growth, excluding the lowest and highest 5% when calculating agglomeration-level averages.

[12] I use TEAOR'03 subsectors which almost correspond to 2-digit NACE Rev 1.1 codes, but groups together 15 and 16, 17 and 18, 21 and 22, 27 and 28, 30-33, 34 and 35, 36 and 37.

firms in the buyer, the supplier and the same industry. In this final step of matching I also drop those potential control cities which are closer than 30 km to the treated. With this I ensure that there are no sizeable spillover effects from the treated to the control locations. In the baseline version I assign a single control city to each treated case. From the remaining potential controls within the given industry-year bracket I take the city which has a propensity score closest to the propensity score of the treated. The same control city can be assigned to multiple cases, and a treated city can be a control more than three years after or more than two years before the plant closure. The black triangles in Figure 2.1 show the location of control cities. Like treated cities, controls are also located all over the country. The full list of control cities with their size, and the name and size of the foreign-owned large firm can be found in Table B.1 and B.2 of the Appendix. As a robustness check I use multiple controls, and assign all the remaining potential controls within the given industry-year bracket to the treated. I weight each control in such a way, that weights are proportional to the inverse of their distance from the treated in terms of propensity scores and weights add up to one.

Checking pre-closure differences shows that treated and control cities are indeed comparable. Table 2.1 presents the results of this comparison when a single control city is assigned to each case. Table B.5 of the Appendix does the same comparison for the version with multiple controls. Here I use weighted regressions with a constant and a treated dummy on the right-hand side. Weights are the ones determined in the matching procedure. When the treated dummy is insignificant, the two groups are similar in terms of the given characteristic. Table 2.1 shows that the pre-closure characteristics used for the matching are not significantly different in the treated and control groups. The only exceptions are city size and propensity score. Cities with a closing plant are on average larger than the control cities.

2.5 Empirical strategy

2.5.1 Estimation

I use a difference-in-differences estimation strategy, combined with an event study approach. In my estimation strategy I build on Greenstone et al. (2010) and partly also on Greenstone and Moretti (2004). In these papers the authors look at the effect of large plant openings on the local economy by using the runner-up locations as controls. Analogously,

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Table 2.1: Similarity of treated and control cities before the closures

Controls: a single control is matched to each case

Pre-closure characteristics	Average for treated	Average for controls	P-value of H0: treated=control
Propensity score	0.31 (0.04)	0.13 (0.02)	0.00
Log working-age population in city	9.44 (0.22)	8.99 (0.15)	0.04
Log working-age population in 30 km	11.80 (0.06)	11.85 (0.05)	0.50
Unemployment rate in city	0.065 (0.006)	0.067 (0.004)	0.82
Unemployment rate in 30 km	0.068 (0.005)	0.067 (0.004)	0.77
2-year change in city unemployment rate (pp)	0.0026 (0.0018)	0.0010 (0.0023)	0.45
2-year change in 30 km unemployment rate (pp)	0.0013 (0.0017)	0.0015 (0.0016)	0.93
Buyer-industry share in 30 km	0.090 (0.010)	0.089 (0.008)	0.99
Supplier-industry share in 30 km	0.122 (0.013)	0.127 (0.010)	0.67
Log total sales in 30 km	19.27 (0.012)	19.38 (0.010)	0.46
Average sales growth in 30 km	0.130 (0.007)	0.128 (0.007)	0.75

Controls are cities with a foreign-owned large firm operating in the same industry as the closing plant, and having the closest propensity score to the treated. Pre-closure characteristics are measured one year before the plant closure. 2-year change in the unemployment rate refers to changes from t-3 to t-1 where t is the year of the plant closure, and it is expressed in percentage points. Working-age population refers to the number of people aged 18-59 on Dec. 31. of the given year. Unemployment rate is the number of registered unemployed on Dec. 20. of the given year, divided by the working-age population. Buyer-industry share is the employment share of firms operating in the buyer industries of the closing plant in total employment. Supplier-industry share is defined analogously. Buyers are industries which use more than 5% of the closing plant industry's output, suppliers are industries of which more than 5% of the closing plant industry's inputs come. Total sales and average sales growth is calculated omitting the closing plant's firm and the foreign-owned large firms in the control cities. Standard errors are in parentheses.

I use comparable locations with similar but still operating plants as controls. I assume that FDI exits are independent of the local economic conditions. Consequently, control locations being similar before the closure provide a proper counterfactual, showing what would have happened in the treated locations without the plant closure.

I measure the effect of plant closures by comparing outcomes of firms located in the treated and in the control area, before and after the closure. I use a somewhat more flexible version of a simple difference-in-differences estimation, as I divide the before and after periods to multiple sub-periods. This approach helps me to separate immediate effects (1-3 years after the closure) from effects in the longer-run (4-5 years after the closure). As there are few cases from the early years with a long post-closure period, my sample size drops considerably six years after the closure, and I cannot reliably estimate long-run effects beyond 5 years. To control for this drop I include separate dummies for early and late periods with few observations. I define an early period as 7 or more years before the plant closure, and a late period as 6 or more years after the plant closure. Figure B.1 of the Appendix shows the number of cases by event-year, where event-years are normalized to zero in the year of the plant closure. All the cases have observations up to 3 years after the plant closure. This supports my choice to cut the first period of interest 3 years after the closure. In the baseline specification I estimate the following equation, where the unit of observation is firm-year-case:

$$\begin{aligned} Y_{it} = {} & \beta_0 + \beta_1 Treated_{ic} + \beta_2 Before7_{ct} + \beta_3 After1\_3_{ct} + \beta_4 After4\_5_{ct} + \beta_5 After6_{ct} \\ & + \beta_6 Treated_{ic} Before7_{ct} + \beta_7 Treated_{ic} After1\_3_{ct} + \beta_8 Treated_{ic} After4\_5_{ct} \\ & + \beta_9 Treated_{ic} After6_{ct} + \alpha_i + \alpha_c + \alpha_t + u_{ict}, \end{aligned} \tag{2.3}$$

where i stands for firm, c denotes case and t denotes year. Y stands for the various outcome variables: log sales, log employment, labor productivity in logs, log per capita wage or log total factor productivity. $Treated$ is a dummy being one if the firm is located in a treated area. I assign firms to treated and control locations based on the location of their headquarters two years before the plant closure. For firms with a later entry I use the first location, for firms with an earlier exit I use the last location. A treated location consists of the city with the closing plant and the agglomeration around the city. I define control locations in the same way. As the baseline I define the agglomeration as a 10 km radius circle around the city. I determine the settlements which belong to each agglomeration by using distance data of settlement pairs.[13] $Before7$, $After1\_3$, $After4\_5$ and $After6$ are case-specific dummies being one in 7 or more years before, 1-3 years after, 4-5 years after or 6 and more years after the plant closure, respectively. $TreatedBefore7$, $TreatedAfter1\_3$, $TreatedAfter4\_5$ and $TreatedAfter6$ denote the interaction terms of time period dummies and the treated dummy. The variables of interest are $TreatedAfter1\_3$ and $TreatedAfter4\_5$, which show if the outcomes of treated firms 1-3 years and 4-5 years after the plant closure are different on average from the outcomes of control firms, controlling for pre-treatment differences in the 6-year period before the closure. Finally, I also include fixed effects for firm (α_i), case (α_c) and calendar-year (α_t), and u_{ict} is the error term. I cluster the standard errors by city[14], allowing for correlated errors within cities. I estimate bootstrapped standard errors in the regression where the left-hand side variable is log TFP, which is an estimated measure. I include only those firms in the analysis which have at least 5 employees, taking the median value. In this way I expect to have more robust estimates, as very small firms tend to misreport more frequently. I also exclude all the firms with a closing plant and the foreign-owned large firms operating in the same industry in the control locations. Finally, I exclude those outliers which ever had a sales value larger than 0.5% of the total sales of all firms in the database that year. There are only 33 such firms.

When I look at the effect on exit probability I estimate a modified version of equation 2.3. I estimate a simple linear probability model with a dummy on the left-hand side being one if the given year is the last year of the firm before exit. Following Bernard and Jensen (2007), instead of firm-fixed effects I control for firm characteristics like age, log of employment, capital to labor ratio, per capita wage, TFP and an indicator showing that the firm has never exported before. I include fixed effects for case, industry[15] and calendar year, and I cluster the standard errors by firm.

As a robustness check I also use two alternative specifications. In line with Greenstone et al. (2010), the first specification controls for potential differences in trends before the closure. This ensures that average differences after the plant closure are not driven by different trends in treated and control locations, which can already be observed in the

[13]Table B.10 of the Appendix shows the average number of treated and control firms per case. As treated cities are on average larger than controls, there are also more firms in the treated locations than in the controls.

[14]For the clustering of standard errors I use the first location of each firm in order to give a nested structure.

[15]I use a time-invariant 2-digit NACE Rev. 1.1 categorisation. I assign a firm to that industry in which it operated for the longest time throughout its life.

pre-closure period. I estimate the following equation:

$$Y_{it} = \beta_0 + \beta_1 Treated_{ic} + \beta_2 Trend_t + \beta_3 Treated_{ic} Trend_t + \beta_4 After_{ct} + \beta_5 Trend_t After_{ct} + \beta_6 Treated_{ic} After_{ct} + \beta_7 Treated_{ic} Trend_t After_{ct} + \alpha_i + \alpha_{ct} + \alpha_t + u_{ict}. \tag{2.4}$$

I include a simple time trend ($Trend$), allowing for different trends in treated and control groups ($TreatedTrend$), and a trend break after the plant closure ($TrendAfter$), which can also be different in treated locations ($TreatedTrendAfter$). In this specification I use observations only from the period 6 years before and 5 years after the closure, omitting the $Before7$ and $After6$ dummies. I also include a single dummy for the period after the plant closure ($After$). The variables of interest are the interactions of $Treated$ with the after period and with the trend difference after the closure. β_6 shows if there is a level shift and β_7 shows if there is a change in the trend after the closure.

The second alternative specification is even more flexible. Instead of the time period dummies I use a full set of event-year dummies, also interacted with the $Treated$ dummy. Event-years are calculated relative to the year of the plant closure. For positive event-years, coefficients on the interaction terms measure if firms in treated and control locations have significantly different outcomes a given year after the plant closure.

In the analysis I also check if there is any heterogeneity in the plant closure effect by the characteristics of local firms or by the characteristics of the closing plant or the location. For doing this I include additional firm group or case group dummies into equation 2.3, also in interactions with all the other right-hand-side variables (treated dummy, time period dummies and their interactions) of equation 2.3. The coefficients of interest are the ones on the triple interaction term of the treated and after period dummies with the firm group or case group dummies. Interactions with firm group dummies show if the plant closure had a significantly different effect on the given firm group compared to firms in the baseline category. Interactions with case group dummies show the same for firms located close to specific types of closing plants.

2.5.2 Identification issues

The two main concerns with the identification are the possible endogeneity of exits and potential other reasons for which controls might not provide a proper counterfactual for the treated locations. Concerning the first, if exits happened systematically in locations with worsening economic conditions, the observed worse performance of local firms after the plant closure would be the result of local tendencies and not the result of the closure. There are three arguments against that. First, the literature shows that foreign firms are more footloose than domestic firms.[16] Foreign-owned firms are more likely to close or relocate due to global strategic considerations which are unrelated to local economic conditions. Second, press announcements and articles on the plant closures in my sample never mention location-specific economic problems among the reasons for the closure.[17] Some of the reasons are country-specific, like high wages compared to Asia or regulation changes after the EU-accession. Using control locations, however, I account for these country-wide factors changing over time. As control cities have large foreign plants operating in the same industry as the closing plant, I also account for potential global industry-specific shocks. Third, I assign control locations in such a way that I ensure pre-closure comparability. Outcomes in the treated and control groups are not significantly different in the period before the closure. Additionally, as a robustness check I test if differences in pre-closure trends can account for differences in post-closure outcomes. Results are robust to the inclusion of treatment group-specific trends. It might also be the case, that the foreign-owned large plants close because they are worse than the comparable plants in the control locations. As a result, the presence of the foreign firm could have a different impact on the local economy in treated and control locations. Local firms, however, have similar performance in treated and control locations before the closure. Additionally, my main results are robust to the exclusion of those cases where the plants closed because of indebtedness.

The second concern is the comparability of controls. The relatively worse performance of the treated firms after the closure might be the result of the exceptionally good performance of control firms. It might be the case if control firms are not hurt by the plant closure but benefit from that. For example, people being laid off from the plant provide cheap labor or supplier firms losing their business partners are ready to provide cheaper inputs. As controls are located far[18] and most of the plants are not large enough[19] to

[16] E.g. Alvarez and Görg (2009), Bernard and Sjöholm (2003), Bernard and Jensen (2007), Kneller et al. (2012), Van Beveren (2007).

[17] The full list of closures with the publicly available information on why plants closed can be found in Table B.3 and B.4 of the Appendix.

[18] According to Google Maps, the average road distance between treated and control cities is 204 km. There are only six cases, where the distance is less than 60 km. The closest city pair is 40 km away from each other.

[19] The average size of a closing plant is 340 employees. 10 plants had more than 500 employees and only 3 plants had more than 1000 employees.

have considerable effect on far-away locations, it is unlikely that the difference is due to favourable consequences of plant closures for the control locations. Alternatively, control locations might have other positive shocks at the time of the plant closures improving their economy and leading to a downward bias in a measured negative plant closure effect. As I have several closures from different years, it is unlikely that control cities systematically get positive shocks in the year of the corresponding closure. Additionally, I show that results remain robust to narrowing down the set of cases to different subgroups.

In the estimations I don't control for additional closures (e.g. smaller firms or domestic ones), mass layoffs or entries. I assume that without the plant closures exits and entries occur randomly. After a plant closure I treat changes in the number of exits or entries as outcomes. On one hand, the negative effect of a large plant closure on the local economy might result in further exits. On the other hand, if the plant closure is exogenous, the location might become attractive for new entrants after the closure. The local economic policy is also likely to work hard for attracting new investors. I consider these as potential results of a closure. In case of new entries the effect I estimate is definitely lower than the direct effect of a plant closure without a new entry. Yet, I am interested in the net effect which includes the potential counterbalance of new entries. If the foreign-owned large plants close because of negative industry-level shocks, the comparable foreign firms operating in the same industry in the control locations might be also affected. If this resulted in mass layoffs in control locations which I don't control for, it would go against me, biasing the estimated effects towards zero.

2.5.3 Different channels of the plant-closure effect

After the baseline estimations I give some evidence on the different channels of the plant closure effect. I use a simplified and somewhat modified version of the model presented in Acemoglu et al. (2015) to show which are the expected effects of a plant closure on the local economy. Here I only summarize the results, I present the model in Appendix B.1. If the closing plant had only few local buyers and sold most of its output in other locations, its closure is such a local shock which I expect to propagate upwards. This means, firms in the supplier industries of the closing plant's industry face lower demand. This leads to decreases both in their output and in the amount of inputs they use. I call this the "input/output linkages channel". The average export share of the closing plants was 62%, and the large manufacturing plants also sold in different locations within Hungary. So it is reasonable to assume that there were very few local buyers, and as a result, firms operating in the buyer industry were not affected more than the average firm. If the "input/output linkages channel" is at work, I expect that firms operating in the supplier industry are hurt more than average, but firms operating in the buyer industry might not be affected differently than the average firm.

Decreasing local labor demand puts a downward pressure on wages. The average wage might indeed decrease if the laid-off are ready to work for a lower wage. From the firms' perspective this is equivalent to a lower input price, and as a result firms use labor more intensively. I call this the "increasing labor supply" channel. Although it is not a model prediction, I expect that those firms can benefit the most from the increased labor supply which employ people with similar skills and experiences as the closing plant. This is definitely true for firms operating in the same industry as the closing plant. If the "increasing labor supply" channel is at work, I expect that firms operating in the same industry as the closing plant are hurt less than average or can even benefit from the closure.

Finally, decreasing local labor demand lowers the income of local households, both by decreasing wages and increasing unemployment if there is no perfect adjustment of wages. Lower income lowers the consumption of local households, decreasing local demand for consumer goods. I call this the "decreasing purchasing power" channel. Especially those firms are affected which sell a lot locally. If the "decreasing purchasing power" channel is at work, I expect firms providing non-tradable local services to be hurt more than average by the plant closure.

I test the above assumptions by allowing for differences in the plant closure effect by industry groups. I estimate a modified version of equation 2.3, where I interact all the right-hand side variables with four industry group dummies, standing for supplier industry, buyer industry, the closing plant's industry and local services. I do all the industry categorizations by 2-digit NACE categories. I define the supplier and buyer industries as I described in the Data section. I define local services as the sum of 52. Retail trade and 55. Hotels and restaurants. I present the average number of firms per case operating in the different industry categories in Table B.10 of the Appendix.

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2.6 Results

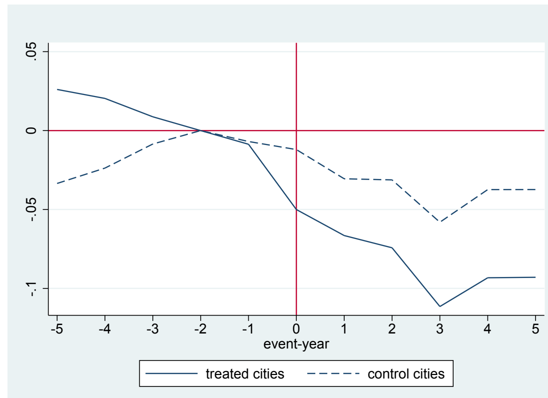
2.6.1 Suggestive evidence on aggregates

As a starting point I show the evolution of aggregate sales and employment in the average closure event, looking at the 10 km agglomeration. Figure 2.2 shows coefficient estimates from case-level regressions of log total sales and employment on event-year dummies and their interaction with the treatment indicator, also controlling for city-fixed effects. I present the estimated average for each event year separately in the treated and control group, taking two years before the closure as the reference point. In the first row of Figure 2.2 I also include sales and employment of the closing plant. The figures suggest that total sales and employment decreased after the closure without recovering even after five years. The figures also suggest that treated and control locations are comparable in terms of aggregates 1-3 years before the closures but not earlier. Figures in the second row show the same estimates when I exclude the closing and the control plants from the estimation. The difference after the closure disappears. Local firms seem to be unaffected on average. This might be the result of no effect, or of a heterogeneous effect, where the positive effect on some firms and the negative effect on others average out. Figures B.2 and B.3 of the Appendix suggest that the effect is indeed heterogeneous, larger firms seem to gain and smaller firms lose, competitors gain and suppliers lose to some extent. As an additional source of heterogeneity, the third row of Figure 2.2 shows that local firms in smaller cities tend to lose also on average.

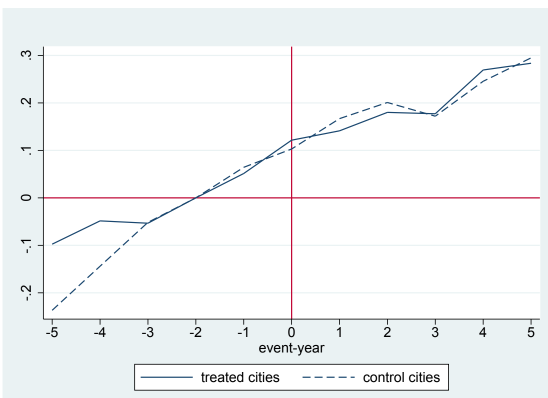
I can further support the heterogeneity across cases by doing a simple back of the envelope calculation. Case by case I compare the growth rate of total sales and total employment in treated and control locations. I look at the period 2 years before and 3 years after the closure. In this exercise I exclude the closing and control plants. I take the average difference across cases in the 5-year growth rates weighted by the levels 2 years before the closure. I find that the average growth rate in treated cities is 17 percentage points higher for sales and 3 percentage points higher for employment. There is a large heterogeneity, though, growth of total sales is lower in the treated city for 25 out of the 41 cases, and growth of employment is lower for 23 cases. When I only look at small cities, I find that the weighted average growth rate in treated cities is 7 percentage points lower for sales and 1.9 percentage points lower for employment compared to controls. Looking at simple unweighted averages, differences between treated and control cities suggest, that total sales growth would have been 15% higher in the treated cities without the plant

Figure 2.2: Case-level averages of the log of total employment and sales within 10 km agglomeration, including or excluding the closing plant

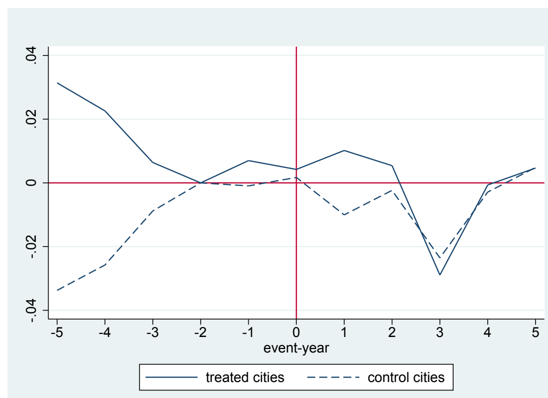
(a) Log sales, including the closing plant



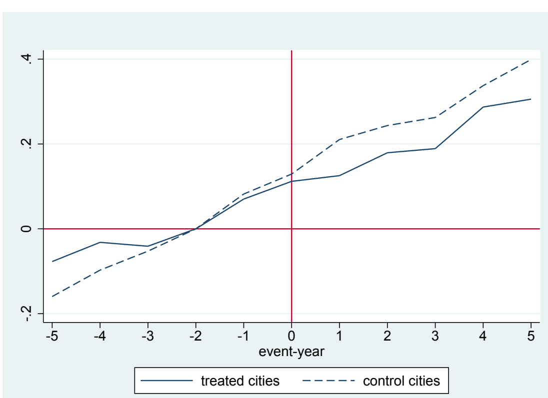
(b) Log employment, including the closing plant



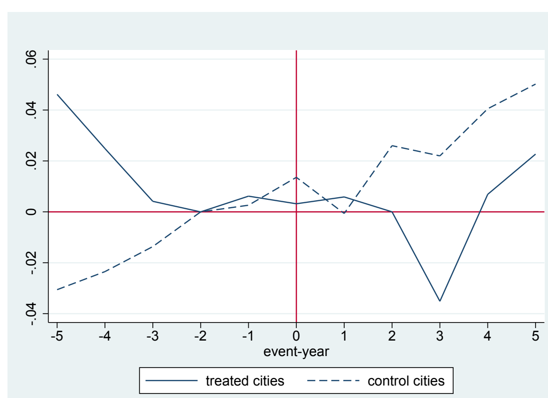
(c) Log sales, excluding the closing plant



(d) Log employment, excluding the closing plant



(e) Log sales in small cities, excluding the closing plant



(f) Log employment in small cities, excluding the closing plant closure. As a comparison, the observed average growth rate in the treated cities is 27%. When I decompose the growth rate difference between treated and controls to the contribution of continuing, newly entering and exiting firms, as suggested in Eaton et al. (2007), I find that the share of continuing firms is quite large in most cases. In the median case the contribution of the continuing firms is 81% for sales and 68% for employment. These results support my approach to focus on the incumbents.

In the followings, I look at firm-level estimates where I can control for potential composition differences between the treated and the control group. First, I present the estimated average effect of a foreign-owned large plant closure on the local incumbent firms. Then I show some evidence on the different channels of the plant closure effect. Next, I show heterogeneity in these estimates by ownership, firm size and productivity. After that, I show how the estimated effect differs by various characteristics of the closing plant and the location. Finally, I evaluate the aggregate employment effect, and show some robustness checks for the main results.

2.6.2 The effect on local firms

In the estimations I focus on the short-run effect of foreign-owned large plant closures on local firms, looking at changes in different firm-level outcomes 1-3 years after the closure. My secondary interest is on the period 4-5 years after the closure. Table 2.2 shows the baseline results for all firms in treated or control cities, having at least 5 employees at the median. On average, sales decreased by 6 percentage points and employment decreased by 3 percentage points 1-3 years after the plant closure. The effects seem to be persistent, as 4-5 years after the plant closure the sales and employment difference between treated- and closure-location firms is even larger. At the same time, I find no significant effect on productivity, average wage or exit probability. The treated dummy is small and insignificant in all cases, which supports my identification strategy. It shows, that firms in treated and control locations are on average not significantly different from each other in the baseline period before the closure.

Next, I show how the difference in sales and employment between treated and control firms evolves over time. I use a flexible specification with event-year dummies instead of time period dummies in the period [t-6,t+5], where t denotes the year of the closure. For early and late years outside this period I use the period dummies, as before. Figure 2.3 shows the yearly difference in sales and employment by plotting the estimated coefficients on the interaction terms of the event-year dummies with the treated dummy. The baseline

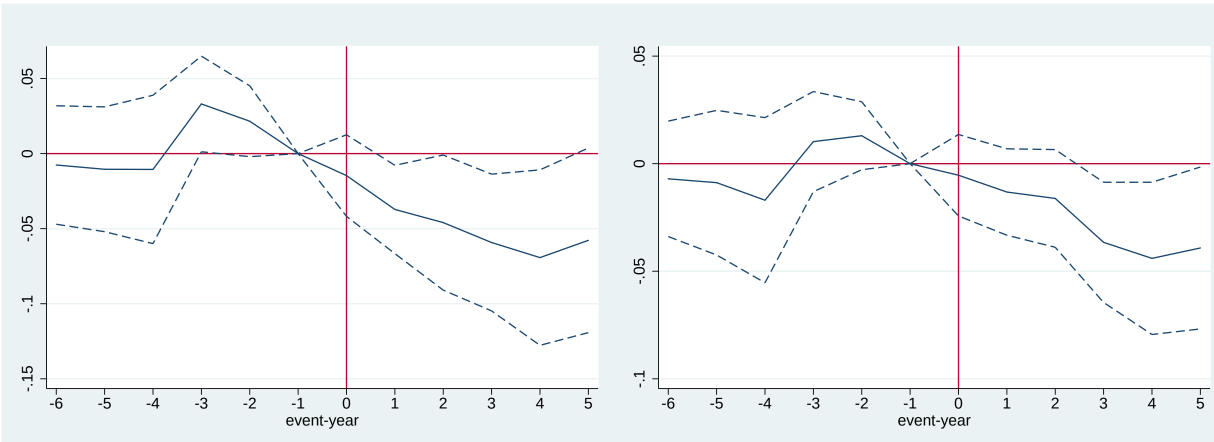
Table 2.2: Baseline regression results for firm-level outcomes

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated	0.008 (0.009)	0.000 (0.007)	0.005 (0.005)	-0.004 (0.003)	-0.003 (0.004)	-0.002 (0.002)
Treated x After(1-3)	-0.061*** (0.020)	-0.030** (0.012)	-0.010 (0.010)	-0.007 (0.006)	-0.005 (0.008)	0.003 (0.002)
Treated x After(4-5)	-0.077** (0.030)	-0.049** (0.019)	-0.013 (0.014)	-0.010 (0.011)	0.001 (0.010)	0.002 (0.003)
Time period dummies	YES	YES	YES	YES	YES	YES
Treated x Far-away period dummies	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	359,826	353,768	326,784	330,158	353,607	332,702
Number of unique firms	26,434	26,512	25,914	26,142	26,527	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

period is one year before the closure, where the difference is normalized to zero. The figures also include the 95% confidence intervals. The yearly patterns show that firms in treated locations start to sell less and employ relatively fewer people somewhat before the closure, and the gap between treated and control firms increases over time. The difference in sales and employment becomes significant only one and two years after the closure. Figure B.4 in the Appendix shows similar estimates for sales and employment separately, plotting the coefficients on event-year dummies and the sum of the coefficients on event-year dummies and their interaction with the treated dummy. The figures show that there are two reasons for the increase between treated and control firms after the plant closure. On one hand, treated firms have lower sales and employment compared to pre-closure levels. On the other hand, control firms start to increase in the period after the closure. This pattern shows, that even simple within-treated comparisons show evidence for a negative effect of the plant closures on local firms. Assuming that the controls form a proper counterfactual, these figures also show that a simple within-treated comparison would underestimate the

Figure 2.3: Baseline regression results with a flexible specification: triple interaction term coefficient estimates with 95% confidence interval



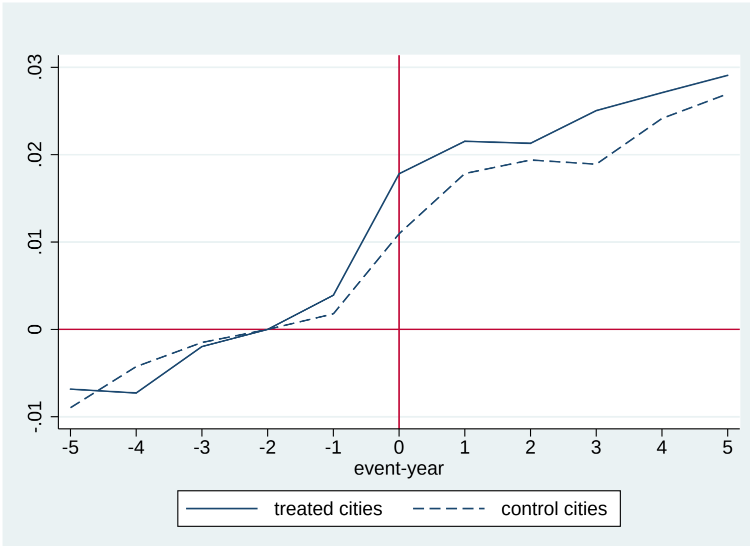
(a) Sales (b) Employment

closure effect, as it doesn't account for the foregone potential increases in the post-closure period.

Using the estimates from the flexible specification I calculate the average annual growth rate lost due to the plant closure. I use the formula $\frac{1}{2}(e^{\delta_3} - e^{\delta_1}) - \frac{1}{7}(e^{\delta_1} - e^{\delta_{-6}})$, where δ_t is the coefficient on the interaction term of the treated dummy with the indicator of event-year t. I calculate that the annual growth rate of sales was 0.5 percentage point lower and the annual growth rate of employment was 0.9 percentage point lower in local firms after the plant closure. As a comparison for the magnitude of the effect, average yearly sales growth in the estimation sample 1-3 years after the closures is 1.5%, and the average yearly employment growth is 1%. As an additional comparison, Carvalho et al. (2014) find that the suppliers of those firms which exit due to the tsunami suffer a 6 percentage point decrease in sales growth after the exit. Barrot and Sauvagnat (2014) find 3.1 percentage points decrease in sales growth for customers of a firm which was hit by a natural disaster. The effect I estimate is lower, but its magnitude is still significant compared to the average growth rate.

Figure 2.4 shows how the average unemployment rate evolved over time around the plant closure in treated and control cities. I estimate a flexible, case-level version of equation 2.3, with unemployment rate in the city as a dependent variable. As right-hand side variables I have event year dummies and their interactions with a dummy for treated cities, and I also include city-fixed effects. I do the estimations for the period including

Figure 2.4: The average unemployment rate in treated and control cities around the plant closure, normalized to zero two years before the closure



five years before and after the plant closure. In order to show unemployment trends in the control cities I plot the estimated coefficients of the event-year dummies. The sum of the coefficients on event-year dummies and their interactions with the treated dummy shows unemployment patterns in the treated cities. The reference period is two years before the plant closure, as in some cases layoffs start even one year before the closure. Unemployment rate increases over time in both groups, but it clearly jumps up in the closure year in treated locations and stays at a relatively higher level even five years after the closure. Figure B.5 of the Appendix shows that no similar pattern can be observed in the number of people moving out of the city. People don't move away after the closures.

2.6.3 Industry groups

In this section I look for evidence which supports the existence of the different channels through which a plant closure affects the local firms. Table 2.3 presents estimates of the heterogeneous effects by industry group. Employment of firms operating in local services or in the supplier industry of the closing plant decreased more than average. On the other hand, firms operating in the same industry as the closing plant significantly increased their employment compared to similar firms in the control locations. The effect on sales is not significantly different by industry group, but patterns are similar to the observed heterogeneity in the employment effect. Additionally, competitors exited in treated locations with a lower probability.

The estimates provide supporting evidence for three potential channels of the plant

Table 2.3: Heterogeneity of the effect by the industry of the local firms

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated x After(1-3)	-0.054**	-0.019	-0.003	-0.006	-0.006	0.000
	(0.027)	(0.015)	(0.012)	(0.007)	(0.009)	(0.003)
Treated x After(1-3) x LocalServices	-0.038	-0.044**	-0.016	-0.001	-0.002	0.002
	(0.027)	(0.021)	(0.022)	(0.011)	(0.015)	(0.006)
Treated x After(1-3) x Competitor	0.162	0.180**	-0.076	-0.018	-0.015	-0.033**
	(0.119)	(0.086)	(0.065)	(0.035)	(0.040)	(0.015)
Treated x After(1-3) x Supplier	-0.045	-0.068*	0.012	0.003	-0.015	-0.002
	(0.045)	(0.041)	(0.028)	(0.018)	(0.012)	(0.006)
Treated x After(1-3) x Buyer	0.052	0.041	-0.015	0.007	0.025	0.010
	(0.066)	(0.041)	(0.034)	(0.016)	(0.019)	(0.008)
Treated x After(4-5)	-0.070**	-0.037	-0.011	-0.014	0.002	0.001
	(0.035)	(0.027)	(0.018)	(0.012)	(0.013)	(0.004)
Treated x After(4-5) x LocalServices	-0.037	-0.037	-0.029	0.031	-0.017	-0.008
	(0.048)	(0.031)	(0.030)	(0.021)	(0.021)	(0.008)
Treated x After(4-5) x Competitor	0.108	0.155	-0.008	0.017	-0.018	0.004
	(0.135)	(0.107)	(0.059)	(0.055)	(0.049)	(0.023)
Treated x After(4-5) x Supplier	-0.044	-0.100*	0.012	0.005	-0.020	0.005
	(0.062)	(0.058)	(0.033)	(0.032)	(0.024)	(0.009)
Treated x After(4-5) x Buyer	0.029	0.067	0.040	-0.042	0.035	-0.011
	(0.107)	(0.079)	(0.045)	(0.029)	(0.032)	(0.011)
Time period dummies	YES	YES	YES	YES	YES	YES
Treated x Far-away period dummies	YES	YES	YES	YES	YES	YES
Industry group dummies in interactions	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	359,826	353,768	326,784	330,158	353,607	332,702
Number of unique firms	26,434	26,512	25,914	26,142	26,527	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. LocalServices indicates firms providing local services. Buyer and Supplier indicate firms operating in the buyer or supplier industries of the closing plant. Competitor indicates firms operating in the same industry as the closing plant. The other right-hand side variables are also interacted with the industry group dummies. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6)), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

closure effect. First, estimated patterns suggest, that firms providing non-tradable local services are hurt more than average by the plant closure. This is in line with the assumption, that people getting unemployed or having jobs with lower wages consume less as their income becomes lower. Then demand from local consumption decreases, especially hurting those firms which sell mostly locally, like firms providing non-tradable local services. The estimated patterns support the existence of the "decrease in local purchasing power" channel. Second, firms operating in the same industry as the closing plant seem to benefit from the closure. The reason might be lower competition for local inputs, like labor. This is in line with the existence of the "increased local labor supply" channel. I expect that especially those firms can benefit, which employ people with similar skills and experiences as the closing plant, like firms operating in the same industry. Third, although results are weak, firms operating in the supplier industry of the closing plant seem to be hurt more than average. This supports the existence of the "input/output linkages" channel, hurting local firms which lose their business partners. I find no differential effects for buyer-industry firms. As the closing plants exported a lot, I expect that there were only very few local buyers. This explains why buyers are not hurt by lost local supplies.

2.6.4 Heterogeneity by the characteristics of the local firms

After looking at differential effects by industry, I allow for a heterogeneous effect by other characteristics of the local firms. Table 2.4 shows estimation results by ownership. I classify a local firm as foreign-owned if it had a majority foreign ownership 2 years before the plant closure. Though coefficients are only marginally significant, foreign-owned firms seem to lose less than domestic firms or even gain in terms of sales and employment. Foreign-owned firms also have higher productivity and lower exit probability after the treatment. Longer-run effects are not significant but have the same sign. These results are reasonable if foreign-owned firms were able to take advantage of increased local labor supply. After the large plant closure the local authorities might also put more effort in keeping these firms from relocating by providing more support or other local benefits.

In Table 2.5 I look at the plant closure effect by productivity group. I define productivity tertiles using estimated TFP values 2 years before the closure. I determine the cutoffs for the tertiles separately for each 2-digit industry. Coefficient estimates are rarely significant, but the patterns suggest, that low-productivity firms lost the most after the plant closure. This pattern is especially clear for sales. Table B.12 of the Appendix shows similar results for size groups. There I use fixed size cutoffs, resulting in decreasing group size for

Table 2.4: Heterogeneity of the effect by the ownership of the local firms

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated x After(1-3)	-0.079*** (0.020)	-0.038*** (0.012)	-0.019* (0.010)	-0.005 (0.006)	-0.011 (0.008)	0.001 (0.002)
Treated x After(4-5)	-0.113*** (0.030)	-0.063*** (0.019)	-0.023 (0.017)	-0.010 (0.012)	-0.013 (0.010)	-0.001 (0.003)
Treated x After(1-3) x Foreign	0.144* (0.079)	0.112* (0.059)	0.093* (0.050)	0.002 (0.023)	0.062* (0.035)	-0.016* (0.010)
Treated x After(4-5) x Foreign	0.158 (0.128)	0.135 (0.088)	0.051 (0.088)	0.054 (0.055)	0.117 (0.076)	0.015 (0.012)
Time period dummies	YES	YES	YES	YES	YES	YES
Treated x Far-away period dummies	YES	YES	YES	YES	YES	YES
Foreign dummy in interactions	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	272,760	268,326	250,249	252,388	271,633	257,250
Number of unique firms	14,690	14,700	14,542	14,688	15,326	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Foreign is an indicator of those firms which were foreign-owned 2 years before the closure. Interactions of the foreign dummy with all the other right-hand side variables are also included. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

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Table 2.5: Heterogeneity of the effect by the productivity of the local firms

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated x After(1-3) x LowTFP	-0.107**	-0.041	-0.020	0.008	-0.017	-0.002
	(0.043)	(0.030)	(0.021)	(0.011)	(0.013)	(0.004)
Treated x After(1-3) x MediumTFP	-0.026	-0.014	0.017	-0.011	0.012*	-0.000
	(0.025)	(0.019)	(0.014)	(0.007)	(0.007)	(0.004)
Treated x After(1-3) x HighTFP	-0.037	-0.004	-0.018	0.006	0.001	-0.005
	(0.032)	(0.023)	(0.015)	(0.011)	(0.009)	(0.004)
Treated x After(4-5) x LowTFP	-0.107	-0.057	0.010	0.031	0.002	-0.009
	(0.066)	(0.047)	(0.030)	(0.021)	(0.023)	(0.006)
Treated x After(4-5) x MediumTFP	-0.030	0.003	-0.003	-0.000	0.018*	-0.000
	(0.035)	(0.029)	(0.024)	(0.019)	(0.010)	(0.006)
Treated x After(4-5) x HighTFP	-0.052	-0.037	-0.022	-0.017	-0.006	0.004
	(0.053)	(0.041)	(0.027)	(0.017)	(0.015)	(0.006)
TFP group dummies in interactions	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	359,826	353,768	326,784	330,158	353,607	332,702
Number of unique firms	26,434	26,512	25,914	26,142	26,527	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. LowTFP is an indicator of those firms which were in the lowest productivity tertiles of their 2-digit industry 2 years before the closure. MediumTFP and HighTFP stands for the middle and the highest productivity tertile. All the other right-hand side variables are included only in interactions with the productivity group dummies. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

larger firms. Similarly to productivity, the estimated coefficients are rarely significant, but the patterns suggest that smaller firms were hurt more by the plant closure.

2.6.5 Heterogeneity by the characteristics of the plant closure

Next, I test if the effect of a plant closure depends on some characteristics of the closing plant or on the type of the treated location. I classify closing plants based on export intensity and size, and also group locations based on city size and pre-closure unemployment level, creating two groups for each. I define high export intensity if the export share of the closing plant's firm is higher than 50% 2 years before the plant closure. I define small plants as plants with at most 300 employees before the closure. The cutoff for city size is at 40,000 working-age inhabitants in the year before the plant closure. I classify a location as having high unemployment share if the unemployment share in the 30 km agglomeration 2 years before the closure is above the median value of the 41 cases. The number of cases with the different characteristics can be found in Table B.13 of the Appendix. Categories are not strongly overlapping.

The upper panel of Table 2.6 shows that plant closures in locations with worse initial economic conditions were hurt more by a plant closure. Sales, employment and productivity of local firms in a location with a high unemployment level decreased considerably more than in locations with a low level of unemployment. This is a reasonable finding, as local economies with a high unemployment level even before the closure are less capable to cope with the problem of new layoffs. The lower panel of Table 2.6 suggests that the effect on sales is uniform across cities with different size, but the employment effect is significantly larger in small cities. Table B.14 of the Appendix shows that there are no significant differences in the effect of closures with high or low export share or by the size of the closing plant. At the same time, the negative effect on labor productivity and average wage becomes significant for the cases with a less export-oriented closing plant. There is no wage effect where the closing plant is more export-oriented. A potential explanation might be that experience of the laid-off workers is valued more when the plant produced for export. This might have counterbalanced the wage-decreasing effect of the increased local labor supply.

I use three additional measures capturing the local importance of the closing plant to see if more important plants had a stronger effect when they closed. First, I group cases based on the relative size of the closing plant compared to the total employment of all other firms within the 10 km agglomeration. I use the median value (5%) and 15% as alternative cutoffs. Table B.15 of the Appendix suggests that those plants which are larger compared to the local economy tend to have a stronger negative effect on local firms, but the difference is not significant. As alternative measures, I proxy the embeddedness of the plant in the local economy with the age of the plant and the length of operation as a foreign-owned firm. I expect that both are correlated with the strength of local links, but the second might be a better measure if the new foreign owners do not keep the old business links. For each measure I create two case groups using 10 years as the cutoff. Alternatively, I interact the

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Table 2.6: Heterogeneity of the effect by the characteristics of the location

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated x After(1-3)	-0.026	-0.016	0.008	-0.006	0.016*	0.001
	(0.026)	(0.018)	(0.015)	(0.010)	(0.009)	(0.003)
Treated x After(4-5)	-0.040	-0.007	-0.009	-0.019	0.018	0.002
	(0.039)	(0.027)	(0.024)	(0.016)	(0.012)	(0.004)
Treated x After(1-3) x HighUnemp	-0.060*	-0.020	-0.034**	-0.003	-0.038***	0.004
	(0.032)	(0.022)	(0.016)	(0.011)	(0.010)	(0.004)
Treated x After(4-5) x HighUnemp	-0.079	-0.094***	-0.002	0.022	-0.033**	0.001
	(0.049)	(0.035)	(0.027)	(0.017)	(0.015)	(0.006)
Number of observations	359,826	353,768	326,784	330,158	353,607	332,702
Number of unique firms	26,434	26,512	25,914	26,142	26,527	
Treated x After(1-3)	-0.047*	-0.001	-0.013	-0.008	-0.006	-0.000
	(0.027)	(0.019)	(0.014)	(0.008)	(0.008)	(0.004)
Treated x After(4-5)	-0.042	-0.006	-0.027	-0.015	0.003	0.002
	(0.041)	(0.035)	(0.017)	(0.012)	(0.012)	(0.005)
Treated x After(1-3) x SmallCity	-0.008	-0.055*	0.013	0.001	0.002	0.002
	(0.035)	(0.028)	(0.020)	(0.011)	(0.011)	(0.005)
Treated x After(4-5) x SmallCity	-0.017	-0.085*	0.043	0.004	0.000	-0.004
	(0.051)	(0.045)	(0.030)	(0.020)	(0.020)	(0.007)
Number of observations	359,826	353,768	326,784	330,158	353,607	332,702
Number of unique firms	26,434	26,512	25,914	26,142	26,527	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. SmallCity is an indicator of those cases where the the city of the closing plant had less than 40,000 working-age inhabitants. HighUnemp is a dummy for cases having a higher than median level unemployment rate in the 30 km agglomeration 2 years before the closure. Interactions of the case group dummy with all the other right-hand side variables are also included. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Column (6) includes firm-year-level characteristics as log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

Table 2.7: Differences in the plant closure effect by the embeddedness of the closing plant in the local economy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Length of operation:	total		as foreign		total		as foreign	
VARIABLES	log sales				log employment			
Treated x After(1-3)	-0.029	0.014	-0.025	0.021	-0.028	-0.033	-0.016	-0.020
	(0.028)	(0.043)	(0.023)	(0.039)	(0.024)	(0.034)	(0.019)	(0.031)
Treated x After(4-5)	-0.037	-0.012	-0.057*	-0.015	-0.016	-0.005	-0.031	-0.024
	(0.036)	(0.060)	(0.031)	(0.049)	(0.033)	(0.055)	(0.026)	(0.046)
Treated x After(1-3) x More than 10 years	-0.051		-0.075**		-0.004		-0.030	
	(0.034)		(0.030)		(0.029)		(0.024)	
Treated x After(4-5) x More than 10 years	-0.062		-0.045		-0.056		-0.050	
	(0.047)		(0.050)		(0.039)		(0.036)	
Treated x After(1-3) x Length		-0.007*		-0.009**		0.000		-0.001
		(0.004)		(0.004)		(0.003)		(0.003)
Treated x After(4-5) x Length		-0.006		-0.007		-0.004		-0.003
		(0.005)		(0.006)		(0.004)		(0.004)
Treated, time period and case group dummies, also in interactions	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE, case FE, calendar year FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	359,826	359,826	359,826	359,826	353,768	353,768	353,768	353,768
Number of unique firms	26,434	26,434	26,434	26,434	26,512	26,512	26,512	26,512

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. More than 10 years is an indicator for the closing plant having operated for more than 10 years (in columns (1) and (5)) or having been foreign for more than 10 years (in columns (3) and (7)). Length measures the number of years above one the closing plant has operated (in columns (2) and (6)) or has been foreign (in columns (4) and (8)). Length variables are also interacted with all other indicators. Fixed effects for firm, case and calendar year are also included. The unit of observation is firm-year-case. Standard errors in parentheses are clustered by city. *** p<0.01 ** p<0.05 * p<0.1.

number of years minus one with the treatment indicator, measuring the additional effect of an extra year when the closing plant existed or was foreign. Table 2.7 shows that the negative effect on the sales of local firms is significantly larger for plants being present for a longer time, especially if these were also foreign-owned for longer. Older plants seem to have no additional effect on the employment of local firms, and the additional effect of plants being foreign owned for a longer time is not significant either.

I also check if the estimated effects differ by the activity of the closing plant. I create four industry groups. Food contains 11 closures in NACE category 15. Textile & leather contains 17 closures in NACE categories 17, 18 and 19. Machinery & equipment contains 8 closures in NACE categories 29, 30, 31, 32 and 34. The remaining 5 closures are in NACE categories 21, 25, 26 and 27. I present the results by case groups in Table B.16 of the Appendix. The overall negative effect on sales and employment is not significantly different in the four industry groups. Still, the effects seem to disappear for plant closures in machinery and equipment industries. Most of these closures are in locations with a low unemployment rate before the closure, and all these firms had high export shares. Consequently, the laid-offs having valuable experiences at the foreign firm might have been able to find a new employment relatively easily in a location with better economic conditions.

Finally, I find some heterogeneity in the effect by the owner of the closing plant. I create four groups of owners: German-speaking countries (Germany, Austria and Switzerland), UK and the Netherlands, Mediterranean countries (Italy, Greece and Cyprus) and others including USA, Taiwan and global firms without a clear home country. Using the group of other owners as the baseline, Table B.17 of the Appendix shows that the effect is not significantly higher for German-speaking firms where the distance to Hungary is the lowest. At the same time, the negative effect is somewhat stronger when the owners come from the UK or the Netherlands. Table B.18 of the Appendix shows that the closing plants in this group operated and were foreign for a longer time, suggesting that they might have been more embedded in the local economy.

2.6.6 Aggregate employment effect

In order to capture the aggregate employment effect of plant closures in the local economy, first I check the plant closure effect on the extensive margin. On average, I find no significant effect on either the number or the size composition of entering or exiting firms. Consequently, I only need to add up the within-firm effect I estimated for employment growth. As $E(log(y)) \neq log(E(y))$, I account for heteroskedasticity using the solution suggested by Silva and Silva and Tenreyro (2006). I estimate a Poisson regression using the functional form $E(y_i) = e^{\beta X_i}$ with βX_i specified as in equation 2.3, except for two modifications. First, for ease of computation I don't include firm-fixed effects, but I restrict the sample to firms being already present before the plant closure. As columns (2) and (3) of Table B.19 in the Appendix show, OLS estimates with and without firm-fixed effects are similar. Second, I allow for heterogeneity in the effect by size, using 20 and 100 employees two years before the closure as size cutoffs.[20] Table B.19 of the Appendix

[20]Experimenting with more size groups suggests that it is not worth to decrease group size by dividing the sample further. Estimated effects are similar for the groups 20-50 and 50-100, and there are no significant differences between groups 100-200 and above 200 either.

shows the estimated coefficients. For each firm located close to a closing plant I calculate the estimated difference in the period after the closure by subtracting the counterfactual employment level from the observed employment. Then I add up the differences to the level of each case. Firm-level counterfactuals are given by

$$y_{it}^{c} = \frac{\hat{y}_{it}}{e^{\beta_7 Size\_group_i}} | (Treated = 1, After = 1), \tag{2.5}$$

where $\hat{y}_{it}$ is the predicted employment for firm i in event-year t, β_7 is a vector of coefficients on the interaction terms of treated location indicator, after closure period indicator and the size group indicators, $Size\_group_i$. I use bootstrap to estimate a confidence interval for the aggregate effects. I find, that in the average case 354 new jobs are created among the incumbent firms 3 years after the closure. As the average number of people being laid off from a single plant is 341, this means that on average local firms absorb the laid-offs 3 years after the closure. Still, estimates are very noisy, the 95% bootstrap confidence interval is (-189, 897), and there is a large heterogeneity across cases. The aggregate effect of the median case is -187, and I estimate a negative aggregate effect in 27 out of the 41 cases (22 located in small cities), though only 3 of them are significantly negative. A negative aggregate effect suggests that total employment losses in the local economy are larger than the initial layoff due to the plant closure. In additional 11 cases the aggregate effect on incumbents' employment is positive but significantly lower than the size of the initial layoff, suggesting a negative total effect on local employment. As a comparison, Gathmann et al. (2015) find, that the employment reduction was 3.7% of the local employment four years after the layoffs. This is about twice as large as the size of the initial layoffs in their sample, which accounted for about 1.9% of the local employment. At the same time, Jofre-Monseny et al. (2015) find, that the total employment effect is only 30-60% of the direct effect.

It is important to note, that the calculated numbers refers to jobs within 10 km agglomeration. It might be the case that local people getting unemployed found jobs outside this circle. While there is no sign of people moving out from these cities, people might travel more to their new workplace, which I cannot measure. Additionally, given the large heterogeneity across cases, new entrants might play an important role in some of the cases, even if I estimate no significant effect on average.

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2.6.7 Robustness checks

In this section I show that the main results are robust to several specification changes. First, I include trends in the main specification as I presented in equation 2.4. Table B.20 of the Appendix shows that pre-closure trends are significantly different in treated and control locations. Still, the average decrease in sales remains significant even after controlling for pre-trend differences, but it is not true for employment. Table B.21 shows similar results estimating a heterogeneous effect by industry groups. The employment effect is still significantly larger for firms operating in local services and in the supplier industry. Estimated effects are not significantly different any more for firms operating in the same industry as the closing plant, but the patterns are similar to my previous estimates.

Table B.22 and B.23 of the Appendix show that my results are robust to the exclusion of closures in the crisis period and in the EU accession years. I consider 2003 and 2004 as EU accession years and 2008 and 2009 as the crisis years. There are 12 cases from EU accession years and 11 cases from the crisis years. The number of remaining cases after excluding these two groups is 18. The magnitude of the short-run effects is somewhat lower and results for firms in the same industry as the closing plant are not significant any more, but the main patterns stay the same. Similarly, Table B.24 and B.25 of the Appendix show the results after excluding those cases where indebtedness played an important role in the plant closure. There are 7 closures where the press announcements mentioned indebtedness as a crucial factor of the closure. Excluding these cases, average results become even stronger. Results for local services lose their significance, but the main patterns stay the same.

As a further robustness check I modify the baseline estimates assigning multiple control cities to each plant closure. I take all those cities as controls where a foreign-owned large plant operated in the same 2-digit industry as the closing plant but did not close. I run weighted regressions, where I create the weights using the distance of a control city from the treated in terms of propensity scores. Tables B.26 and B.27 in the Appendix present the results for all local firms and by industry categories. As the controls are less comparable to the treated, some of the estimated coefficients lose their significance, but the main patterns remain the same. Local firms sell less after the plant closure, firms in the local service industry lose more than the average firm, and firms in the same industry as the closing plant gain on average.

Finally, I look at the baseline effects in a different agglomeration. I take the 20 km radius agglomeration around treated and control cities, excluding the 10 km radius agglomeration I used so far. This shows if there are significant effects of the plant closure beyond a relatively limited area around the city. Table B.28 of the Appendix shows the results. The upper panel of Table B.28 suggests that the effect of a plant closure is highly concentrated in space. There are no significant differences between the 10-20 km areas surrounding treated and control locations. The lower panel of Table B.28 shows similar patterns separately for different industry groups of the local firms. Yet, firms in the same industry as the closing plant seem to be affected negatively, and supplier-industry firms have lower productivity in treated locations. At the same time, most of these effects are only marginally significant.

2.7 Conclusion

In this paper I look at the effect of large foreign-owned plant closures on nearby firms. For this I use a difference-in-differences approach by comparing firms located near the closing plant and in comparable areas, comparing outcomes before and after the plant closure. I assign control locations to each case using propensity score matching. I find that overall there is a significantly negative effect on sales and employment. These negative effects are significant even 4-5 years after the plant closure. Foreign-owned local firms are able to benefit from the closures. Low-productivity and small firms are hurt the most. Effects are larger in smaller cities and in locations with worse economic conditions. Firms providing local services or operating in supplier industries of the closing plant are hurt more than average by the plant closure. This pattern is in line with two potential channels: decreasing local purchasing power and lost input/output linkages. Firms in the same industry as the closing plant seem to gain from the closure. This result suggests that some of the local firms can benefit from the increasing local labor supply. Concerning aggregate effects, there is a large heterogeneity across cases. As a result I cannot find a negative aggregate effect on average, but small cities seem to lose even when looking at aggregates.

As I next step I plan to involve linked employer-employee data in the analysis. With the help of this database I will be able to check if laid-off employees of the closing plants were indeed predominantly employed by firms operating in the same industry, or found jobs farther away than the agglomeration of 10 km. I can also investigate wage effects more precisely, accounting for composition changes in the employees of the affected firms.

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Chapter 3

Learning to Import from Your Peers

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3.1 Introduction

Evidence suggests that imports have a positive effect on firm productivity (Amiti and Konings (2007), Halpern et al. (2015)). Yet there is much heterogeneity in seemingly similar firms' importing behavior. One possible explanation for this heterogeneity is informal trade barriers based on information and trust. Indeed, specific knowledge, and access to a trusted trading partner, may be important for a productive import relationship. When such informal barriers are active, importing, and its productivity benefits, may diffuse from firm to firm through personal and business connections. In the context of exports, Mion and Opromolla (2014) and Fernandes and Tang (2014) document this mechanism: they show that knowledge diffusion in managerial and neighborhood networks affect firms' export behavior. But from these studies about exports one cannot generalize to knowledge diffusion about imports. While finding an import partner may be easier, finding a high-quality partner who can be trusted may be harder than in the case of exports. At the same time, measuring the barriers to importing and the underlying mechanisms is important given the potential productivity gains from importing.

In this paper we use firm-level data from Hungary to document knowledge diffusion in importing. We have two main contributions. First, our rich observational data allows us to use an empirical strategy which rules out many alternative stories and helps us measure diffusion in multiple networks. Specifically, we exploit source-country variation in importing, effectively asking whether a peer with import experience from the Czech Republic, rather than Slovakia, makes the firm more likely to import from the Czech Republic than from Slovakia. And we can trace diffusion through narrowly defined neighborhood networks, including the same building and directly neighboring buildings; through managerial networks created by managerial moves; as well as through ownership networks. Second, we exploit information on peer firms and the characteristics of imported goods to shed light on the mechanism of knowledge spillovers. Our results show knowledge flows in all three networks; and also that these flows are highly localized in space and stronger when peer firms are larger, more productive, are in the same industry, and import the same product. These results support the view that knowledge specific to the foreign market segment is important for importing, and highlight a potential benefit of industrial clusters for encouraging international trade.

For the analysis we use rich firm-level panel data on Hungarian firms during 1993-2003. We combine three data sources which cover this period: a Hungarian firm register from CompLex, balance sheet data from the National Tax and Customs Administration and trade data from the Hungarian Customs Statistics.[1] The firm register contains the full universe of Hungarian firms, including the precise address of the firm, all the owners and employees having signing right, and the country of the owners. As a result, we can follow moves of people and changes in ownership links between firms and over time. The balance sheet data also contain information on the industry and the foreign ownership share of firms. Moreover, for each firm we have annual trade data on country-HS6 product level.

Our empirical strategy is to estimate a linear probability model measuring the effect of peer firms' country-specific experience on a firm's decision about starting to import from a given country from which it had not imported before. Our identification comes from cross-country variation in peers' experience. We discuss concrete threats to identification below. We look at four countries which are comparable in terms of imports from Hungary: the Czech Republic, Slovakia, Romania, and Russia. To ensure that all firms are the same distance from any foreign country we only include firms located in Budapest. The key variables in the estimating equation are indicators for peers' past experience with a given country. We separately include peer experience indicators for all three networks: closely-located, person-connected as well as ownership-connected peers. Closely-located peers can be firms in the same building, in the closest neighboring buildings, or in the closest cross-

[1] We do not have access to the trade data after 2003.

street buildings. Person-connected peers are firms from whom a person with signing rights has moved to the firm of interest where it became an owner. And ownership-connected firms are firms sharing ultimate owners with the firm of interest. We exclude ownership connected firms from the closely-located and person-connected categories. In our regression we include firm-year and country-year fixed effects, thus effectively identifying from variation within a firm in a given year. Specifically, we ask if having a peer that has past foreign experience with a given country increases the probability of starting to import from *that country* rather than from another country.

Our first main result is that there are significant positive import spillovers in all three networks. Regarding neighborhood networks, spillovers are highly localized in space. Having a neighbor with import experience in the same building increases the probability of starting to import by 0.2 percentage points. This doubles the average probability of starting to import from one of the four countries. The effect of a firm with a similar experience in the neighboring building is only one-fifth as large. Person-connected peers matter as well, but only those with export experience. Ownership links are also important: the effect of country-specific import experience in the ownership network is more than twice as large as the effect of a same-building peer. Our main results are robust to several specification changes. The magnitude of the effects is comparable to export spillovers estimated with a similar identification strategy. These findings suggest that spillovers from experienced peers are important in the decision of starting to import from a given country. Firm clusters may help to increase not only exports, but also imports.

A key identification concern is omitted variables: those firms which tend to import from a given country also tend to become peers for reasons unrelated to learning. For example, firms may cluster by ownership or industry and these firms also tend to import from the same country. Our empirical approach addresses this concern in a number of ways. First, our basic empirical specification by design rules out several omitted variables. The neighboring building versus cross-street building comparisons rule out spatially correlated omitted variables as long as knowledge spillovers decay faster than the spatial correlation in the omitted variable. Because we control for ownership links across firms, we also control for omitted variables based on joint ownership. And we show below that firms also tend to learn from peers operating in different industries, addressing same-industry clustering. Second, we complement our basic specification with an event study which exploits firm moves. We look at firms with country-specific import experience moving into an address where no such experience was present earlier. The move can be regarded as a plausibly exogenous shock to local country-specific knowledge. We show that firms located in such an address start to import from the country with a higher probability than from other countries. Third, we also address the reverse causality problem that firms about to import hire expert managers with country-specific experience, by showing that spillovers are also present when the firm gets a new owner with country-specific experience, as new owners are unlikely to be matched to firms based on plans to import.

Our second set of main results concern heterogeneity of the spillover effect. We explore heterogeneity both by the characteristics of the firm and the characteristics of the peers. We find that the effect of same-building and ownership-connected peer experience is present in almost all firm or peer groups, but with varying magnitude. Specifically, larger, more productive and foreign-owned firms learn more. Similarly, firms learn from those peers more which are larger, more productive or foreign-owned. These average effects hide additional heterogeneity based on the productivity gap between the firm and its peer: low-productivity firms tend to learn from low-productivity peers, while high-productivity firms learn more from high-productivity peers. These patterns suggest that firms learn more from similar peers, perhaps because the knowledge gap to be bridged is not that large.

We also look at heterogeneous effects based on industry and product category. We find that the effect of peers operating in the same industry or having import experience with the same product category is significantly larger than the effect of other peers. At the same time, spillovers from peers operating in different industries or importing different product types is also significant. As mentioned above, the existence of these cross-industry and cross-product effects supports our identification strategy. The larger peer effect within industry and product category, in combination with the larger peer effects among similarly-productive firms, highlights one benefit of putting similar firms into industrial clusters. It appears that knowledge spillovers are higher among firms facing similar business decisions.

3.1.1 Literature

This paper is related to the literature on knowledge spillovers in trade. These papers examine how knowledge transfer from spatial neighbors, moving employees or foreign-owned firms in the industry affects a firm's export. To our knowledge similar analysis on imports is scarce.

Neighbors with export experience: There are quite a few papers on how firms learn to export from neighboring firms with export experience. This literature finds mixed effects for neighbors with general export experience. On the one hand, Aitken et al. (1997), Barrios et al. (2003), Bernard and Jensen (2004), Lawless (2009) and Pupato (2010) find no significant export spillovers for Mexican, Spanish, US, Irish or Argentine firms. On the other hand, Clerides et al. (1998) find some evidence on regional and industrial export spillovers in Colombia, Mexico and Morocco. Lovely et al. (2005) show that US exporters are spatially correlated, and this correlation increases with the difficulty of the market. Greenaway and Kneller (2008) find that agglomeration spillovers increase the probability of export entry for firms in the UK. Dumont et al. (2010) look at the channels of export spillovers for Belgian firms, finding that both increased productivity and decreased perceived sunk cost play an important role.

Neighbors with country-specific export experience: Findings on the effect of neighbors with country-specific export experience are more conclusive. Koenig (2009) shows the presence of destination-specific and destination-industry-specific export spillovers for French manufacturing firms. Koenig et al. (2010) show that there are only extensive-margin effects of export spillovers, which are stronger for product- or destination-specific neighbors. Castillo and Silvente (2011) show the existence of country-specific export spillovers on the choice of entry to a new export market for Spanish firms. Ramos and Moral-Benito (2013) show that entry is more likely and export relationships are more stable if also nearby firms export to a country. Firms are more clustered if they sell to more difficult markets. Poncet and Mayneris (2013) also show that export spillovers are product- and country-specific, and stronger for more difficult markets. Artopoulos et al. (2013) do case studies in Argentina to show the crucial role of country-specific knowledge spread by export pioneers in starting to export to a developed country.[2] In this paper we use closely located countries, still finding positive spillovers from peers. The previous two papers suggest that spillover effects might be even larger for more exotic countries. Fernandes and Tang (2014) build a decision model in which a positive signal from the neighbors increases entry probability. Chinese data match the predicted patterns. Mayneris and Poncet (2015) also find product- and country-specific spillovers in China from neighboring foreign firms. Compared to all these papers we use a much finer definition of geographic neighborhood. The previous papers look at neighbors in the city Fernandes and Tang (2014), in the employment area (Koenig (2009) and Koenig et al. (2010)) or in an even larger agglomeration, whereas we use neighbors only in the same, neighboring or cross-street buildings. As Arzaghi and Henderson (2008)

[2]Krautheim (2012) uses this result in a theoretical paper to explain why the effect of distance on trade doesn't decrease over time. He shows that export spillovers combined with the pattern that less firms export to remote markets can explain this puzzle.

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show, networking benefits have a rapid spatial decay.[3] Thus we might find stronger import spillovers using a narrower neighborhood definition. Additionally, as opposed to most of the papers (except Fernandes and Tang (2014)), we include country-year and firm-year fixed effects and identify the spillover effect only from cross-destination variations within a firm. A recent paper of Kamal and Sundaram (2014) uses rich data on Bangladeshi textile firms exporting to US firms, estimating partner-specific export spillovers. While we have no data on import partners, our results are more general by including firms operating in different sectors. Finally we also include person-connected and ownership-connected neighbors and look at the effect of different types of country-specific experiences: imports, exports and ownership. A closely related paper of Choquette and Meinen (2015) also separate different mechanisms for export spillovers. They look at the effect of high-wage labor movement, intra-industry spillovers and inter-industry backward and forward linkages for manufacturing firms in Denmark. They find heterogeneous effects by firm size and export market. As opposed to this paper they use a broader neighborhood definition, commuting areas. Using country-specific export and ownership experience is also a novelty of the current paper.

Moving employees: Choquette and Meinen (2015) also relate to another strand of the literature, which look at knowledge spillovers transferred by moving employees. Bertrand and Schoar (2003) show that a manager-fixed effect explains a large part of the heterogeneity in firms' decisions. Balsvik (2011) find that employees with experience in multinational firms increase the productivity of non-multinational Norwegian manufacturing plants. Additionally, their private return is smaller than the benefit of the firm. Stoyanov and Zubanov (2012) show that Danish firms hiring workers from more productive firms increase their productivity in a persistent way after the hiring. Some more recent papers focus on the effect of experienced movers on the export decision of firms. Mion and Opromolla (2014) show on Portuguese data that a firm with an entering manager who has previous export experience has higher export performance, including higher probability of entry. This effect is even stronger for market-specific experience. In a follow-up paper Mion et al. (2015) find that country-specific or product-specific export knowledge of the manager matters for export performance. Sala and Yalcin (2015) find that Danish firms having a manager with general export experience start to export with a higher probability. Masso et al. (2015) use Estonian data to have similar findings for region-specific export experience

[3]See Henderson (2007) for a review of the knowledge spillover literature.

but not for general export experience. The effect is stronger if it is more recent experience and if it is in exporting a similar product. In the current paper knowledge transfer by moving managers is only one of the potential channels of import spillovers. As opposed to most papers mentioned before we can explicitly control for ownership links between the firms, which gives a more reliable identification of the manager effect. Additionally, we use different definitions of moving managers to handle the problem of reverse causality. Finally, we also consider managers with previous experience in firms having export, import or ownership connections to a specific country.

Foreign ownership: One type of country-specific experience we look at is ownership from a specific country. There are papers which investigate the effect of multinational firms on the export behavior of local firms. Greenaway et al. (2004) find that domestic firms in the UK start to export with a higher probability and export more in the presence of multinationals. Kneller and Pisu (2007) find the same for foreign firms in the same industry and region or in downstream industries. Sun (2009) have similar findings for China. As opposed to these papers we look at the effect of country-specific ownership.

Import spillovers: To our knowledge, only Harasztosi (2011) and Harasztosi (2013) estimate the effect of import spillovers on starting to import from a specific country. Harasztosi uses Hungarian data and applies the approach of Koenig et al. (2010), finding that only same-country and same-product neighbors matter. He uses NUTS4 neighborhoods which is broader than our definition. Our approach is also different in terms of capturing different spillover channels and different types of country-specific experience.

The rest of the paper is organized as follows. In Section 3.2 we describe the data and present some stylized facts. Section 3.3 presents the identification strategy. Section 3.4 presents the results and Section 3.5 concludes.

3.2 Data and stylized facts

3.2.1 Data

Data sources

For our analysis we use rich data on Hungarian firms. We combine three firm-level panel datasets. The first is the Hungarian Company Register from CompLex Kiadó Kft. It contains the full universe of Hungarian firms for the period 1990-2013. It includes data on firm name, tax id, precise address up to building, floor and door number, and owners of the firm with tax id for firms and address and mother's name for people. It also has information on the country of the owners. Finally, it also includes firm representatives with address and mother's name, allowing to follow people moving across firms. These can either be directors, members of the supervisory board or other employees with signing right. We can follow changes over time, as all these entries include precise start and end dates. We also know the age of the firms.

Our second source is the official balance sheet database from the National Tax and Customs Administration of Hungary. It includes the full universe of double-bookkeeping Hungarian firms for the period 1992-2013. Beyond balance sheet data it also includes the foreign-owned share of the firm and its industry. We classify a firm as being foreign-owned if it has majority foreign ownership. We use the industry classification up to two digits, which corresponds to NACE Rev. 1.1. For the analysis we use estimated total factor productivity (TFP) of firms. For these we assume a Cobb-Douglas production function with coefficients varying by two-digit industries, and with labor, material and capital as inputs. We use the method of Levinsohn and Petrin (2003) for estimating TFP.

Our third data source is the Hungarian Customs Statistics. It contains yearly imported and exported value by firm, country and product for the period 1991-2003. Products are given by HS6 classification. For the analysis we group these by the purpose of the product, assigning them to Broad Economic Categories (BEC). Additionally, we also use the product classification of Rauch, which separates goods traded on an organized exchange, reference-priced goods and differentiated products.[4] We use data on four comparable import countries: the Czech Republic, Slovakia, Russia and Romania. There are separate trade data for the first two only from 1993 on, as Czechoslovakia was split into the Czech Republic and Slovakia in 1993. As detailed trade data which we can match to the other two data sources is only available up to 2003, the period of our analysis is 1993-2003.

Summary statistics

Overall, there are 991,627 firms in the database. We use only firms with headquarters in Budapest, ending up with 212,859 firms on 79,097 distinct addresses. When a firm moves its headquarters out of Budapest, it gets out of the sample as if it died. We define a firm as an importer from a country if it ever imported before from that country. In this way we assume that country-specific import experience stays also in the long run. We

[4] The classification is available at `http://econweb.ucsd.edu/~jrauch/rauch_classification.html`.

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define exporter and ownership experience in an analogous way. We focus on firms starting to import from a destination, conditional on never importing from there before. In our sample there are 209,423 firms in Budapest not yet importing from at least one of the four destinations, located in 77,640 different addresses. 10,598 firms located in 9466 different addresses import from at least one of the destinations in the observed period. Table C.1 of the Appendix shows the number and average characteristics of firms by countries they import from. Figures C.1-C.3 of the Appendix show their industry composition for each import country, also for new importers separately. All these show that firms importing from different countries are similar in terms of observables. Table C.2 of the Appendix presents the yearly total number of firms and the number of importers per country. Table C.3 of the Appendix shows the share of firms importing from one or multiple countries. Somewhat more firms import from the Czech Republic and somewhat less from Russia, importers from the Czech Republic tend to import also from Slovakia, but overall, the shares are quite similar. As in the main analysis, here we define importers as firms which imported from that country ever before. The second column presents the same pattern for successful importers. We define a firm as a successful importer in year t if it imports from a country at least twice in the 3-year period $[t-1, t+1]$. The table shows the share of importers which were ever successful. Less than one third of the ever importer firms is also a successful importer. Table C.4 of the Appendix shows that the imports of a firm is highly concentrated by the type of the good. Most firms in our sample import industrial supplies (BEC category 2 and 3) and firms in the second most popular group import mainly consumer goods (BEC category 1 and 6).

Creating groups of peers

Geographic neighbors: We use a highly localized definition of geographic neighbors. We look at peers separately in the same building, in the neighboring building (defined by same street and building number +/-2) and in the cross-street building (defined by same street and building number +/-1). We create three different indicator variables for each firm-country pair in each year which show if there is a peer in the same, neighboring or cross-street building which has import experience from the specific country. We do the same for country-specific export and ownership experience. Table C.5 of the Appendix shows the share of firms with different number of neighbors in the same, neighbor or cross-street building. Firms have typically few neighbors. 22% of the firms have no neighbors in the same building and more than one third have at most one neighbor. We take out those firms from the analysis which have more than 50 neighbors in the same or in the neighboring buildings, ensuring that our results are not moved by large hubs. We also exclude those firms from the geographic neighbors which have ownership links to the firm of interest in the given year.

Person-connected peers: There are more than 1.4M people in our data, more than 940,000 with signing right, also including directors and CEO-s, and more than 1.3M owners. In our baseline definition we define firm A to be a person-connected peer of firm B in year t if 1. there is a person who is an owner in firm B in year t, 2. and who had signing right in firm A before t. Firm A is a person-connected peer with country c-specific import experience of firm B in year t if 1. there is a person who is an owner in firm B in year t, 2. and who had signing right in firm A before t, 3. and firm A already imported from country c before t and before τ, where τ is the date of separation of the person from firm A. The aim of using only owners of firm B is to mitigate reverse causality concerns. It might be that firms planning to import from a country employ a manager with country-specific experience in order to help in importing, which they would also do without the manager. It is less likely though that a new owner is brought to the firm in order to make use of her country-specific experiences. Nevertheless, we also use two alternative definitions for person-connected peers. In the first we require that the connecting person has a signing right in firm B. In the second we allow for any connections to both firms. In all cases we exclude liquidators and people connected to more than 15 firms from the connecting people. We also exclude firms from person-connected peers which are on the exact same address (including floor and door number) or which are ever connected to the firm through direct or indirect ownership links. Yet, we also consider person-connected peers outside Budapest. As a result we end up with more than 1.1M firm pairs connected by people using the baseline definition. There are almost 1.4M firm pairs when a connecting person is defined as having signing right in both firms. There are 2.8M firm pairs when any type of connection is considered.

Onwership-connected peers: Firm A and B are in the same ownership network in year t if they have a common ultimate owner. This means the firms 1. either have a direct or indirect common owner, 2. firm A is a direct or indirect owner of B, or 3. firm B is a direct or indirect owner of A. Firm A is an ownership-connected peer of firm B with country c-specific experience in year t if A and B are in the same ownership network in year t and A already has country c specific experience in year t. Firms in the same ownership network outside Budapest are also considered. As a result we get more than 4.7M firm pairs in the same ownership network.

3.2.2 Stylized facts

Looking at basic patterns in the data suggests that there is a connection between having peers with country-specific knowledge and starting to import from the same country. Table C.6 of the Appendix shows the share of observations by different peer categories in which the firm has a peer with country-specific experience (column (1)) or experience with any of the four countries (column (2)). Export and import experience are not necessarily present together, and there are less observations with peers having an owner from a given country. There are closely located neighbors with country-specific experience in more than 20% of the observations. The share of observations with person-connected or ownership-connected experienced peers is much lower. Columns (3) and (4) show the share of observations within each peer group in which the firm has ever imported from the country. This share is higher for firms with an experienced peer than for firms without such peers. The share of importers is the highest if there are both importing and exporting peers, suggesting that both type of experience might be valuable. The share of importers with peers having only import experience is higher than the same share with peers having only export experience. This suggests that the same type of experience might matter more. The share of importers is higher in those groups which have experienced peers from multiple peer groups. This suggests the importance of all the different channels. Still, these patterns cannot serve as an evidence for a causal relationship between the presence of experienced peers and import entry.

Table C.7 of the Appendix shows that the share of importers is higher among those firms which have more neighbors in the same building, and even higher if these peers have import experience. Table C.8 of the Appendix includes firms which start to import from at least one of the countries. It has four separate panels for the different types of peers. Within each panel the first row shows the share of firms which start to import from a single country c, and the second row is the share of firms which start to import from any other country but c. Percentages do not add up to one as we exclude those firms which start to import from both c and from another country at the same time. In the first column there are those firms which have peers of a certain type with c-specific experience but which have no peers with experience from other countries. The second column includes those firms which have some experienced peers but the experience is not country c-specific. We calculate the shares for each of the four countries separately and present their weighted average, where the weights are the number of observations for a given country. Looking at any peer group, the share of importers from country c is always higher among firms which have only peers with country c-specific experience than among those which have peers with other experience. These patterns suggest that peers with country-specific experience play an important role in a firm's decision about starting to import from a specific country. Though we still need to test causality by controlling for potential confounding factors.

3.3 Empirical strategy

3.3.1 Identification strategy

Our main hypothesis is that firms learn from neighbors and other connected firms which already have country-specific experience, most importantly which already imported from a given country. As a result, firms with experienced peers import from the country with a higher probability. The main threat to identification is that importing firms locate close or become connected to each other for other reasons. Then what we see is not learning, only co-location or connectedness of special firms. The identification strategy we use aims to address this issue.

We identify from cross-country variation within a firm. This allows us to control for time-varying characteristics of a firm being common across all countries and time-varying characteristics of a country being common across all firms. Our identification comes from the different number of peers having experience with the different countries and the change of these peers over time. We assume that omitted variables are not specific to a particular country. Concerning geographic neighbors we also use a highly localized neighborhood to measure knowledge spillover. This helps our identification, as we can assume that knowledge spillover decays faster with distance than the correlation in omitted variables. This choice can also be motivated by the findings of Arzaghi and Henderson (2008) who find that knowledge spillovers are highly localized in space. For person-connected peers we can also exploit the timing of managers getting connected to new firms.

We focus on the decision to enter a new import market, using the sample of not yet importers from the given country. In our definition of importers and experienced peers we assume that experience remains after being ever obtained. A firm is an importer - i.e. it has import experience - from Slovakia in year t if it ever imported from Slovakia in t or before. Similar definitions apply for exports and ownership from one of the four countries. We also do robustness checks looking at the effect of more recent experience.

In the estimation we only include firms in Budapest. In this way the distance from a given country is the same for all of the firms. We use peers from the previous year to handle simultaneity and to allow for time to build new import relations. As opposed to the majority of the export spillover literature, in our main specification we don't look at the number of experienced peers, only the existence of such peers matter. In this way we assume that the main difference is between firms having or not having an experienced peer, and we do not control for the cumulative effect of additional peers in the same peer group. We do some robustness checks to see if this assumption holds.

3.3.2 Estimation

We estimate a linear hazard regression using the following equation:

$$X_{ict} = \sum_{n} \sum_{m} \beta_{nm} X_{nm}(a(i, t-1), c, t-1) + \mu_{ct} + \alpha_{it} + \epsilon_{ict} \tag{3.1}$$

The unit of observation is firm-year-country. The dependent variable X_{ict} is an indicator for firm i being an importer (i.e. imported ever before up to that year) from country c in year t. On the right-hand side we include separate indicators for the different peer groups and country-specific experience types. $X_{nm}(a(i, t-1), c, t-1)$ is one if there is at least one firm in firm i-s peer group n in year $t-1$ which has experience type m from country c. In the analysis we look at the effect of peers from the previous year. As a result we use the period 1994-2003 in the estimation. We include five different peer groups (n): 1. firms in the same building, 2. firms in the neighboring building (building number +/-2), 3. firms in the cross-street building (building number +/-1), 4. previous firms of the entering new owners and 5. firms in the same ownership network. We define geographic neighbors in year t based on the address a of firm i in year t. We include separate indicators for three different experience types (m): 1. imports, 2. exports and 3. having an owner from the country. In some of the specifications where we look at heterogeneous effects by type of the peers we only include import experience. We use four comparable source countries: c ={the Czech Republic, Romania, Russia, Slovakia}. Our baseline estimation sample includes firm-year pairs only in those years when the firm has not imported from the country until the previous year, but it might start to import in year t. We also include those firm-country pairs in which the firm never starts to import from the country in the period of observation. Then $\beta_{nm} > 0$ means that a peer in peer group n with country-specific experience of type m has a positive effect on the probability of the firm starting to import from the same country in the next year. μ_{ct} denotes country-year fixed effects and α_{it} denotes firm-year fixed effects. ϵ_{ict} is the error term. We cluster the standard errors by building. In the section where we look at the heterogeneity of the estimated effect by the characteristics of the firm we interact the indicator variables X_{nm} with indicators for firm groups. We also look at the heterogeneity of the spillover effect by the type of the peer. There we include X_{nmg} indicators which show if there is a peer in peer group n with country-specific experience type m in firm group g, where g can stand for size, productivity, ownership or industry.

3.3.3 Identification issues

The major concern with our identification strategy is the following: our estimates are biased if there is any remaining firm-country-specific variation correlated with both the import entry decision and the existence of peers with country-specific experience. It might happen that those firms co-locate or become connected through person or ownership links for which it is easier to import from a given country. One reason for that might be the clustering of firms by industry. Firms in the pharmaceutical industry might import chemicals from country c and firms in the paper industry might import raw materials from country c'. If pharmaceutical firms co-locate in district D and paper firms co-locate in district D', we incorrectly attribute the observed patterns to knowledge spillovers. Alternatively, there can be good locations within Budapest where firms import from the West and bad locations where firms import from the East. We address this issue in multiple ways. First, we use quite comparable countries in the analysis. This makes it less likely that good firms import from one country and bad firms import from another. Table C.1 of the Appendix also shows that observable characteristics of importers from the different countries are similar. Second, we control for ownership links among firms. This rules out the possibility that two firms are closely located and start to import in a sequential way because of a common owner's decision. Column (2) of Table C.18 in the Appendix shows that without accounting for ownership links some of the estimated effects would be upward biased. Third, we address concerns with the co-location of same-industry firms by looking at the effect of experienced peers operating in the same industry as the firm or in a different industry. Table 3.5 shows that peers operating in the same industry have indeed a larger effect, but peers from different industries also increase the probability of import entry. Finally, we also show an event study type evidence, exploiting movers with import experience within Budapest. Firms getting a new neighbor with import experience from a country start to import from this country with a higher probability than from other countries with which the mover has no experience.

3.4 Results

3.4.1 Baseline results

Table 3.1 shows our main results. In columns (1)-(3) we only include indicators for peers with import experience, separately for each peer group. Column (4) includes all peer groups and in column (5) we add indicators for peers having export or ownership experience from the country. Coefficient estimates are quite stable across the different specifications. Only the effect of person-connected importer neighbors becomes insignificant after controlling for the other types of peers. We cannot claim though that the effect of person-connected peers is zero, as estimates are noisy. Results show that all types of peer groups and all type of country-specific experience has an effect on import entry, but with varying magnitudes. The probability that a firm starts to import from a country is 0.2 percentage points higher when in the previous year there was a neighbor in the same building which already imported from that country. The neighbor effect is highly localized in space. The effect of an importing firm in the neighboring building is about one fifth of the same-building effect. The effect of a firm's import experience in the same ownership network is about twice as large as the same-building effect. We do not consider it as a knowledge spillover, it merely documents that import decisions are correlated within the ownership network. This might be the result of sequential importing decision by common owners.

Peers with country-specific export experience also play a role in the import entry decision, but to a lower extent than peers with import experience. The only exception is person-connected exporter peers which have a considerable effect on the import decision. Our specific definition of person-connected peer can be responsible for this pattern. Connecting people are former managers of a firm becoming owners of another firm. Their new firm might do somewhat related but different activities than the previous one. In this case some of the previous business partners might be useful for providing inputs for the new activity. Finally, those neighbors in the same building which are owned from a given country also increase the probability of starting to import from the same country, but their effect is about a quarter of the importer neighbors' effect.

These results suggest that peers with country-specific import experience are the most important for the import entry decision. Controlling for the experience of other firms in the

Table 3.1: The effect of peers with country-specific experience on the probability of starting to import from the same country

Sample: not yet importers until the previous year
Dependent variable: Importer

	(1)	(2)	(3)	(4)	(5)
Cross-street exporter neighbor					-0.000173 (0.000230)
Neighbor-building exporter neighbor					0.000340* (0.000204)
Same-building exporter neighbor					0.000254 (0.000218)
Person-connected exporter neighbor					0.00244** (0.00101)
Owner-connected exporter neighbor					0.00134*** (0.000403)
Cross-street importer neighbor	0.000309 (0.000245)			0.000297 (0.000245)	0.000316 (0.000244)
Neighbor-building importer neighbor	0.000440** (0.000200)			0.000434** (0.000199)	0.000392* (0.000204)
Same-building importer neighbor	0.00224*** (0.000258)			0.00221*** (0.000257)	0.00214*** (0.000259)
Person-connected importer neighbor		0.00153* (0.000913)		0.00131 (0.000909)	0.000996 (0.000920)
Owner-connected importer neighbor			0.00536*** (0.000494)	0.00531*** (0.000494)	0.00511*** (0.000492)
Cross-street neighbor owned from the country					0.000221 (0.000289)
Neighbor-building neighbor owned from the country					-0.000185 (0.000201)
Same-building neighbor owned from the country					0.000566** (0.000261)
Person-connected neighbor owned from the country					0.00159 (0.00214)
Ownership-connected neighbor owned from the country					-0.000435 (0.000693)
Firm-year FE	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES
Nr. of observations	3,778,517	3,778,517	3,778,517	3,778,517	3,778,517

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific experience in the previous year. An exporter or importer neighbor refers to a peer with country-specific export or import experience. A neighbor owned from the country refers to a peer who ever had an owner from the given country. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

same ownership network, experienced neighbors in the same building have the strongest effect on the import decision. The baseline probability of firms starting to import from a country is 0.00252 in our estimation sample. This means that a same-building neighbor which already imported from a given country almost doubles the probability of a firm starting to import from the same country.

3.4.2 Heterogeneity

Heterogeneity by the firm

As a next step we look at the heterogeneity of the estimated effects by the type of the firm. We interact all the indicator variables for experienced peers with different firm group indicators. We group firms by size, age, productivity, ownership and industry.

Firm size: Table 3.2 shows the results for peers with import experience. Column (1) includes the effects by size group. Group 1 refers to firms with at most 5 employees, firms in group 2 have 6-20 employees, firms in group 3 have 21-100 employees and group 4 firms have more than 100 employees. Spillovers from same-building, neighbor-building and ownership-connected peers are present in all size groups (except for neighbor-building peers in the smallest firm group). The magnitude of the effect increases with the size of firms.

Firm age: The second column of Table 3.2 presents results separately for age groups. Group 1 refers to the youngest firms and the age cutoffs are 3, 5 and 7 years. Same-building and ownership-connected peers play a significant role for firms in all age groups. There are no clear further patterns. The estimated effects tend to increase by age, but same-building effect is the largest for the youngest firms.

Productivity: Column (3) of Table 3.2 shows similar results by productivity groups. These groups are created based on the yearly productivity quartiles of firms operating in the same 2-digit industry. We use our TFP estimates as a measure of productivity. The estimated effects are clearly larger for more productive firms. In their case both cross-street and neighbor-building peers increase the probability of import entry. There is no effect of same-building peers for firms in the lowest productivity quartile. Ownership-linked peers matter for all firms. This is in line with our assumption that patterns for ownership-linked firms are not the result of learning but of joint decision making.

Ownership: Column (1) of Table 3.3 looks at the heterogeneity by ownership. In this specification we include interactions of peer group dummies with a foreign-owned dummy,

Table 3.2: The effect of peers with country-specific experience on the probability of starting to import from the same country, by size, age and productivity of the observed firm

Sample: not yet importers until the previous year

Dependent variable: Importer	Firm groups by		
	size	age	productivity
	(1)	(2)	(3)
Cross-street importer neighbor x Firm in group 1	-0.000552** (0.000246)	-0.00122* (0.000675)	-0.00200** (0.000801)
Cross-street importer neighbor x Firm in group 2	0.00417*** (0.00146)	0.000361 (0.000575)	-0.000351 (0.000837)
Cross-street importer neighbor x Firm in group 3	0.00548 (0.00416)	0.000219 (0.000640)	0.000565 (0.00102)
Cross-street importer neighbor x Firm in group 4	0.0231* (0.0122)	0.00149** (0.000587)	0.00292*** (0.00113)
Neighbor-building importer neighbor x Firm in group 1	-0.000465** (0.000214)	7.67e-05 (0.000562)	-0.000146 (0.000682)
Neighbor-building importer neighbor x Firm in group 2	0.00359*** (0.00132)	0.000209 (0.000469)	0.000288 (0.000685)
Neighbor-building importer neighbor x Firm in group 3	0.0102*** (0.00306)	0.000657 (0.000553)	0.000839 (0.000891)
Neighbor-building importer neighbor x Firm in group 4	0.0222** (0.0100)	0.00101** (0.000480)	0.00225** (0.000931)
Same-building importer neighbor x Firm in group 1	0.000753*** (0.000255)	0.00326*** (0.000753)	0.000259 (0.000691)
Same-building importer neighbor x Firm in group 2	0.00624*** (0.00122)	0.00169*** (0.000586)	0.00186** (0.000843)
Same-building importer neighbor x Firm in group 3	0.0150*** (0.00291)	0.00277*** (0.000716)	0.00351*** (0.000973)
Same-building importer neighbor x Firm in group 4	0.0334*** (0.00866)	0.00314*** (0.000556)	0.00767*** (0.00110)
Person-connected importer neighbor x Firm in group 1	0.000112 (0.000894)	0.00180 (0.00237)	0.000290 (0.00271)
Person-connected importer neighbor x Firm in group 2	0.00600 (0.00564)	0.00271 (0.00174)	-0.00779** (0.00346)
Person-connected importer neighbor x Firm in group 3	-0.00989 (0.0130)	0.000564 (0.00287)	0.00642 (0.00414)
Person-connected importer neighbor x Firm in group 4	0.0405 (0.0385)	-0.00291 (0.00192)	0.00143 (0.00314)
Owner-connected importer neighbor x Firm in group 1	0.00364*** (0.000528)	0.0103*** (0.00160)	0.00318** (0.00153)
Owner-connected importer neighbor x Firm in group 2	0.0130*** (0.00215)	0.00567*** (0.00115)	0.00679*** (0.00177)
Owner-connected importer neighbor x Firm in group 3	0.00987** (0.00400)	0.00572*** (0.00127)	0.00926*** (0.00189)
Owner-connected importer neighbor x Firm in group 4	0.0367*** (0.0133)	0.00391*** (0.000930)	0.0105*** (0.00177)
Neighbors with export and owner experience	YES	YES	YES
Firm-year FE	YES	YES	YES
Country-year FE	YES	YES	YES
Nr. of observations	2,849,438	2,852,336	1,715,142

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific experience in the previous year, interacted by firm group dummies. Firm group 1 is 1 if the given firm belongs to the lowest category. Size cutoffs are 5, 20 and 100 employees. Age cutoffs are 3 5 and 7 years. Quartiles of previous year's TFP estimates by 2-digit industry are used for productivity. An importer neighbor refers to a peer with country-specific import experience. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. Controls for neighbors with country-specific export or ownership experience are also included. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

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Table 3.3: The effect of pees with country-specific experience on the probability of starting to import from the same country, by the observed firm's and the peer's ownership

Sample: not yet importers until the previous year Dependent variable: importer	Grouped by ownership of the	
	firm	neighbor
	(1)	(2)
Cross-street importer neighbor	-0.000145	5.94e-05
	(0.000299)	(0.000270)
Cross-street importer neighbor x Foreign-owned	0.00321**	0.000715
	(0.00128)	(0.000522)
Neighbor-building importer neighbor	0.000123	0.000284
	(0.000248)	(0.000213)
Neighbor-building importer neighbor x Foreign-owned	0.00300***	0.000526
	(0.00105)	(0.000476)
Same-building importer neighbor	0.00148***	0.00123***
	(0.000303)	(0.000263)
Same-building importer neighbor x Foreign-owned	0.00658***	0.00313***
	(0.00109)	(0.000547)
Person-connected importer neighbor	0.000824	0.00161
	(0.000947)	(0.000999)
Person-connected importer neighbor x Foreign-owned	0.00360	-0.00124
	(0.0115)	(0.00200)
Owner-connected importer neighbor	0.00567***	0.00480***
	(0.000604)	(0.000499)
Owner-connected importer neighbor x Foreign-owned	0.00621**	0.00403***
	(0.00285)	(0.00143)
Firm-year FE	YES	YES
Country-year FE	YES	YES
Nr. of observations	2,823,756	3,778,517

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific import experience in the previous year. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. Foreign-owned dummy in the interaction terms refers to the observed firm being foreign-owned in column (1) and having a foreign-owned neighbor from the specific type in column (2). All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

which is one if the firm has majority foreign ownership from any foreign country. The baseline group consists of domestic-owned firms and firms with no ownership information. The table shows that the estimated import spillovers are higher for foreign-owned firms, but same-building and ownership-connected peers have a positive effect on domestic firms as well.

Industry: The first column of Table C.9 and C.10 of the Appendix shows estimation results by the industry of the firm. We use industry groupings based on 1-digit NACE categories. The table shows that the same-building effect is the strongest for firms in manufacturing (NACE group D) and trade and repair (NACE group G), but it is also significant for other firms in the service industry (NACE groups H-Q). The effect of ownership-connected peers is the highest for trade and repair (NACE group G), but it is also significant for manufacturing firms (NACE group D), construction and supplier firms (NACE groups E-F) and hotels and restaurants and transport, storage and communication firms (NACE groups H-I). Different industrial patterns in these two neighbor groups support the assumed explanation of the observed patterns: learning from same-building neighbors and joint decision making for ownership-connected peers.

Heterogeneity by the peers

We also look at the heterogeneity of the effect by the characteristics of the peers. As before, we group peers by size, productivity, ownership and industry. We also look at the type of the good the peer imported before. In these specifications we include additional indicator variables for firms having a certain type of experienced peer with given characteristics. As we don't have information on all the characteristics for all peers, we also include the original peer indicators. Indicators for specific peer groups show the additional effect of peers with given characteristics compared to the baseline effect of the given peer type. In these specifications we only look at the import experience of peers.

Firm size: Column (1) of Table 3.4 shows the effect of experienced peers by firm size. Cutoffs are the same as before: 5, 20 and 100 employees. As a reference group we use the smallest size group and those peers for which we have no information on size. Larger neighbors located in the same or in the neighboring buildings tend to have a larger effect, except for peers with more than 100 employees. Person-connected or ownership-connected peers have a significantly positive effect on import entry in the reference group, but there are no additional effects for larger neighbors.

Productivity: The second column of Table 3.4 shows similar estimates for productivity

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Table 3.4: The effect of peers with country-specific experience on the probability of starting to import from the same country, by the size and productivity of the peer

Sample: not yet importers until the previous year Dependent variable: Importer	Neighbor groups by	
	size	productivity
	(1)	(2)
Cross-street importer neighbor	0.000251 (0.000273)	0.000518 (0.000330)
Cross-street importer neighbor in group 2	-0.000672 (0.000577)	-0.00149*** (0.000529)
Cross-street importer neighbor in group 3	0.000518 (0.000765)	0.000115 (0.000526)
Cross-street importer neighbor in group 4	0.00159 (0.00116)	-0.000170 (0.000561)
Neighbor-building importer neighbor	-1.30e-05 (0.000208)	-0.000180 (0.000257)
Neighbor-building importer neighbor in group 2	0.00134*** (0.000490)	1.03e-05 (0.000524)
Neighbor-building importer neighbor in group 3	0.00149** (0.000729)	0.00134*** (0.000504)
Neighbor-building importer neighbor in group 4	-0.000303 (0.00102)	0.00109** (0.000441)
Same-building importer neighbor	0.00126*** (0.000274)	0.000939*** (0.000344)
Same-building importer neighbor in group 2	0.00184*** (0.000557)	0.000422 (0.000629)
Same-building importer neighbor in group 3	0.00291*** (0.000730)	0.00112** (0.000539)
Same-building importer neighbor in group 4	0.000975 (0.00104)	0.00312*** (0.000559)
Person-connected importer neighbor	0.00277** (0.00126)	0.00140 (0.00115)
Person-connected importer neighbor in group 2	0.00196 (0.00330)	-0.000244 (0.00291)
Person-connected importer neighbor in group 3	-0.00363 (0.00237)	-0.000130 (0.00247)
Person-connected importer neighbor in group 4	-0.00300* (0.00179)	-0.000180 (0.00188)
Owner-connected importer neighbor	0.00537*** (0.000660)	0.00484*** (0.000710)
Owner-connected importer neighbor in group 2	0.000425 (0.00106)	-0.00118 (0.00113)
Owner-connected importer neighbor in group 3	-0.000774 (0.00101)	7.20e-05 (0.00107)
Owner-connected importer neighbor in group 4	-0.000427 (0.00132)	0.00236** (0.00106)
Firm-year FE	YES	YES
Country-year FE	YES	YES
Observations	3,778,517	3,778,517

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific import experience in the previous year, also interacted by neighbor group dummies. Neighbor group 1 refers to the lowest category. The reference group consist of group 1 and those neighbors where there is no imformation on size or productivity. Size cutoffs are 5, 20 and 100 employees. Quartiles of TFP estimates by 2-digit industry are used for productivity. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

quartiles. We use the lowest quartile and peers without any information on their productivity as a reference group. All types of peers located in the same building or being connected by ownership links have a positive effect, but the effect is larger for high-productivity peers. The neighbor-building effect is only significant for high-productivity peers. In Table C.11 of the Appendix we check if the stronger effect of high-productivity experienced peers is uniform across productivity groups of the not yet importing firms. Column (4) shows that using below-median productivity firms and peers as a baseline, the effect of above-median productivity peers is not significantly larger for below-median firms. Moreover, the estimated coefficients of high-productivity peers are sometimes even negative, though insignificant. Our estimates of the additional effect of above-median productivity peers on above-median productivity firms are positive and also significant for same-building and ownership-linked peers. These results suggest that only high-productivity firms can benefit from the presence of high-productivity peers. Low-productivity firms learn more from low-productivity peers. Results in Table C.12 of the Appendix using productivity quartiles with a baseline of firms and peers in the lowest productivity quartile suggest a similar pattern. The additional effect of peers with higher productivity tend to be positive for firms with higher productivity and insignificant but sometimes even negative for firms with lower productivity.

Ownership: Column (2) of Table 3.3 shows estimates by ownership of the peers. The reference group is domestic-owned peers and peers without any information on ownership. The effect of same-building and owner-connected peers is significant for all types of peers, but the effects are considerably larger for foreign-owned peers.

Industry: Column (2) of Table C.9 and C.10 in the Appendix shows the heterogeneity in the estimated effects by the industry of the peers. We use peers without any information on their industry as a reference group. We find a similar same-building effect for peers in multiple industries (NACE groups D-G and J-K). Neighbor-building and ownership-connected peers have a significant effect on imports only if they operate in the trade and repair industries, and effects are marginally significant for manufacturing peers and peers in the hotel and restaurant and transport-storage and communication industries.

Product type: Table C.13 of the Appendix classifies peers based on the type of the product the peer imported from the given country before. We use the product classification of Rauch to separate differentiated and reference-priced goods. The baseline category includes goods traded on an organized exchange and some non-classified goods. Results show that the experience of same-building neighbors in both differentiated and reference-priced goods matters, but the former has a somewhat stronger effect. There is no significant heterogeneity in the type of the imported group for ownership-connected peers.

Same-industry and same-product effects

After looking at the heterogeneity of the estimated effect both by the characteristics of the firms and the peers we check if import spillovers are specific for same-industry or same-product experiences.

Same-industry effects: We estimate same-industry effects by including separate indicators for experienced peers which operate in the same industry as the observed firm. We do this separately for each peer type. We also control for country-specific export and ownership experience but only present results for import experience. Column (2) of Table 3.5 shows that same-industry and ownership-connected peers have a stronger effect if they operate in the same industry as the firm. The estimated effect more than doubles for ownership-linked peers and becomes more than four times higher for same-building neighbors. Still, it is important to note that peers in different industries also have a significant effect on import entry. As a robustness check we do the same exercise including only manufacturing firms. Column (4) shows that the baseline effects are robust, but due to noisy estimates we find no significant additional effect of same-industry peers within manufacturing. Compared to the baseline hazard within manufacturing, effects have the same magnitude as the effects estimated for all firms, except for the neighbor-building effect, which is stronger for manufacturing firms.

Same-product effects: Table 3.6 estimates our baseline specification with two modifications. First, it looks at not yet importer firms in a given product category. As an additional control variable we include an indicator for firm i having ever before imported goods in another product category from country c. Second, we include additional indicators for experienced peers having imported a good in the given product category from country c before. We call them same-product importers. The four columns of Table 3.6 show our estimates by product categories, which we created based on BEC categories. Estimates are quite stable across product groups. Same-product importers tend to have a larger effect, but the effect of peers importing different products is also significantly positive.

Table C.14 of the Appendix looks at the same-country and same-product experience effect using an alternative specification. We use the sample of firms which import for the first time from one of the four countries and haven't imported before from any of them. We call these firms first ever importers. We include these firms in a single year, when they

Table 3.5: The effect of peers with country-specific experience on the probability of starting to import from the same country, separately for same-industry peers

Sample: not yet importers until the previous year

Dependent variable: importer	all firms		manufacturing firms	
	(1)	(2)	(3)	(4)
Cross-street importer neighbor	0.000316	0.000229	-0.000634	-0.000583
	(0.000244)	(0.000242)	(0.00122)	(0.00122)
Neighbor-building importer neighbor	0.000392*	0.000299	0.00254**	0.00206*
	(0.000204)	(0.000198)	(0.00109)	(0.00106)
Same-building importer neighbor	0.00214***	0.00146***	0.00452***	0.00381***
	(0.000259)	(0.000253)	(0.00119)	(0.00121)
Person-connected importer neighbor	0.000996	0.000334	0.00363	0.00488
	(0.000920)	(0.000878)	(0.00489)	(0.00472)
Owner-connected importer neighbor	0.00511***	0.00373***	0.00923***	0.00773***
	(0.000492)	(0.000511)	(0.00191)	(0.00212)
Cross-street importer neighbor in same industry		0.000776		-0.000976
		(0.000998)		(0.00792)
Neighbor-building importer neighbor in same industry		0.000880		0.0115
		(0.000868)		(0.00802)
Same-building importer neighbor in same industry		0.00456***		0.00775*
		(0.000921)		(0.00462)
Person-connected importer neighbor in same industry		0.00530		-0.00657
		(0.00377)		(0.0143)
Owner-connected importer neighbor in same industry		0.00596***		0.00598
		(0.00130)		(0.00513)
Neighbors with export and owner experience	YES	YES	YES	YES
Firm-year FE	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES
Observations	3,772,739	3,778,517	376,739	376,739
Basline hazard:	0.0025	0.0025	0.0056	0.0056

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. Columns (3) and (4) contain only manudacturing firms. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific experience in the previous year. An importer neighbor refers to a peer with country-specific import experience. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. In columns (2) and (4) separate indicator variables show if there are experienced neighbors operating in the same 2-digit industry as the observed firm. Controls for neighbors with country-specific export or ownership experience are also included. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building. Baseline hazard refers to the share of importers in the estimation sample.

Table 3.6: The effect of peers with country-specific experience on the probability of starting to import from the same country, separately for different types of products and peers already importing the product type

Sample: not yet importers until the previous year

Dependent variable: importer	Product category			
	Consumer goods (1)	Industrial supplies (2)	Capital goods (4)	Parts and accessories (3)
Cross-street importer neighbor	-5.82e-05 (0.000182)	0.000387 (0.000285)	0.000112 (0.000159)	6.25e-06 (0.000142)
Cross-street same-product importer neighbor	0.000282 (0.000297)	-0.000370 (0.000339)	5.46e-05 (0.000275)	0.000335 (0.000290)
Neighbor-building importer neighbor	0.000139 (0.000154)	0.000123 (0.000204)	0.000121 (0.000135)	3.08e-05 (0.000108)
Neighbor-building same-product importer neighbor	-6.84e-05 (0.000240)	0.000324 (0.000272)	0.000117 (0.000253)	0.000189 (0.000242)
Same-building importer neighbor	0.000372** (0.000188)	0.000186 (0.000251)	0.000529*** (0.000144)	0.000393*** (0.000139)
Same-building same-product importer neighbor	0.00136*** (0.000307)	0.00155*** (0.000357)	0.000728** (0.000288)	0.00153*** (0.000328)
Person-connected importer neighbor	-3.64e-05 (0.000842)	0.00185 (0.00152)	0.00107 (0.000844)	-0.00101 (0.000632)
Person-connected same-product importer neighbor	-0.000149 (0.000983)	-0.000331 (0.00153)	-0.000745 (0.00111)	0.00253** (0.00108)
Owner-connected importer neighbor	0.00113*** (0.000324)	0.00170*** (0.000461)	0.000748*** (0.000258)	0.000250 (0.000233)
Owner-connected same-product importer neighbor	0.00265*** (0.000645)	0.00238*** (0.000641)	0.00166*** (0.000530)	0.00271*** (0.000652)
Not yet importer from destination	YES	YES	YES	YES
Firm-year FE	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES
Observations	3,821,755	3,805,958	3,828,759	3,829,629
Baseline hazard	0.0011	0.0015	0.0007	0.0007

Sample: firm-country pairs in those years when the firm has not imported a product category from the country until the previous year. The unit of observation is firm-country-year. Products are categorized using the BEC classification. Consumer goods refer to BEC 1 and 6, industrial supplies refer to BEC 2 and 3, capital goods refer to BEC 41,51 and 52, parts and accessories refer to BEC 42 and 53. The dependent variable is an indicator for the firm importing the given product type from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific import experience in the previous year. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. Separate indicator variables are included for experienced neighbors importing a good in the regarded product category. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building. Baseline hazard refers to the share of importers of the product group in the estimation sample.

started to import from one of the countries. We include all four countries for each of these firms as a separate observation, and also include separate observations for each of the four previously defined product categories. Then the estimation results show the probability of a firm starting to import a given product category from a given country, conditional on the firm starting to import from at least one of the countries and doing it for the first time. The observed patterns suggest that same-country and same-product importer peers increase the probability that the firm starts to import a specific product from a specific country.

3.4.3 Robustness checks

After presenting our main results we do some robustness checks and placebo exercises.

Successful importers: First, we repeat our baseline estimates using an alternative definition of importers and experienced peers: successful importers. We define a firm as a successful importer from country c in year t if it imports from country c at least in two years from the three-year period $[t-1,t+1]$. Column (4) in Table C.15 of the Appendix shows that our main results are robust to this definition change for the firms starting to import.[5] Columns (2) and (3) show estimation results when we define an experienced peer as a successful importer from the country. In this way we both look at recent import experience and exclude one-time importers. Similar definitions apply for the export and ownership experience of peers. Our estimates show that a considerable fraction of the effect comes from successful importer peers. Columns (5) and (6) of the same table combine the two modifications and use both successful import entry and successful peers, leading to similar results.

Experience of the peers: We also check if firms can rather learn from peers with a longer import experience. As additional right-hand side variables we include the longest additional import experience above one year by peer group. Table C.16 of the Appendix shows that the probability of starting to import from a country is significantly higher when the same-building, neighbor-building or ownership-linked peer which has already imported from that country imported for a longer period. Having peers in the same building with 3-4 years of experience doubles the effect compared to having peers with only one year experience. Results are robust to alternative definitions of the maximum length of experience in a peer

[5] In those specifications in which we use successful imports as the dependent variable, we consider the period $[t,t+2]$.

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group. As right-hand side variables we either include the number of years when the peer with the longest import experience in a given group imported from the country, or we only include recent continuous experience where we allow for single-year gaps in importing from the country, but stop counting the years of experience when there are two consecutive years without import.[6]

Number of peers: Similarly to the previous exercise we also look at the additional effect of having more than one peer with country-specific import experience in a peer group. As additional right-hand side variables we include for each peer group the number of peers above one having country-specific import experience. Column (4) of Table C.17 in the Appendix shows that increasing the number of experienced peers increases the probability of import entry. Results are robust to alternative measures, i.e. an indicator for having at least two (column (1)), or exactly two and at least three experienced peers (column (2)), simply including the number of experienced peers (column (3)) and allowing for non-linearity in the effect of an additional peer from zero to one or above one (column (4)). The effect of experienced peers is increasing with the number of these peers. The effect of having two peers in the same building with country-specific experience is about twice the effect of having only one, and the effect is about six-times higher when there are at least three of them. There is clear non-linearity for neighbor-building and owner-connected peers. In line with the assumption that firms might meet other firms in the neighboring building with a lower probability than in the same building, neighbor-building peers have a significant effect only when there are at least two of them. The additional effect of having more than one experienced peer in the ownership-linked group is much lower and even insignificant in some specifications. This is in line with the assumption that the observed correlation in ownership-linked firms' import decision is not the result of learning but it comes from the sequential import entry decision of the same decision maker.

Ownership: We also check if our results are moved by firms being owned from one of the countries. Column (3) of Table C.18 in the Appendix shows estimation results for a sub-sample of firms where we exclude those firms which have owners from any of the four countries. Results are robust for these changes.

Connecting person definition: We also use alternative definitions for people connection

[6] As we don't know the import history of firms before 1992, there is a measurement error in the variable capturing the length of import experience. Neglecting this censoring problem is likely to bias our estimates towards zero. At the same time, experience obtained before the transition or in the early years after that might differ from the experience obtained later.

firms. Column (2) of Table C.19 in the Appendix uses person-connected peers where the connecting people are those who have signing right both in their previous and in their new firms. Column (3) uses the broadest definition, in which person-connected peers can have any type of connections to either of the firms. As expected, these definitions increase the estimated effect of person-connected peers. Yet, reverse causality might be a problem biasing our estimates. Additionally, the effect of person-connected peers with export experience disappears in the alternative specifications. A potential explanation can be the relatively low number of person-connected peers with import or export experience. More importantly, the estimated effect of experienced peers in the other peer groups is not sensitive to changes in the definition of person-connected peers.

Changes in the sample: In our baseline specification we look at the effect of experienced peers on firms starting to import from a country for the first time. Table C.20 of the Appendix shows estimation results when we define our estimation sample in a different way. Instead of an indicator for ever importing from country c up to year t, now we change the dependent variable to an indicator showing if a firm imports from a specific country in a specific year. Column (1) includes all firm-country pairs in all years. It answers the question whether a firm imports from a country in a year with a higher probability if it has peers with country-specific experience, irrespective of the firm's own import experience. Column (2) includes only those firms which start to import from one of the countries but never imported before from any of the four countries. Each of these firm is included only in one year, when it started to import from one of the countries. We include a separate observation for each of the four countries for each firm. This specification shows if a firm starts to import from a country with a higher probability if it had peers with country-specific experience last year, conditional on starting to import form at least one of the four countries. Column (3) is the closest to our baseline specification, but it excludes those firms entirely which already imported from at least one of the four countries. Patterns are similar in all three cases. Country-specific importer and owner experience of same-building neighbors, export experience of person-connected peers and import and export experience of ownership-connected peers has a robust effect on import probability. In column (1) also neighbor-building and cross-street neighbors, as well as person-connected peers with import experience have a significant effect. Here the identification is less clear as firms might have their own experience, but the results might suggest that peers also play an important role in continuing imports. Column (4) includes experienced firms which have already imported form the country before, but which import at most once in the period

$[t-2,t]$ where t is the current year. This can serve as a placebo check, as we expect that the effect of peers' experience is not considerable on such firms which have their own experience. Indeed, estimated coefficients are not significant, though estimates are noisy.

Mover design: Finally, we do an additional exercise to provide further support for our results. We look at firms which move their headquarters from one address to another within Budapest. Moves are quite frequent, more than 25% of the firms moves at least once. We exploit variation in their country-specific import experience. We look at those movers where no firm imported before from a given country in their new address. Then we consider the appearance of the new experienced firm as an exogenous shock changing local knowledge. One to three years after the move we look at the share of those firms in the new locations which start to import from the country the mover has already imported from. We compare these numbers to the same share in the same locations for countries where neither the mover nor the incumbent firms have import experience. These numbers are presented in the first two columns of Table C.21 of the Appendix. The third column shows similar shares as the second with the difference that it also includes locations where movers have no import experience from any of the four countries. In line with our previous findings, the share of firms starting to import from the specific country is higher if the mover had import experiences from that country.

We also estimate the effect of exogenous import knowledge brought by the mover with linear probability regressions. Table 3.7 presents the results. As before, the sample contains only not yet importer firms, but we restrict the sample further to observations in which the firm is located in such an address where no firm has any country-specific experience. This means there are no firms located in the same or neighboring building in year $t-1$ or t which have ever imported from the country up to that year. The only exception might be firms moving to the address in year t.[7] The dependent variable is an indicator for becoming an importer in the future. We look at importer status in $t+1$, $t+2$ and $t+3$ separately, allowing for a time lag in import entry. The right-hand side variable of the main interest is an indicator for a mover firm having country-specific import experience. As in the baseline regressions, we include country-year and firm-year fixed effects, and we identify from cross-country variations within a firm. Results show that knowledge brought by a mover having country-specific import experience increases the probability of starting to import from the same country by 0.27 percentage points next year and even more in the

[7]Descriptive statistics can be found in Table C.22 of the Appendix.

Table 3.7: The effect of firms with country-specific experience moving to the address on the probability of firms in the same building starting to import from that country

Dependent variable:	importer in t+1		importer in t+2		importer in t+3	
	(7)	(8)	(9)	(10)	(11)	(12)
Mover with import experience	0.00268***	0.00273***	0.00320***	0.00405**	0.00384***	0.00615***
	(0.000890)	(0.000950)	(0.00122)	(0.00164)	(0.00133)	(0.00226)
Cross-street importer neighbor		-0.000124		0.00312***		0.00409***
		(0.000245)		(0.000645)		(0.000782)
Neighbor-building importer neighbor		0.00512		0.000243		0.000629
		(0.00517)		(0.000486)		(0.000734)
Same-building importer neighbor				0.000535		0.00136*
				(0.000624)		(0.000739)
Person-connected importer neighbor		0.00174*		0.0368***		0.0680***
		(0.00101)		(0.00390)		(0.00711)
Owner-connected importer neighbor		0.00433***		0.00861***		0.0151***
		(0.000583)		(0.00111)		(0.00173)
Firm-year FE	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES
Observations	2,921,851	2,792,137	2,921,851	2,227,563	2,921,851	1,739,771

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year, excluding firms on those addresses where there is any other firm in the same or neighboring building in t-1 or t which has already imported from that country. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in t+1, t+2 or t+3. The main right-hand side variable is an indicator for the address having a mover firm with country-specific import experience. Further controls are indicators for the firm having different types of peers with country-specific import experience in the previous year (i.e. in t, t+1 or t+2). Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

subsequent years. Columns (2),(4) and (6) show that results are robust to controlling for the evolution of import experience in other peer groups. This additional research design exploiting exogenous variation in country-specific import knowledge supports our previous findings.

3.4.4 The magnitude of the effect

Finally, we evaluate the importance of the estimated import spillovers from three aspects. First, we compare them to export spillovers which we estimate using the same data and the same identification strategy. Second, we calculate social multipliers. Third, we show some evidence on whether firms learning from their peers switch from different countries or start to import new goods from some of the four countries.

Import and export spillovers: Table C.23 of the Appendix shows the results when we do the same estimates for exports. As before, the same type of experience has a higher effect, i.e. the effect of export experience on starting to export is higher than that of import experience, but also importer peers in the same-building and in owner-connected groups increase the probability of export entry to a specific country. The estimated coefficients of import and export spillovers are quite close to each other. The baseline hazard of starting to import is 0.00252, which is somewhat lower than the same number for exports, 0.00271. Same-building effect and owner-connected peers' effect with the same type of experience is relatively higher for import spillovers (85% and 203% of the baseline hazard) than for export spillovers (74% and 174% of the baseline hazard). As opposed to import spillovers, spillovers from person-connected peers with experience in the same activity are significant for export entry.

Social multiplier: Using the estimated effect of peers with country-specific import experience in the same and neighboring buildings (0.214 and 0.0392 percentage points respectively) we do a back of the envelope calculation for getting the social multiplier effect of imports. The five-year social multiplier of a firm starting to import from a country is 1.03. If we take a firm in a random building which starts to import from a specific country, the probability that an additional firm will start to import in the same or neighboring building due to this firm within five years is 3.14 percentage points. For this exercise we use the average number of firms in a building (2.28) and the share of buildings with no importers from a given country (96.66%).[8]

Switch or new imports: As a final exercise we look for evidence if firms starting to import from one of the four countries switch from other source countries or import new products. Using 6-digit product categories we find that firms which start to import certain products from one of the four countries have imported less than third of these products already before from any other country in the world. Additionally, when we look at firm-product-country triples, we find that in about half of the cases firms continued to import the same 6-digit good from the country they imported before, even after starting to import from one of the four countries. As a comparison, when we take a random product, a random country and a random cutoff year, the average share of cases in which firms continue to import a specific product from the country after the cutoff year is 37%, conditional on importing the product from the country before. These patterns suggest, that import spillovers do not only result in switching source countries but also help to import new products.

3.5 Conclusion

In this paper we show evidence on import spillovers: firms learn to import from their peers. The effect of import spillovers is comparable to export spillovers. Controlling for ownership links we show that the presence of firms with country-specific import experience in the same-building almost doubles the probability of starting to import from a country, compared to the baseline probability. Spatial spillovers are highly localized. We also find a positive but lower effect for peers in the neighboring building. Additionally, peers with country-specific export experience or with owners from the given country also increase the probability of import entry. Considering only spatial spillovers, we estimate that the five-

[8]Then the probability that in the first year there will be a new importer from the given country in the same building because of our firm is $0.9666 \cdot 0.00214 \cdot 2.28 = 0.00472$. The probability that in the first year there will be a new importer from the given country in one of the neighboring buildings because of our firm is $0.9666 \cdot 0.9666 \cdot 0.9666 \cdot 2.28 \cdot 2 \cdot 0.000392 = 0.00162$. The probability that in the second year there will be a new importer from the given country in the same building because of our firm is $0.00472 + (1-0.00472) \cdot 0.00472 + (1-0.00472) \cdot 0.00162 \cdot 0.00086$. The first term stands for a new importer in year 1, the second term refers to the probability of a new importer in year 2 due to the same-building effect conditional on not having a new importer in year 1. The third term shows the probability of having a new importer in year 2 due to the neighbor-building effect conditional on not having a new importer in the same building in year 1 but having a new importer in the neighboring building. As the third term is small we can neglect it and we can calculate the 5-year effect on same-building and neighbor-building firms as $[1 + (1-0.00472) + (1-0.00472)^2 + ... + (1-0.00472)^4] \cdot (0,00472 + 0,00162) = 0.0314$.

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year social multiplier effect of imports is about 1.03. Larger, more productive and foreign-owned firms learn more. Firms learn more from a peer if it is larger, more productive, foreign-owned, operates in the same 2-digit industry or imports the same product category. At the same time, low-productivity firms rather learn from low-productivity peers. An additional extension of the current analysis might be to repeat our estimations using more exotic countries and compare our findings for 'easy' and 'difficult' countries.

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Appendix A

Appendix for Chapter 1

Figure A.1: The yearly sales of Audi, Opel and Suzuki over time

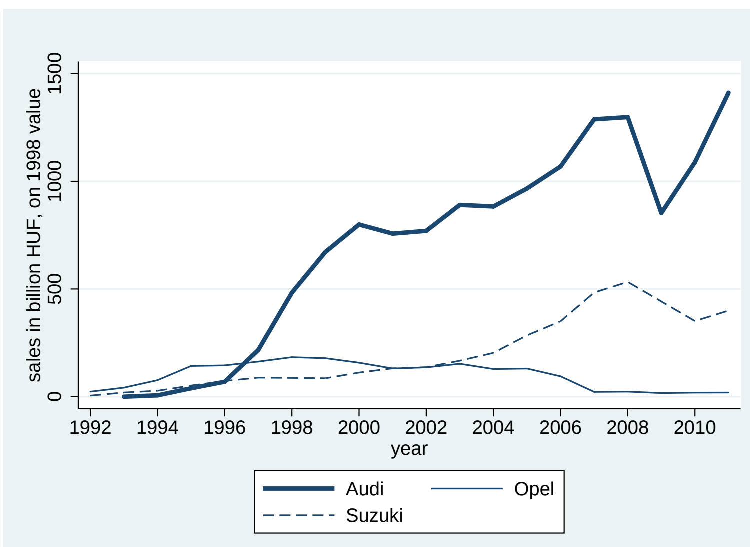

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Figure A.2: The location of the known suppliers of Audi in Hungary

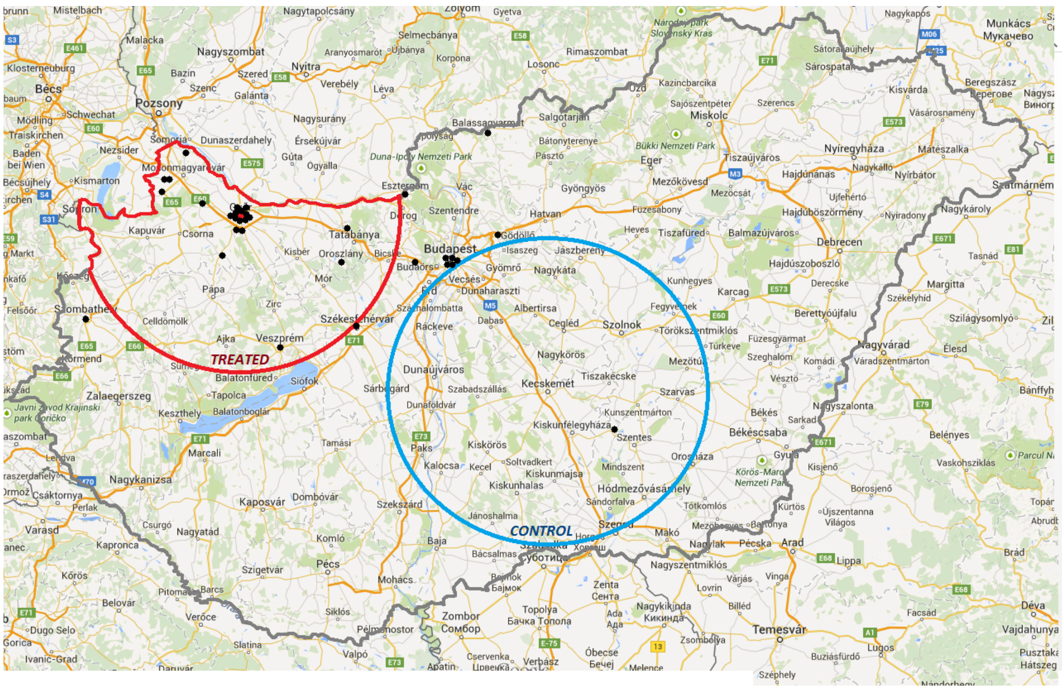
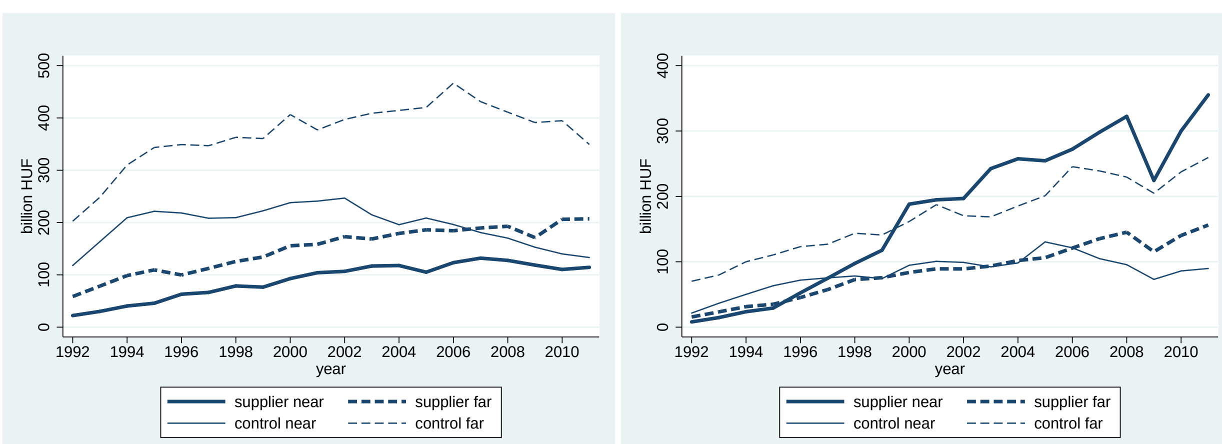


Figure A.3: The evolution of total domestic sales and export sales in the different firm groups



(a) Domestic sales

(b) Export sales

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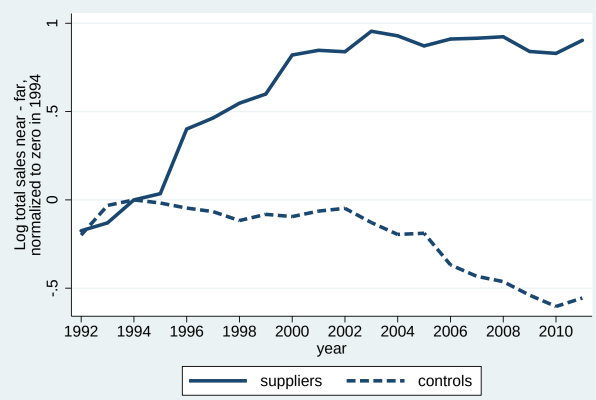
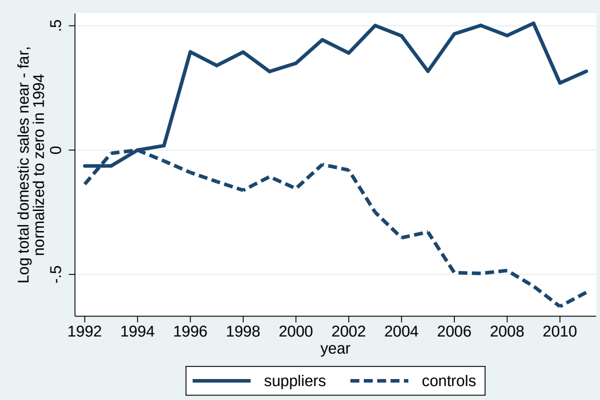
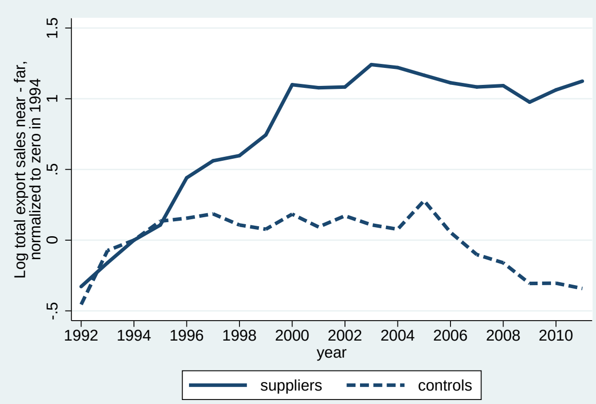
Figure A.4: The difference in the log of total sales, domestic sales, export sales and employment between the treated and control region



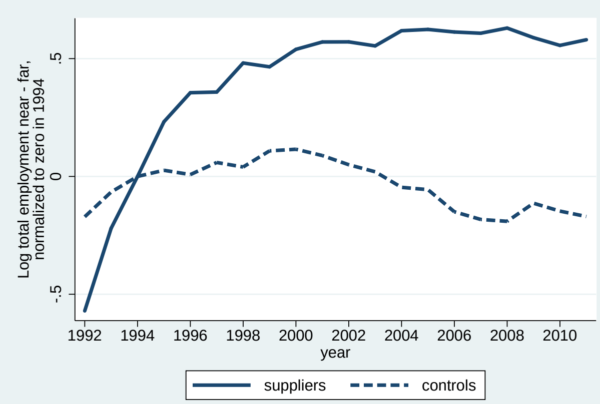
(a) Sales



(b) Domestic sales



(c) Export sales



(d) Employment

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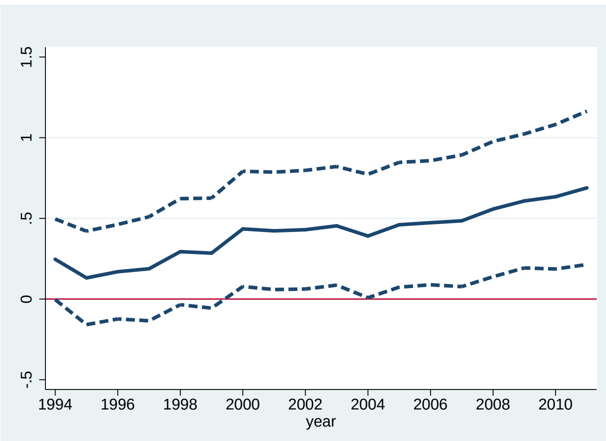
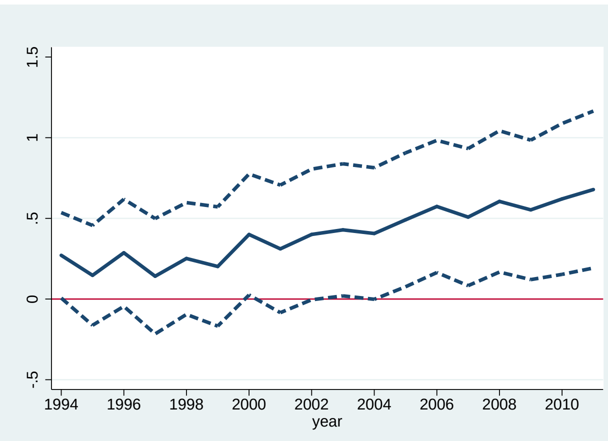
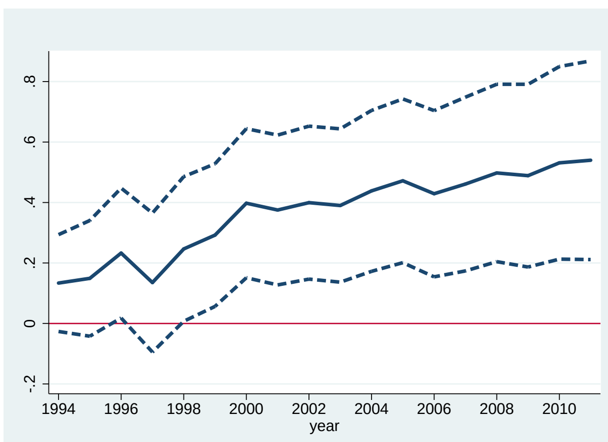
Figure A.5: The estimated coefficients of the triple interaction terms with year dummies and their 90% confidence interval using the flexible specification of equation 1.3



(a) Sales



(b) Domestic sales



(c) Employment

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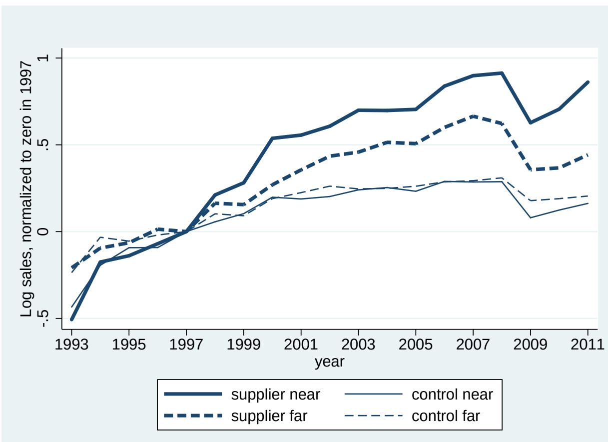
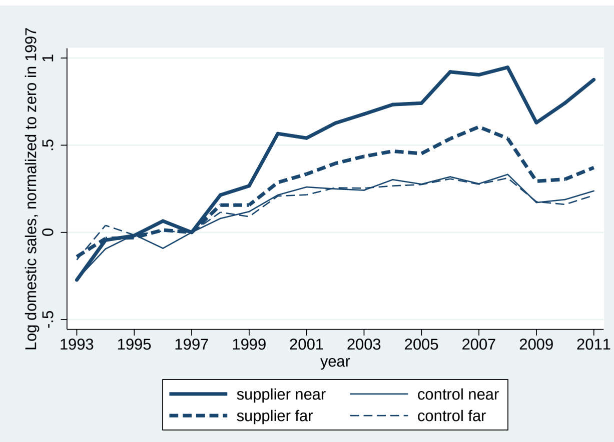
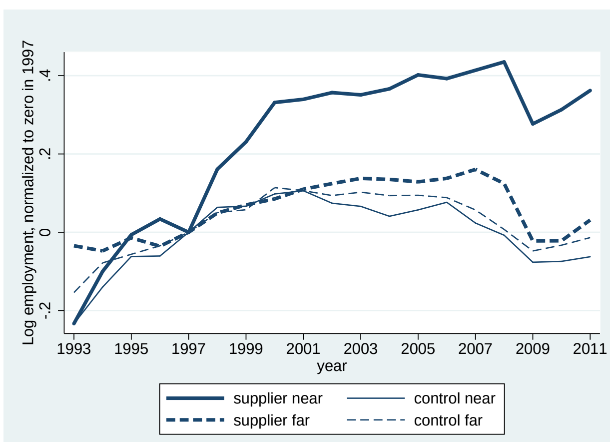
Figure A.6: The evolution of average log sales, log domestic sales and log employment in the different firm groups, normalized to zero for all groups in 1997



(a) Sales



(b) Domestic sales



(c) Employment

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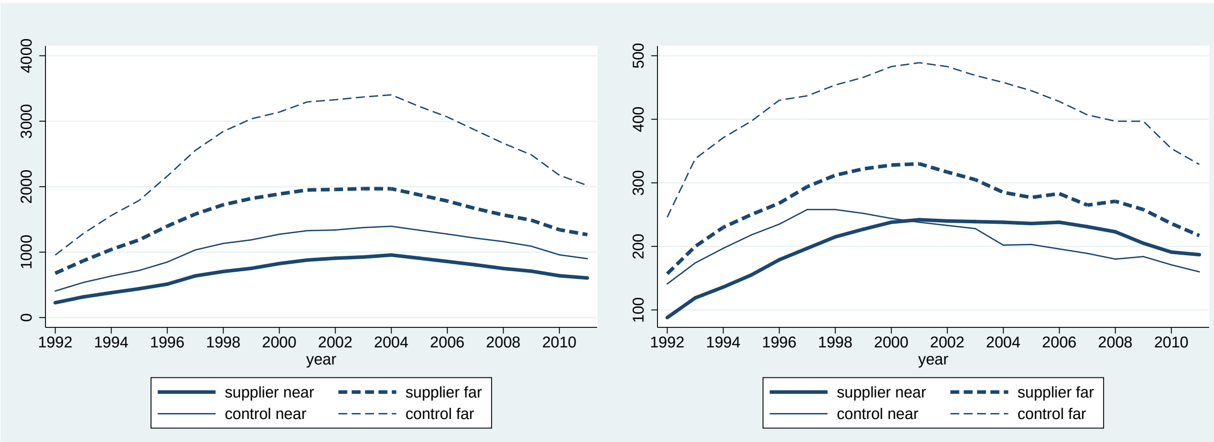
Figure A.7: The number of firms by ownership



(a) Domestic firms

(b) Foreign firms

Table A.1: The estimated coefficients of the Cobb-Douglas production function by 2-digit industry

Dep. var: sales

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
NACE-2	nace 15	nace 17	nace 18	nace 19	nace 20	nace 21	nace 22	nace 24	nace 25	nace 26
employment	0.443***	0.363***	0.453***	0.463***	0.348***	0.312***	0.627***	0.399***	0.343***	0.304***
	(0.012)	(0.014)	(0.013)	(0.021)	(0.013)	(0.033)	(0.018)	(0.035)	(0.015)	(0.016)
capital	0,023	0.088***	0.189***	0.253***	0.079***	0.040	0.168***	0.141***	0.086***	0.232***
	(0.020)	(0.028)	(0.020)	(0.049)	(0.026)	(0.039)	(0.020)	(0.055)	(0.029)	(0.055)
material	0.483***	0.279***	0.200***	0.086	0.496***	0.456***	0.293***	0.567***	0.498***	0.374***
	(0.034)	(0.050)	(0.026)	(0.083)	(0.038)	(0.068)	(0.048)	(0.055)	(0.037)	(0.082)
Observations	51,226	13,410	23,798	6,294	26,488	5,724	45,649	9,319	23,305	16,593

	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
NACE-2	nace 27	nace 28	nace 29	nace 30	nace 31	nace 32	nace 33	nace 34	nace 35	nace 36
employment	0.318***	0.401***	0.386***	0.602***	0.332***	0.370***	0.374***	0.353***	0.381***	0.441***
	(0.042)	(0.010)	(0.014)	(0.049)	(0.018)	(0.022)	(0.017)	(0.030)	(0.062)	(0.018)
capital	0,073	0.091***	0.136***	0	0.113***	0,051	0.072***	0,013	0.256***	0.226***
	(0.060)	(0.019)	(0.014)	(0.062)	(0.033)	(0.041)	(0.025)	(0.048)	(0.069)	(0.017)
material	0.436***	0.466***	0.432***	0,059	0.360***	0.306***	0.335***	0.464***	0.282***	0.203***
	(0.087)	(0.026)	(0.025)	(0.045)	(0.046)	(0.055)	(0.059)	(0.062)	(0.107)	(0.030)
Observations	4,057	62,930	40,001	2,861	12,589	9,866	17,858	4,479	2,374	27,545

Coefficients of Levinson-Petrin production function estimates, separately for each 2-digit NACE industry. Variables are measured in logs.

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Table A.2: The list of 4-digit supplier industries, using NACE Rev 1.1.

Supplier industries			
NACE		NACE	
1711	Preparation and spinning of cotton-type fibres	2722	Manufacture of steel tubes
1712	Preparation and spinning of woollen-type fibres	2734	Wire drawing
1713	Preparation and spinning of worsted-type fibres	2741	Precious metals production
1714	Preparation and spinning of flax-type fibres	2742	Aluminium production
1721	Cotton-type weaving	2743	Lead, zinc and tin production
1722	Woollen-type weaving	2744	Copper production
1725	Other textile weaving	2745	Other non-ferrous metal production
1730	Finishing of textiles	2751	Casting of iron
1752	Manufacture of cordage, rope, twine and netting	2752	Casting of steel
1754	Manufacture of other textiles n.e.c.	2753	Casting of light metals
1910	Tanning and dressing of leather	2811	Manufacture of metal structures and parts of structures
2412	Manufacture of dyes and pigments	2840	Forging, pressing, stamping and roll forming of metal; powder metallurgy
2414	Manufacture of other organic basic chemicals	2851	Treatment and coating of metals
2416	Manufacture of plastics in primary forms	2852	General mechanical engineering
2430	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	2863	Manufacture of locks and hinges
2463	Manufacture of essential oils	2873	Manufacture of wire products
2466	Manufacture of other chemical products n.e.c.	2874	Manufacture of fasteners, screw machine products, chain and springs
2511	Manufacture of rubber tyres and tubes	2875	Manufacture of other fabricated metal products n.e.c.
2512	Retreading and rebuilding of rubber tyres	2911	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
2513	Manufacture of other rubber products	2912	Manufacture of pumps and compressors
2521	Manufacture of plastic plates, sheets, tubes and profiles	2913	Manufacture of taps and valves
2522	Manufacture of plastic packing goods	2914	Manufacture of bearings, gears, gearing and driving elements
2523	Manufacture of builders' ware of plastic	2924	Manufacture of other general purpose machinery n.e.c.
2524	Manufacture of other plastic products	2943	Manufacture of other machine tools n.e.c.
2611	Manufacture of flat glass	3110	Manufacture of electric motors, generators and transformers
2612	Shaping and processing of flat glass	3120	Manufacture of electricity distribution and control apparatus
2613	Manufacture of hollow glass	3130	Manufacture of insulated wire and cable
2614	Manufacture of glass fibres	3140	Manufacture of accumulators, primary cells and primary batteries
2615	Manufacture and processing of other glass, including technical glassware	3161	Manufacture of electrical equipment for engines and vehicles n.e.c.
2682	Manufacture of other non-metallic mineral products n.e.c.	3210	Manufacture of electronic valves and tubes and other electronic components
2710	Manufacture of basic iron and steel and of ferro-alloys	3430	Manufacture of parts and accessories for motor vehicles and their engines
2721	Manufacture of cast iron tubes	3663	Other manufacturing n.e.c.

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Table A.3: The list of 4-digit control industries, using NACE Rev 1.1

Control industries			
NACE		NACE	
1511	Production and preserving of meat	1600	Manufacture of tobacco products
1512	Production and preserving of poultrymeat	1751	Manufacture of carpets and rugs
1513	Production of meat and poultrymeat products	1771	Manufacture of knitted and crocheted hosiery
1520	Processing and preserving of fish and fish products	1772	Manufacture of knitted and crocheted pullovers, cardigans and similar articles
1531	Processing and preserving of potatoes	1810	Manufacture of leather clothes
1532	Manufacture of fruit and vegetable juice	1821	Manufacture of workwear
1533	Processing and preserving of fruit and vegetables n.e.c.	1822	Manufacture of other outerwear
1541	Manufacture of crude oils and fats	1823	Manufacture of underwear
1542	Manufacture of refined oils and fats	1824	Manufacture of other wearing apparel and accessories n.e.c.
1543	Manufacture of margarine and similar edible fats	1830	Dressing and dyeing of fur; manufacture of articles of fur
1551	Operation of dairies and cheese making	1920	Manufacture of luggage, handbags and the like, saddlery and harness
1552	Manufacture of ice cream	1930	Manufacture of footwear
1561	Manufacture of grain mill products	2010	Sawmilling and planing of wood; impregnation of wood
1562	Manufacture of starches and starch products	2020	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards
1571	Manufacture of prepared feeds for farm animals	2040	Manufacture of wooden containers
1572	Manufacture of prepared pet foods	2122	Manufacture of household and sanitary goods and of toilet requisites
1581	Manufacture of bread; manufacture of fresh pastry goods and cakes	2124	Manufacture of wallpaper
1582	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes	2211	Publishing of books
1583	Manufacture of sugar	2212	Publishing of newspapers
1584	Manufacture of cocoa; chocolate and sugar confectionery	2213	Publishing of journals and periodicals
1585	Manufacture of macaroni, noodles, couscous and similar farinaceous products	2214	Publishing of sound recordings
1586	Processing of tea and coffee	2215	Other publishing
1587	Manufacture of condiments and seasonings	2221	Printing of newspapers
1588	Manufacture of homogenized food preparations and dietetic food	2222	Printing n.e.c.
1589	Manufacture of other food products n.e.c.	2223	Bookbinding
1591	Manufacture of distilled potable alcoholic beverages	2224	Pre-press activities
1592	Production of ethyl alcohol from fermented materials	2225	Ancillary activities related to printing
1593	Manufacture of wines	2231	Reproduction of sound recording
1594	Manufacture of cider and other fruit wines	2232	Reproduction of video recording
1595	Manufacture of other non-distilled fermented beverages	2233	Reproduction of computer media
1596	Manufacture of beer	2310	Manufacture of coke oven products
1597	Manufacture of malt	2320	Manufacture of refined petroleum products
1598	Production of mineral waters and soft drinks	2415	Manufacture of fertilizers and nitrogen compounds

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Table A.4: The list of 4-digit control industries, using NACE Rev 1.1 (cont.)

Control industries			
NACE		NACE	
2420	Manufacture of pesticides and other agro-chemical products	2953	Manufacture of machinery for food, beverage and tobacco processing
2441	Manufacture of basic pharmaceutical products	2954	Manufacture of machinery for textile, apparel and leather production
2442	Manufacture of pharmaceutical preparations	2955	Manufacture of machinery for paper and paperboard production
2451	Manufacture of soap and detergents, cleaning and polishing preparations	2960	Manufacture of weapons and ammunition
2452	Manufacture of perfumes and toilet preparations	2971	Manufacture of electric domestic appliances
2465	Manufacture of prepared unrecorded media	2972	Manufacture of non-electric domestic appliances
2621	Manufacture of ceramic household and ornamental articles	3001	Manufacture of office machinery
2622	Manufacture of ceramic sanitary fixtures	3002	Manufacture of computers and other information processing equipment
2624	Manufacture of other technical ceramic products	3220	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
2625	Manufacture of other ceramic products	3230	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods
2626	Manufacture of refractory ceramic products	3310	Manufacture of medical and surgical equipment and orthopaedic appliances
2630	Manufacture of ceramic tiles and flags	3320	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
2640	Manufacture of bricks, tiles and construction products, in baked clay	3330	Manufacture of industrial process control equipment
2651	Manufacture of cement	3350	Manufacture of watches and clocks
2661	Manufacture of concrete products for construction purposes	3511	Building and repairing of ships
2662	Manufacture of plaster products for construction purposes	3512	Building and repairing of pleasure and sporting boats
2663	Manufacture of ready-mixed concrete	3520	Manufacture of railway and tramway locomotives and rolling stock
2664	Manufacture of mortars	3530	Manufacture of aircraft and spacecraft
2665	Manufacture of fibre cement	3541	Manufacture of motorcycles
2666	Manufacture of other articles of concrete, plaster and cement	3542	Manufacture of bicycles
2670	Cutting, shaping and finishing of ornamental and building stone	3550	Manufacture of other transport equipment n.e.c.
2731	Cold drawing	3611	Manufacture of chairs and seats
2732	Cold rolling of narrow strip	3612	Manufacture of other office and shop furniture
2733	Cold forming or folding	3613	Manufacture of other kitchen furniture
2754	Casting of other non-ferrous metals	3614	Manufacture of other furniture
2812	Manufacture of builders' carpentry and joinery of metal	3615	Manufacture of mattresses
2822	Manufacture of central heating radiators and boilers	3621	Striking of coins
2861	Manufacture of cutlery	3622	Manufacture of jewellery and related articles n.e.c.
2931	Manufacture of agricultural tractors	3630	Manufacture of musical instruments
2932	Manufacture of other agricultural and forestry machinery	3640	Manufacture of sports goods
2941	Manufacture of portable hand held power tools	3650	Manufacture of games and toys
2951	Manufacture of machinery for metallurgy	3661	Manufacture of imitation jewellery
2952	Manufacture of machinery for mining, quarrying and construction	3662	Manufacture of brooms and brushes

Table A.5: The number of firms by 2-digit industry, and industry composition by region in the pre-entry period

NACE2	near		far		total number of firms
	control	supplier	control	supplier	
15	13.1%	0.0%	15.1%	0.0%	1036
17	2.7%	1.7%	2.5%	1.4%	133
18	6.3%	0.0%	7.2%	0.0%	455
19	1.6%	0.3%	1.6%	0.1%	112
20	6.2%	0.0%	4.8%	0.0%	181
21	1.3%	0.0%	1.7%	0.0%	8
22	6.0%	0.0%	6.8%	0.0%	242
23	0.1%	0.0%	0.2%	0.0%	9
24	2.2%	1.6%	1.4%	1.1%	124
25	0.0%	5.9%	0.0%	6.5%	411
26	3.2%	0.7%	2.5%	0.6%	239
27	0.4%	1.0%	0.2%	1.1%	84
28	3.4%	12.2%	3.2%	12.4%	1088
29	6.7%	5.3%	6.7%	6.0%	435
30	1.0%	0.0%	0.6%	0.0%	18
31	1.2%	1.4%	1.6%	2.1%	111
32	1.5%	0.7%	1.4%	1.0%	124
33	3.2%	0.0%	3.5%	0.0%	143
34	0.1%	0.8%	0.2%	0.9%	54
35	0.5%	0.0%	0.4%	0.0%	26
36	6.5%	1.1%	4.2%	1.0%	415

Columns 1-4 show the composition of industry-region groups before the Audi entry, by 2-digit NACE categories, as a percentage of the total number of firms in a group. Column 5 shows the total number of firms in the given industry group which were included in the analysis in either the pre- or the post-entry period.

Table A.6: Comparing the short- and long-run effect of Audi by dividing the post-entry period into four sub-periods: sales, employment and productivity

Dep. var.:		log sales (1)	log domestic sales (2)	log employment (3)	labor productivity (4)	total factor productivity (5)
Triple interaction term with after entry periods	1994-1997	0.187	0.212	0.163*	-0.118	-0.101*
		(0.129)	(0.141)	(0.091)	(0.083)	(0.061)
	1998-2001	0.362**	0.296*	0.326***	-0.061	-0.109
		(0.168)	(0.176)	(0.117)	(0.099)	(0.070)
	2002-2006	0.440**	0.461**	0.419***	-0.114	-0.165**
		(0.183)	(0.197)	(0.127)	(0.105)	(0.073)
	2007-2011	0.586***	0.585***	0.494***	-0.017	-0.102
		(0.209)	(0.216)	(0.148)	(0.110)	(0.080)
Double interaction terms		YES	YES	YES	YES	YES
After entry period dummies		YES	YES	YES	YES	YES
Industry-year-fixed effects		YES	YES	YES	YES	YES
Firm-fixed effects		YES	YES	YES	YES	YES
Observations		54,017	51,857	53,394	51,663	50,341

Triple interaction term: time dummies for after Audi entry periods, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry period dummies interacted with close to Audi location dummy or supplier industry dummy. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét. Labor productivity is value added per capita, total factor productivity is estimated from a Cobb-Douglas production function with coefficients varying by 2-digit industries. Both are measured in logs. Industry-year fixed effects use 2-digit industry classifications.

Table A.7: Comparing the short- and long-run effect of Audi by dividing the post-entry period into four sub-periods: trade

		log exported value			probability of starting to export			log imported value
Dep. var.:		to all destinations (1)	to Germany (2)	to Austria (3)	to all destinations (4)	to Germany (5)	to Austria (6)	(7)
Triple interaction term with after entry periods	1994-1997	0.199	0.122	1.073**	0.077*	0.056	0.002	-0.328
		(0.304)	(0.400)	(0.461)	(0.040)	(0.037)	(0.026)	(0.268)
	1998-2001	0.252	0.383	1.369**	0.029	0.027	-0.029	-0.210
		(0.360)	(0.464)	(0.558)	(0.040)	(0.034)	(0.027)	(0.326)
	2002-2006	0.204	0.559	0.966	0.044	0.022	-0.005	-0.315
		(0.383)	(0.505)	(0.614)	(0.041)	(0.035)	(0.027)	(0.338)
Double interaction terms		YES	YES	YES	YES	YES	YES	YES
After entry period dummies		YES	YES	YES	YES	YES	YES	YES
Industry-year-fixed effects		YES	YES	YES	YES	YES	YES	YES
Firm-fixed effects		YES	YES	YES	YES	YES	YES	YES
Observations		12,681	6,944	4,472	21,862	21,862	21,862	13,798

Triple interaction term: time dummies for after Audi entry periods, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry period dummies interacted with close to Audi location dummy or supplier industry dummy. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét. Industry-year fixed effects use 2-digit industry classifications.

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Table A.8: Comparing the short- and long-run effect of Audi: 1^{st}, 2^{nd}, 3^{rd} and 5^{th} difference estimations

Dep. var.:	log sales (1)	log domestic sales (2)	log employment (3)
First differencing			
Triple interaction term	0.164	0.210*	0.131**
	(0.109)	(0.110)	(0.065)
Observations	48,416	45,284	47,833
Second differencing			
Triple interaction term	0.249**	0.295**	0.183**
	(0.111)	(0.115)	(0.080)
Observations	43,295	40,267	42,638
Third differencing			
Triple interaction term	0.234*	0.286**	0.247***
	(0.131)	(0.138)	(0.091)
Observations	38,585	35,696	37,942
Fifth differencing			
Triple interaction term	0.321**	0.373**	0.263**
	(0.152)	(0.150)	(0.110)
Observations	30,303	28,003	29,713
Double interaction terms	YES	YES	YES
After entry dummy	YES	YES	YES

Triple interaction term: time dummy for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or supplier industry dummy. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Industry-year fixed effects are included. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét.

Table A.9: The number of firms with foreign owners by firm group

	Suppliers		Controls		Total
	Near	Far	Near	Far	
Number of firms	864	1406	1040	2139	5449
Number of firms with foreign owners	226	242	225	313	1006
Number of firms in 1993	239	544	403	814	2000
Number of foreign firms in 1993	58	60	70	88	276

A firm with foreign owner is defined as a firm with at least 20% foreign ownership share in any year. A foreign firm in 1993 is defined as a firm with at least 20% foreign ownership share in year 1993.

Table A.10: The effect of Audi on firms with foreign owners by how much the German trust in the owner's country

Dep. var.	log sales (1)	log employment (2)	log sales (3)	log employment (4)	log sales (5)	log employment (6)
Triple interaction term	0.901**	0.902***	0.185	0.456	0.185	0.456
	(0.356)	(0.225)	(0.833)	(0.579)	(0.833)	(0.579)
Triple interaction term X Trust in units			0.839	0.543		
			(0.958)	(0.656)		
Triple interaction term X Trust in st.dev.					0.232	0.150
					(0.265)	(0.182)
Double interaction terms and after entry dummy, also interacted with the trust measure	YES	YES	YES	YES	YES	YES
Industry-year-fixed effects	YES	YES	YES	YES	YES	YES
Firm-fixed effects	YES	YES	YES	YES	YES	YES
Observations	7,799	7,758	7,799	7,758	7,799	7,758
Number of firms	681	681	681	681	681	681

The sample is all firms with an owner from EU15 or from Norway. Owners in 1993 or in the first available year are regarded. When owners are from multiple countries, the firm is assigned to the country the most trusted by the German. Triple interaction term: time dummy for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or supplier industry dummy. Trust uses Eurobarometer survey data from 1995, aggregated by Guiso et al. (2009, p. 1102, Table I), measuring the difference of trust in the given country compared to the lowest level of trust (in Italians) by the German. The original question was "How much trust you have in people from various countries?" with answer options lot of trust (4), some trust (3), not very much trust (2) or no trust at all (1). Trust in units uses the simple difference in the aggregate trust measure. Trust in st.dev. expresses the difference in standard deviation of the trust measure across countries. In columns (3) - (6) the baseline category is firms with Italian owners. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included. Industry-year fixed effects use 2-digit industry classifications.

Table A.11: The effect of Audi by firm size

Dep. var.:		log sales (1)	log domestic sales (2)	log employment (3)	labor productivity (4)	total factor productivity (5)	log exported value (6)	log imported value (7)
Triple interaction term X size tertiles	1st tertile	0.367	0.261	0.384**	-0.064	-0.047	0.347	-0.330
		(0.229)	(0.233)	(0.164)	(0.178)	(0.140)	(0.778)	(0.577)
	2nd tertile	0.396	0.282	0.363**	0.013	-0.073	0.033	-1.068*
		(0.254)	(0.275)	(0.179)	(0.136)	(0.099)	(0.610)	(0.571)
	3rd tertile	0.038	0.349	0.137	-0.190	-0.178*	0.238	0.025
		(0.270)	(0.311)	(0.170)	(0.146)	(0.097)	(0.423)	(0.377)
Double interaction terms		YES	YES	YES	YES	YES	YES	YES
After entry period dummy		YES	YES	YES	YES	YES	YES	YES
Industry-year-fixed effects		YES	YES	YES	YES	YES	YES	YES
Firm-fixed effects		YES	YES	YES	YES	YES	YES	YES
Observations		22,871	22,102	22,645	22,032	21,478	7,375	7,942

Triple interaction term: time dummy for after Audi entry, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or supplier industry dummy. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét. Labor productivity is value added per capita, total factor productivity is estimated from a Cobb-Douglas production function with coefficients varying by 2-digit industries. Both are measured in logs. Size tertiles determined based on before Audi value. Industry-year fixed effects use 2-digit industry classification.

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Table A.12: The effect of Audi by ownership, size and productivity

Sample: firms being present in 1993

Dep. var:	log sales			log employment		
	overall	by size groups	by productivity groups	overall	by size groups	by productivity groups
	(1)	(2)	(3)	(4)	(5)	(6)
Triple interaction term	0.095			0.053		
	(0.180)			(0.122)		
Triple interaction term	0.805**			0.845***		
x foreign	(0.368)			(0.253)		
Triple interaction term		0.179	-0.149		0.204	-0.074
x 1st tertile		(0.231)	(0.333)		(0.177)	(0.214)
Triple interaction term		0.104	0.429*		0.058	0.215
x 2nd tertile		(0.281)	(0.259)		(0.186)	(0.181)
Triple interaction term		-0.106	0.037		-0.076	0.128
x 3rd tertile		(0.294)	(0.262)		(0.180)	(0.252)
Triple interaction term		0.698	0.938		0.615	1.078**
x 1st tertile x foreign		(0.663)	(0.759)		(0.432)	(0.426)
Triple interaction term		0.865	0.394		0.932**	0.762*
x 2nd tertile x foreign		(0.601)	(0.539)		(0.404)	(0.394)
Triple interaction term		0.572	1.098**		0.624*	0.616
x 3rd tertile x foreign		(0.495)	(0.497)		(0.340)	(0.435)
Double interaction terms	YES	YES	YES	YES	YES	YES
After entry dummy	YES	YES	YES	YES	YES	YES
Industry-year-fixed effects	YES	YES	YES	YES	YES	YES
Firm-fixed effects	YES	YES	YES	YES	YES	YES
Observations	24,309	22,379	20,996	23,928	22,157	20,746
Number of firms	1,957	1,724	1,599	1,959	1,725	1,599

Triple interaction term: time dummy for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or supplier industry dummy. All these also interacted with foreign dummy being one if in at least one year the firm had more than 20% foreign ownership share. Size tertile indicators are also included in columns (2) and (5), and productivity tertile indicators in columns (3) and (6), interacted with all other indicators and interaction terms. Size and productivity tertiles are determined based on before Audi value. Productivity tertiles are determined separately for each 2-digit industry. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét. Labor productivity is value added per capita, total factor productivity is estimated from a Cobb-Douglas production function with coefficients varying by 2-digit industries. Both are measured in logs. Only domestic (always 100%) and foreign (minimum 20% foreign ownership at some point) owned firms included. Industry-year fixed effects use 2-digit industry classifications.

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Table A.13: The effect of Audi by firm size and productivity

Sample: firms present in 1993

Dep. var:			log sales	log employment
			(1)	(2)
Triple interaction term X firm groups	Small	Low-productivity	0.697	0.394
			(0.451)	(0.257)
		Medium-productivity	0.490	0.444
			(0.346)	(0.295)
		High-productivity	0.174	0.385
			(0.372)	(0.284)
	Medium-size	Low-productivity	-0.062	0.129
			(0.420)	(0.304)
		Medium-productivity	1.054***	0.655**
			(0.403)	(0.272)
		High-productivity	0.649	0.537*
			(0.396)	(0.304)
	Large	Low-productivity	-0.525	0.000
			(0.470)	(0.266)
		Medium-productivity	-0.037	0.223
			(0.408)	(0.282)
		High-productivity	0.827*	0.262
			(0.439)	(0.278)
Double interaction terms			YES	YES
After entry dummy			YES	YES
Industry-year-fixed effects			YES	YES
Firm-fixed effects			YES	YES
Observations			21,456	21,203
Number of firms			1,621	1,621

Triple interaction term: time dummy for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or supplier industry dummy. All these also interacted with size tertile and productivity tertile indicators, and their interactions. Size and productivity tertiles are determined based on before Audi value. Productivity tertiles are determined separately for each 2-digit industry. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét. Labor productivity is value added per capita, total factor productivity is estimated from a Cobb-Douglas production function with coefficients varying by 2-digit industries. Both are measured in logs. Industry-year fixed effects use 2-digit industry classifications.

Table A.14: Robustness checks of the demand effect for selective entry and different age composition across firm groups

Sample:	Firms already existing in 1992			All firms		
Dep. var.:	log sales	log domestic sales	log employment	log sales	log domestic sales	log employment
	(1)	(2)	(3)	(4)	(5)	(6)
Triple interaction term	0.329**	0.400**	0.304***	0.370**	0.368**	0.307***
with after dummy	(0.151)	(0.173)	(0.112)	(0.150)	(0.158)	(0.105)
Double interaction terms	YES	YES	YES	YES	YES	YES
After entry dummy	YES	YES	YES	NO	NO	NO
Firm age	NO	NO	NO	YES	YES	YES
Industry-year-fixed effects	YES	YES	YES	YES	YES	YES
Firm-fixed effects	YES	YES	YES	YES	YES	YES
Observations	19,583	18,966	19,265	54,017	51,857	53,394
Number of firms	1,576	1,574	1,577	5,427	5,410	5,434

Triple interaction term: time dummy for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry period interacted with close to Audi location dummy or supplier industry dummy. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét. Industry-year fixed effects use 2-digit industry classifications.

Table A.15: The baseline sales and employment regressions, comparing different specifications

Control region:	80 km around Kecskemét						Pest & Budapest	
Sample:	All firms				Firms present in 1993		All firms	
Dep. var.:	log sales	log employm.	log sales	log employm.	log sales	log employm.	log sales	log employm.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Triple interaction term	0.347**	0.309***	0.288*	0.271**	0.426**	0.279**	0.395***	0.304***
	(0.151)	(0.105)	(0.161)	(0.110)	(0.168)	(0.127)	(0.141)	(0.095)
Double interaction terms	YES	YES	YES	YES	YES	YES	YES	YES
After entry dummy	YES	YES	YES	YES	YES	YES	YES	YES
Industry-year-fixed effects	YES	YES	NO	NO	YES	YES	YES	YES
Firm-fixed effects	YES	YES	YES	YES	NO	NO	YES	YES
Observations	54,017	53,394	54,017	53,394	24,607	24,226	77,828	76,708
Number of firms	5,427	5,434	5,427	5,434			7,798	7,804

Triple interaction term: time dummy for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or supplier industry dummy. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Only firms with at least 5 employees are included. Industry-year fixed effects use 2-digit industry classifications.

Table A.16: The effect of Audi across 4-digit industries, allowing for separate effects on levels and trends: sales, employment and productivity

Unit of obs.: NACE 4 industry by region

Dep. var.:	log sales (1)	log domestic sales (2)	log employment (3)	labor productivity (4)	total factor productivity (5)
Triple interaction term	0.199	0.406	0.384**	-0.230	-0.054
with after dummy	(0.280)	(0.329)	(0.160)	(0.214)	(0.088)
Triple interaction term	0.083***	0.059**	0.038**	0.006	0.001
with after trend	(0.023)	(0.025)	(0.016)	(0.011)	(0.010)
Double interaction terms	YES	YES	YES	YES	YES
After entry dummy and trend	YES	YES	YES	YES	YES
Industry-year-fixed effects	YES	YES	YES	YES	YES
Observations	6,387	6,322	6,283	6,212	6,109

Triple interaction term: time dummy or time trend for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy or trend interacted with close to Audi location dummy or supplier industry dummy. Control region: 80 km around Kecskemét. Labor productivity and total factor productivity are calculated as yearly 4-digit industry averages. Industry-year fixed effects use 2-digit industry classification. Weighted regressions, using total employment by NACE4 in 1993 as weights. Standard errors are clustered by 2-digit industry-supplier group-region.

Table A.17: The effect of Audi across 4-digit industries, allowing for separate effects on levels and trends: trade

Unit of obs.: NACE 4 industry by region

Dep. var.:	log exported value			share of exporters			log imported value
	to all destinations (1)	to Germany (2)	to Austria (3)	to all destinations (4)	to Germany (5)	to Austria (6)	(7)
Triple interaction term	1.020*	0.274	0.741	-0.002	0.095***	0.011	0.278
with after dummy	(0.578)	(0.463)	(0.716)	(0.040)	(0.026)	(0.027)	(0.458)
Triple interaction term	0.000	0.217***	0.128**	-0.000	-0.009***	0.001	0.028
with after trend	(0.049)	(0.064)	(0.048)	(0.005)	(0.003)	(0.003)	(0.046)
Double interaction terms	YES	YES	YES	YES	YES	YES	YES
After entry dummy and trend	YES	YES	YES	YES	YES	YES	YES
Industry-year-fixed effects	YES	YES	YES	YES	YES	YES	YES
Observations	3,068	2,300	1,984	3,882	3,882	3,882	3,200

Triple interaction term: time dummy or time trend for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy or trend interacted with close to Audi location dummy or supplier industry dummy. Control region: 80 km around Kecskemét. Industry-year fixed effects use 2-digit industry classification. Weighted regressions, using total employment by NACE4 in 1993 as weights. Standard errors are clustered by 2-digit industry-supplier group-region.

Table A.18: Comparing the exit probability of firms in the different firm groups

Dep. var.: Indicator for the firm exiting next year	(1)	(2)
Triple interaction term	0.009	0.002
	(0.015)	(0.014)
Firm characteristics	YES	YES
Double interaction terms	YES	YES
After entry dummy	YES	NO
Supplier dummy	YES	NO
NACE 2 industry FE	NO	YES
Year FE	NO	YES
Industry-year-fixed effects	YES	YES
Observations	31,768	31,768

Triple interaction term: time dummy for after Audi entry years, region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Double interaction terms: after Audi entry dummy interacted with close to Audi location dummy or supplier industry dummy. Time-varying firm characteristics: employment, total factor productivity, age. Time-invariant firm characteristics: firm ever exporter, region dummy, also interacted with supplier industry dummy. Industry-year fixed effects use 2-digit industry classifications. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét.

Table A.19: Comparing the characteristics of exiting firms in the different firm groups

Dep. var.:	log sales (1)	log domestic sales (2)	log employment (3)	labor productivity (4)	total factor productivity (5)	log exported value (6)	log imported value (7)
Interaction term	0.039	-0.146	0.032	-0.113	-0.136	-0.704	-1.115*
	(0.197)	(0.215)	(0.125)	(0.141)	(0.150)	(0.487)	(0.593)
Industry and region dummies	YES	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES
Observations	2,069	1,913	2,052	1,935	1,825	529	515

Sample: firms exiting after the Audi entry one year before their exit. Interaction term: region dummy for locations close to Audi and industry dummy for the supplier industries interacted. Standard errors in parentheses are clustered by 4-digit NACE industry - county groups. Labor productivity is value added per capita, total factor productivity is estimated from a Cobb-Douglas production function with coefficients varying by 2-digit industries. Both are measured in logs. Only firms with at least 5 employees are included. Control region: 80 km around Kecskemét.

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Appendix B

Appendix for Chapter 2

B.1 A simple model about the effect of a plant closure

The original model is from Acemoglu et al. (2015), based on the model of Long and Plosser (1983). Here I present a simplified and somewhat modified version, neglecting government purchases ($G = 0$ and $T = 0$). There is an economy with n sectors. Each sector is perfectly competitive, zero profit condition applies. Each sector has a Cobb-Douglas production technology, using labor (l_i) and the output of other sectors (x_{ij}) as input. The production function of sector i is

$$y_i = e^{z_i} l_i^{\alpha_i^l} \prod_{j=1}^{n} x_{ij}^{\alpha_{ij}}, \tag{B.1}$$

with $\alpha_i^l > 0$ and $\alpha_{ij} \geq 0$. There is a representative household supplying labor (l) and consuming production goods (c_i) with a Cobb-Douglas utility function

$$u = \gamma(l) \prod_{i=1}^{n} c_i^{\beta_i}, \tag{B.2}$$

where $\frac{\partial \gamma(l)}{\partial l} \leq 0$, $\beta_i \geq 0$, $\sum_{i=1}^{n} \beta_i = 1$, and the budget constraint is

$$\sum_{i=1}^{n} p_i c_i = wl. \tag{B.3}$$

Decision makers (producers and the representative household) take prices as given.
Compared to Acemoglu et al. (2015) I make two modifications in the model. First, I

assume that there is decreasing returns to scale in production, i.e. $\alpha_i^l + \sum_{j=1}^{n} \alpha_{ij} < 1, \ \forall i$. Second, I assume a small open economy, trading with the rest of the world, including other parts of the country and foreign countries as well. Sales within the location occur at a price p_i, and the world price is fixed at p_i^w. I also assume that there is a positive iceberg-type transport cost for both exports (τ_x) and imports (τ_m). As local players are small, transport cost should be paid by them, and foreign transaction partners earn or pay exactly the world price. Then a local importer of a product of sector i has to pay $p_i^w + \tau_m$ and a local exporter in sector i receives $p_i^w - \tau_x$. Local buyers choose to import the product of sector i if $p_i^w + \tau_m \leq p_i$, and local sellers of sector i choose to export their product if $p_i \leq p_i^w - \tau_x$. Let p_i^e denote the equilibrium local price of sector i's product in case of a closed economy. If $p_i^e < p_i^w - \tau_x$, then after opening up the local price will be $p_i = p_i^w - \tau_x$ and there will be exports in sector i (local supply exceeding local demand). If $p_i^e > p_i^w + \tau_m$, then after opening up the local price will be $p_i = p_i^w + \tau_m$ and there will be imports in sector i (local demand exceeding local supply). Otherwise the local price will remain $p_i = p_i^e$ and there will be no trade with the rest of the world (local supply being equal to local demand). I assume that any amount can be exported or imported at the world price (equivalently, supply and demand in the local economy is small relative to the rest of the world).

There is no mobility of labor, the labor market clearing condition is

$$l = \sum_{i=1}^{n} l_i. \tag{B.4}$$

The market clearing condition in the goods market is

$$y_i = c_i + \sum_{j=1}^{n} x_{ji} + nx_i, \tag{B.5}$$

where nx_i denotes net exports in sector i. For a non-tradable sector $nx_i = 0$ and the goods market condition of the Acemoglu et al. (2015) paper still applies.

I assume that the closing plant's sector (denoted by i) is an exporter, i.e. $p_i = p_i^w - \tau_x$ and $nx_i > 0$. I also assume that there is relatively low local demand for sector i's product and its export share is large.

The equilibrium conditions are given by the input demand functions from the profit maximization problem

$$l_i = \alpha_i^l \frac{p_i y_i}{w},\ \forall i \tag{B.6}$$

$$x_{ij} = \alpha_{ij} \frac{p_i y_i}{p_j},\ \forall i, j. \tag{B.7}$$

The labor supply function from the household's optimization problem is

$$-\frac{\gamma'(l) l}{\gamma(l)} = 1, \tag{B.8}$$

and the consumer's demand for goods from the household's optimization problem is

$$c_i = \beta_i \frac{wl}{p_i}. \tag{B.9}$$

As in the original model, the labor supply function is independent of w or $\mathbf{p}$.
I model a plant closure in sector i as a decrease in the productivity of sector i, i.e. $dz_i < 0$.[1] As in the original model, from the production function we get that after a drop in productivity the supply of sector i decreases. As sector i was an exporter before, selling at price $p_i = p_i^w - \tau_x$, and local demand for sector i's product is low, the price won't change.[2] This results in decreasing revenues of sector i. The few local buyers can buy the product of sector i at the same price as before, so there is no downward propagation.
As sector i produces lower quantity on unchanged price $p_i^w - \tau_x$, it will decrease its demand for inputs x_{ij} and l_i. Supplier industries will get a negative demand-side shock, resulting in an upward propagation of the original shock. This is the channel of "input/output linkages". In this model only those supplier industries are hurt which didn't export before, as demand from the rest of the world substitutes for the lost local demand. Additionally, if there are imports in an industry and local supply is relatively low, a moderate drop in local demand will not affect the price, neither the quantity. In all the other cases (i.e. non-exporter and relatively low-scale importer industries) both equilibrium price and quantity decreases.
Demand for labor decreases both by industry i and by the supplier industries. As labor

[1] Alternatively, I can model a plant closure as an exogenous decrease in the production of sector i. Results remain the same.

[2] The price could increase if local supply decreases so much that the new closed-economy equilibrium price is higher than the export price, but lower than the import price. Still, equilibrium quantity produced (y_i) would decrease even in that case. Then similar results would hold, but there would also be downward propagation of the shock.

supply is fixed, wage should either go down for a new equilibrium in the labor market, or there will be unemployment if the wage cannot decrease to its new equilibrium level. In any case, the income of the household decreases. If wage can adjust to some extent, labor will be cheaper for production and will be used more intensively by local firms. This is the effect of "increased local labor supply". As the income of the household decreases, the household budget constraint will tighten and consumption from all sectors will decrease. This is the channel of "decreased local purchasing power", which affects the non-trading industries like local services.

B.2 Additional figures and tables

Figure B.1: The number of cases per event-year which have settlement-level or firm-level data

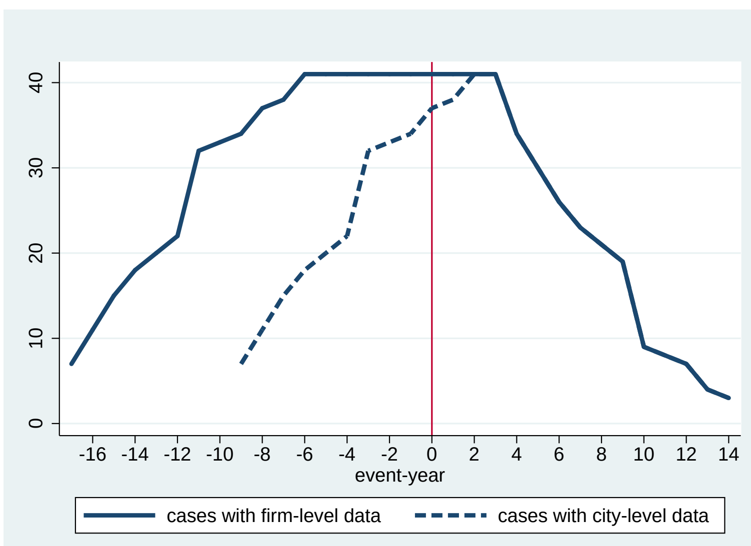

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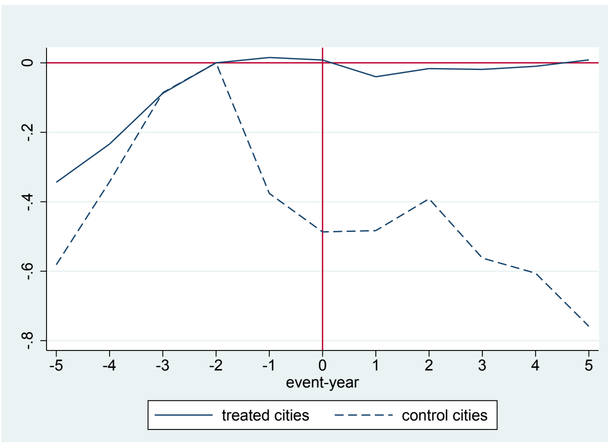
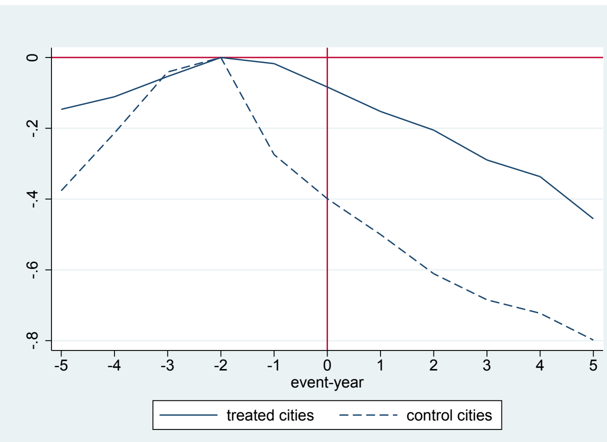
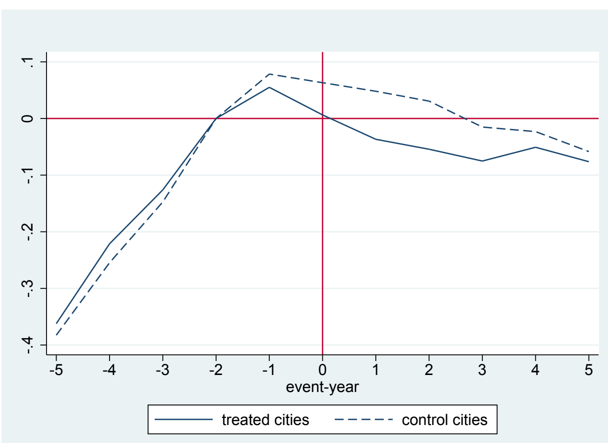
Figure B.2: Case-level averages of the log of total employment and sales within 10 km agglomeration, excluding the closing plant, by size group



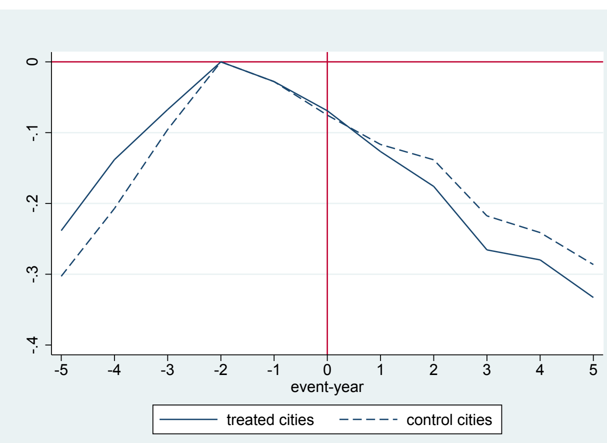
(a) Log sales of firms with more than 100 employees



(b) Log employment of firms with more than 100 employees



(c) Log sales of firms with 5-20 employees



(d) Log employment of firms with 5-20 employees

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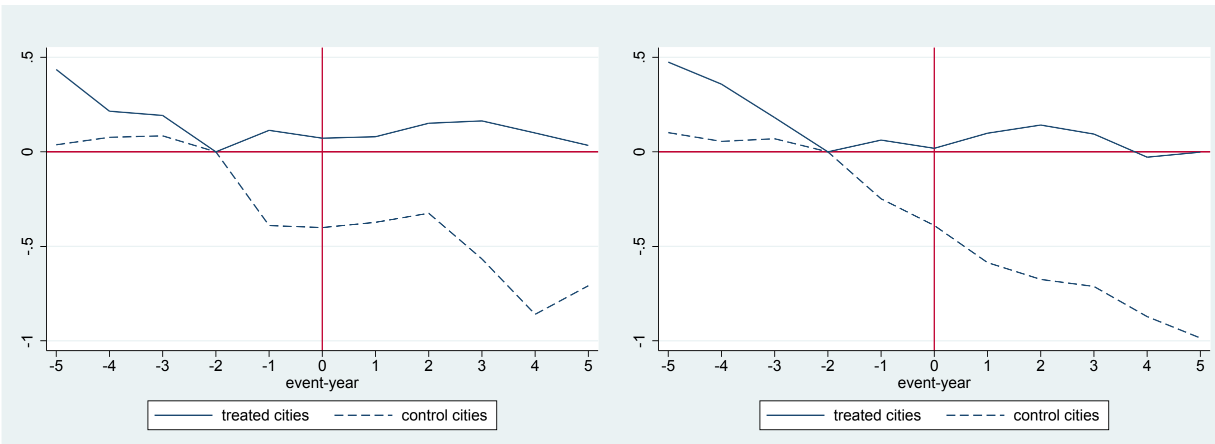
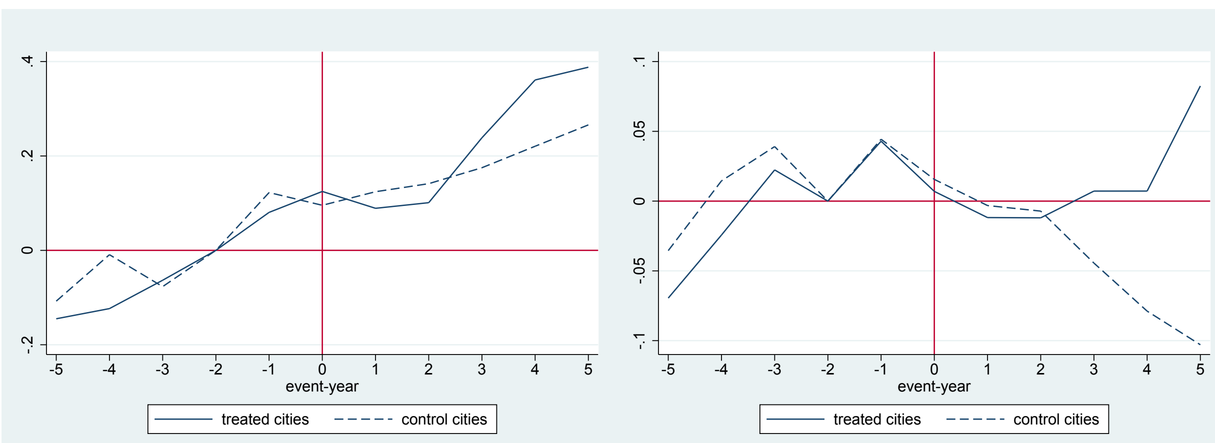
Figure B.3: Case-level averages of the log of total employment and sales within 10 km agglomeration, excluding the closing plant, by industry



(a) Log sales of competitors

(b) Log employment of competitors



(c) Log sales of supplier-industry firms

(d) Log employment of supplier-industry firms

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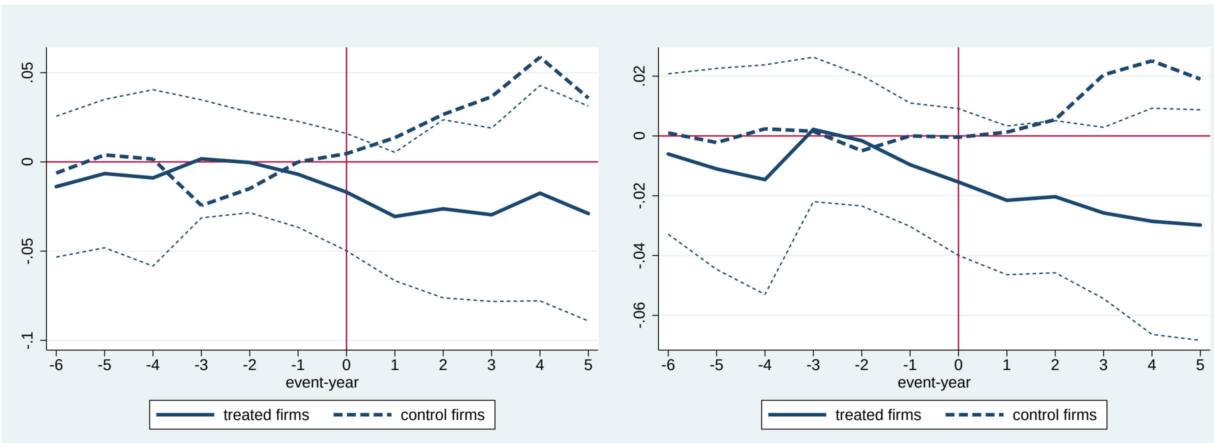
Figure B.4: The yearly evolution of average log sales and employment in treated and control firms, with 95% confidence interval on the treated-control difference, and controls normalized to zero one year before the closure



(a) Log sales

(b) Log employment

Figure B.5: The average move-out rate in treated and control cities around the plant closure

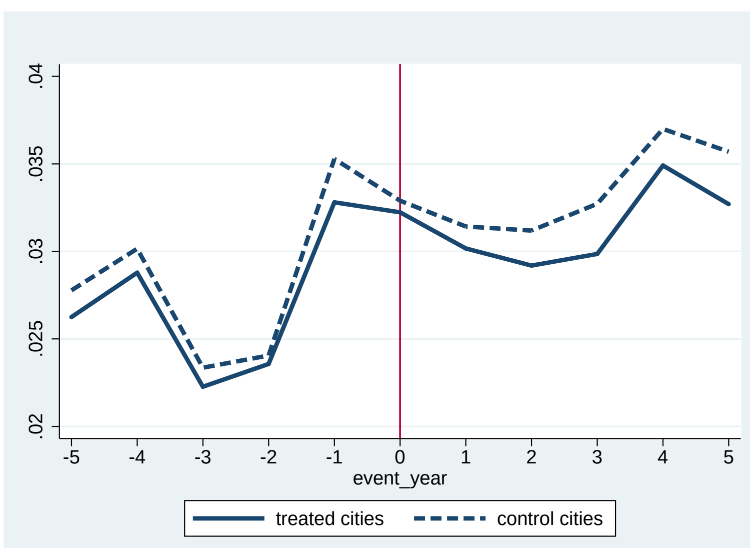


Table B.1: The list of treated and control cities with attributes

industry	treated				control				closure date
	city	city size	plant	employees	city	city size	plant	employees	
NACE 1.1 - 15: Manufacture of food products and beverages									
	Nagykanizsa	33910	Dreher	289	Keszthely	13414	Helikorn	182	1999 Dec
	Sárvár	10106	Magyar Cukor (Agrana)	350	Siófok	14709	Sió Eckes	148	1999 Q1
	Jászberény	16972	Corona	180	Keszthely	13150	Helikorn	187	2003 Jan
	Zagyvarékas	2204	Hajdú-Bét	800	Szerencs	6318	Szerencsi Cukorgyár (Béghin-Say SA)	263	2002
	Pásztó	6043	Sole	110	Karcag	13209	Cargill	193	2004 Q1
	Pécs	93118	MiZo	238	Baja	22682	Bácska Agráripari Rt	118	2005 Oct
	Kaba	3924	Eastern Sugar	200	Szeged	100312	SOLE-MiZo	1380	2006 Q4
	Nagybánhegyes	860	Friesland	183	Zichyújfalu	617	Provimi	182	2007 Sept
	Szolnok	46539	Mátra Cukor (Nordzucker)	150	Baja	22662	Csabai Tartósipari Rt (Globus)	175	2007 Nov
	Mezőhegyes	3901	Eastern Sugar	224	Siófok	14709	Sió Eckes	143	1997 Dec
	Sarkad	6418	Eastern Sugar	239	Lajosmizse	6750	Olivia	160	1998 March
NACE 1.1 - 16: Manufacture of tobacco products									
	*Debrecen	128575	Reemtsma	380					2004 Apr
	*Eger	34996	Philip Morris	334					2005 May
NACE 1.1 - 17: Manufacture of textiles									
	Szombathely	52105	Savatex	200	Dombóvár	12874	Pasha	735	2001
	Dunaújváros	32382	Berwin	240	Dombóvár	12480	Pasha	344	2005 Dec
	Kaposvár	40932	Coats	195	Tolna	7345	Tolnatext	247	2007 Nov
NACE 1.1 - 18: Manufacture of wearing apparel; dressing and dyeing of fur									
	*Zalaegerszeg	38733	ZA-KO	1200					2002 Dec
	Bátonyterenye	9090	Hammer	160	Zalaszentgrót	4706	SH Rekord	219	2003 July
	Mezőkövesd	10423	Ruhaipari Szövetkezet	252	Zalaszentgrót	4706	SH Rekord	219	2003
	Ajka	20450	Shoe Makers	175	Zalaszentgrót	4706	SH Rekord	219	2003 Okt
	Vasvár	2842	Styl	160	Rajka	1704	Calida	298	2003 Q4
	Marcali	7738	Mustang	371	Nagykálló	6430	Olimpias	379	2007 March
	Kiskunhalas	18228	Levi Strauss	549	Zalaszentgrót	4515	SH Rekord	212	2009 June
	Nyíregyháza	74946	Berwin	395	Zalaszentgrót	4515	SH Rekord	212	2009 Jan
	Várpalota	13537	Berwin	162	Zalaszentgrót	4586	SH Rekord	212	2008 Sept

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Table B.2: The list of treated and control cities with attributes - continued

industry	treated				control				closure date
	city	city size	plant	employees	city	city size	plant	employees	
NACE 1.1 - 19: Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear									
	Bonyhád	9029	Salamander	640	Martfű	4555	Lorenz	706	2003 Oct
	*Szeged	100743	Mary 2000	220					2003 Q3
	Tiszakeszi	1648	Mary 2000	242	Martfű	4555	Lorenz	706	2003 Aug
	Beled	1806	Marc	200	Martfű	4555	Lorenz	706	2003 Q3
	*Körmend	7875	Marc	250					2003 Oct
	Őriszentpéter	793	Marc	200	Martfű	4516	Lorenz	638	2006 Jan
	**Szombathely	50520	Marc	1010					2004 Q4
	Vasvár	2811	Richter	180	Martfű	4418	Lorenz	654	2008 March
NACE 1.1 - 21: Manufacture of pulp, paper and paper products									
	Lábatlan	3232	Piszke Papír (Zeritis)	263	Ács	4250	Hartmann	496	2008 Dec
	Szolnok	46078	Mondi	265	Ács	4290	Hartmann	488	2008 June
NACE 1.1 - 25: Manufacture of rubber and plastic products									
	Komárom	12118	Perlos	1100	Szeged	100977	ContiTech	436	2009 July
NACE 1.1 - 26: Manufacture of other non-metallic mineral products									
	Bélapátfalva	2086	PannonCem	200	Nyergesújfalu	4926	Eternit	182	2000 Sept
	Salgótarján	23568	R-Glass	268	Tapolca	10569	Rockwool	183	2009 Nov
NACE 1.1 - 27: Manufacture of basic metals									
	Miskolc	103155	DAM 2004	878	Ózd	22375	ÓAM	470	2009 March
NACE 1.1 - 29: Manufacture of machinery and equipment n.e.c.									
	Szentgotthárd	5551	GFP Mezőgépgyár	150	Mezőtúr	11428	RAFI	212	2003 Sept
NACE 1.1 - 30: Manufacture of office machinery and computers									
	**Székesfehérvár	65420	IBM Data Storage Systems	3700					2003 Q1
NACE 1.1 - 31: Manufacture of electrical machinery and apparatus n.e.c.									
	Szeged	102218	Kábelgyár (Siemens)	245	Szentes	18877	Legrand	595	1998 Q3
	Szombathely	50520	Philips	800	Gyöngyös	20175	Magnetec	230	2004 Sept
	Eger	34396	Leoni	627	Gyöngyös	19286	Magnetec	260	2008 Aug
NACE 1.1 - 32: Manufacture of radio, television and communication equipment and apparatus									
	Sárbogárd	8012	Mannesmann	845	Tiszakécske	6940	Hechinger	310	2000 Oct
	Tatabánya	43682	Artesyn	370	Tiszakécske	6943	Hechinger	193	2005 Q4
	Kecskemét	68006	DDDK (Bosch)	500	Lőrinci	3499	Bumjin	448	2009 July
	*Szombathely	48189	Laird	700					2009 Q2
NACE 1.1 - 34: Manufacture of motor vehicles, trailers and semi-trailers									
	Székesfehérvár	65420	Ikarusbus	187	Rétság	1985	Enbi	250	2003 Aug

City size - measured by the number of inhabitants - is given one year before the plant closure or in 2000 if closure occured before 2001. Plant size is also given around that time when information is available. Plant closures marked by a * are not involved in the final analysis as no comparable control locations could be matched. Plant closures marked by ** are jointly forming a case with another closure happening in the same city and in the same year.

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Table B.3: Why did the plants close?

city	name	country of the owner	why did the plant close?
Ajka	Shoe Makers	Italy (Carmens Holding)	costs (goes to Romania)
Bátonyterenye	Hammer	Germany	costs
Bélapátfalva	PannonCem	Switzerland (Holderbank) and Germany (Heidelberger Zement AG)	market considerations
Beled	Marc	Switzerland (MSC Group)	costs, demand (imports from India)
Bonyhád	Bonsa	Germany (Salamander)	losses, restructuring activities
Debrecen	Reemtsma	UK (Imperial Tobacco Group)	tax increase, demand, EU-accession
Dunaújváros	Berwin	UK	cheap competition
Eger	Leoni	Germany	costs, low prices (goes to Poland)
Eger	Philip Morris	USA	tax increase, demand, EU-accession
Jászberény	Corona	Switzerland (Delimpex)	market conditions
Kaba	Eastern Sugar	UK (Tate&Lyle) and France (Saint Louis Sucre)	EU accession
Kaposvár	Coats	UK	costs, demand (imports from Africa and Asia)
Kecskemét	Digital Disc Drives	Germany (Bosch)	crisis, demand
Kiskunhalas	Levi Strauss	USA	cheap competition, demand
Komárom	Perlos	Taiwan	crisis, demand
Körmend	Marc	Switzerland (MSC Group)	costs, demand and legal issues (imports from Asia)
Lábatlan	Piszke	Greece (Zeritis-group)	making losses
Marcali	Mustang	Germany	costs, restructuring activities
Mezőkövesd	Ruhaipari Szövetkezet		
Mezőhegyes	Eastern Sugar	UK (Tate&Lyle) and France (Saint Louis Sucre)	EU accession
Miskolc	DAM 2004	Ukraine and Switzerland (Donbass-group)	crisis, demand
Nagybánhegyes	Friesland	The Netherlands	concentrate production (to Debrecen)
Nagykanizsa	Dreher	The Netherlands (Fienierr)	concentrate production (to Kőbánya)
Nyíregyháza	Berwin	UK	crisis
Őriszentpéter	Marc	Switzerland (MSC Group)	costs, demand (imports from India)
Pásztó	Sole	Italy	EU accession, concentrate production (to Szeged)
Pécs	MiZo	Cyprus	concentrate production (to Szeged), low prices

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Table B.4: Why did the plants close? - continued

city	name	country of the owner	why did the plant close?
Salgótarján	R-GLASS	Slovakia	debts
Sárbogárd	Mannesmann	Germany	costs (goes to China)
Sarkad	Eastern Sugar	UK (Tate&Lyle) and France (Saint Louis Sucre)	EU accession
Sárvár	Magyar Cukor	Austria (Agrana)	EU accession
Szeged	kábelgyár	Germany (Siemens)	demand, restructuring activities
Szeged	MARY 2000	Italy	debts
Székesfehérvár	IBM	Germany	global demand
Székesfehérvár	Ikarusbus	Italy (IrisBus - Iveco)	competition, lost demand, bad management
Szentgotthárd	GFP Mezőgépgyár	Germany (Küpa)	relocation (goes to Latvia)
Szolnok	Mátra Cukor	Germany (Nordzucker AG)	EU accession
Szolnok	Mondi	international enterprise	low demand, competition
Szombathely	Philips	The Netherlands	relocation (to Székesfehérvár and China)
Szombathely	Marc	Switzerland (MSC Holding)	low demand, high costs, relocation (to China)
Szombathely	Savatex		debts
Szombathely	Laird	UK	lost demand, relocation (to China and Mexico)
Tatabánya	Artesyn	USA	lost demand, relocating buyers (to Romania)
Tiszakeszi	Mary 2000	Italy	debts
Várpalota	Berwin	UK	high costs, recession, drop in demand
Vasvár	Styl	Germany (Bäumler)	concentrate production (to Szombathely)
Vasvár	Richter	Austria	competition, high costs, relocation (to Slovakia)
Zagyvarékas	Hajdu-Bét		debts, competition
Zalaegerszeg	Za-Ko	Austria	debts

Table B.5: Pre-closure similarity of treated and controls when multiple controls are assigned to each case

Controls: multiple controls are matched to each case

Pre-closure characteristics	Average for treated	Average for controls	P-value of H0: treated=control
Propensity score	0.31	0.08	0.23 (0.02)
Log working-age population in city	9.44	8.63	0.81 (0.14)
Log working-age population in 30 km	11.80	11.78	0.01 (0.05)
Unemployment rate in city	0.065	0.074	-0.0081 (0.0043)
Unemployment rate in 30 km	0.068	0.072	0.0041 (0.0036)
2-year change in city unemployment rate (pp)	0.0026	0.0012	0.0014 (0.0016)
2-year change in 30 km unemployment rate (pp)	0.0013	0.0012	0.0001 (0.0012)
Buyer-industry share in 30 km	0.090	0.081	0.009 (0.007)
Supplier-industry share in 30 km	0.122	0.116	0.006 (0.009)
Log total sales in 30 km	19.28	19.23	0.049 (0.088)
Average sales growth in 30 km	0.130	0.131	-0.001 (0.005)

Controls are cities with a foreign-owned large firm operating in the same industry as the closing plant. Regressions are weighted by the normalized inverse distance of the controls' propensity score from the treated. Weights of controls within a case sum up to one. Pre-closure characteristics are measured one year before the plant closure. 2-year change in the unemployment rate refers to changes from t-3 to t-1 where t is the year of the plant closure, and it is expressed in percentage points. Working-age population refers to the number of people aged 18-59 on Dec. 31. of the given year. Unemployment rate is the number of registered unemployed on Dec. 20. of the given year, divided by the working-age population. Buyer-industry share is the employment share of firms operating in the buyer industries of the closing plant in total employment. Supplier-industry share is defined analogously. Buyers are industries which use more than 5% of the closing plant industry's output, suppliers are industries of which more than 5% of the closing plant industry's inputs come. Total sales and average sales growth is calculated omitting the closing plant's firm and the foreign-owned large firms in the control cities. Standard errors are in parentheses.

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Table B.6: The list of supplier industries

List of supplier industries by 2-digit industry

15. Manufacture of food products and beverages
    - 1. Agriculture, hunting and related service activities
    - 51. Wholesale trade and commission trade, except of motor vehicles and motorcycles
    - 74. Other business activities

16. Manufacture of tobacco products
    - 1. Agriculture, hunting and related service activities
    - 21. Manufacture of pulp, paper and paper products
    - 24. Manufacture of chemicals and chemical products
    - 51. Wholesale trade and commission trade, except of motor vehicles and motorcycles
    - 74. Other business activities
    - 92. Recreational, cultural and sporting activities

17. Manufacture of textiles
    - 18. Manufacture of wearing apparel; dressing and dyeing of fur
    - 24. Manufacture of chemicals and chemical products
    - 36. Manufacture of furniture; manufacturing n.e.c.
    - 40. Electricity, gas, steam and hot water supply

18. Manufacture of wearing apparel; dressing and dyeing of fur
    - 17. Manufacture of textiles
    - 31. Manufacture of electrical machinery and apparatus n.e.c.
    - 51. Wholesale trade and commission trade, except of motor vehicles and motorcycles
    - 74. Other business activities

19. Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
    - 17. Manufacture of textiles
    - 18. Manufacture of wearing apparel; dressing and dyeing of fur
    - 74. Other business activities

21. Manufacture of pulp, paper and paper products
    - 40. Electricity, gas, steam and hot water supply
    - 51. Wholesale trade and commission trade, except of motor vehicles and motorcycles

25. Manufacture of rubber and plastic products
    - 24. Manufacture of chemicals and chemical products
    - 74. Other business activities

26. Manufacture of other non-metallic mineral products
    - 14. Other mining and quarrying
    - 23. Manufacture of coke, refined petroleum products and nuclear fuel
    - 24. Manufacture of chemicals and chemical products
    - 40. Electricity, gas, steam and hot water supply
    - 45. Construction
    - 51. Wholesale trade and commission trade, except of motor vehicles and motorcycles
    - 60. Land transport; transport via pipelines
    - 74. Other business activities

Table B.7: The list of supplier industries - continued

List of supplier industries by 2-digit industry	
27. Manufacture of basic metal	
	23. Manufacture of coke, refined petroleum products and nuclear fuel
	40. Electricity, gas, steam and hot water supply
	51. Wholesale trade and commission trade, except of motor vehicles and motorcycles
29. Manufacture of machinery and equipment n.e.c.	
	27. Manufacture of basic metal
	28. Manufacture of fabricated metal products, except machinery and equipment
	31. Manufacture of electrical machinery and apparatus n.e.c.
	51. Wholesale trade and commission trade, except of motor vehicles and motorcycles
	74. Other business activities
30. Manufacture of office machinery and computers	
	32. Manufacture of radio, television and communication equipment and apparatus
	74. Other business activities
31. Manufacture of electrical machinery and apparatus n.e.c.	
	25. Manufacture of rubber and plastic products
	27. Manufacture of basic metal
	28. Manufacture of fabricated metal products, except machinery and equipment
	32. Manufacture of radio, television and communication equipment and apparatus
	74. Other business activities
32. Manufacture of radio, television and communication equipment and apparatus	
	31. Manufacture of electrical machinery and apparatus n.e.c.
34. Manufacture of motor vehicles, trailers and semi-trailers	
	28. Manufacture of fabricated metal products, except machinery and equipment
	29. Manufacture of machinery and equipment n.e.c.
	31. Manufacture of electrical machinery and apparatus n.e.c.

Table B.8: The list of buyer industries

List of buyer industries by 2-digit industry

15. Manufacture of food products and beverages
    - 1. Agriculture, hunting and related service activities
    - 5. Fishing, fish farming and related service activities
    - 55. Hotels and restaurants
    - 85. Health and social work

16. Manufacture of tobacco products
    - \-

17. Manufacture of textiles
    - 18. Manufacture of wearing apparel; dressing and dyeing of fur
    - 19. Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear

18. Manufacture of wearing apparel; dressing and dyeing of fur
    - 17. Manufacture of textiles
    - 19. Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear

19. Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
    - 36. Manufacture of furniture; manufacturing n.e.c.

21. Manufacture of pulp, paper and paper products
    - 16. Manufacture of tobacco products
    - 22. Publishing, printing and reproduction of recorded media

25. Manufacture of rubber and plastic products
    - 31. Manufacture of electrical machinery and apparatus n.e.c.
    - 33. Manufacture of medical, precision and optical instruments, watches and clocks
    - 45. Construction
    - 85. Health and social work

26. Manufacture of other non-metallic mineral products
    - 14. Other mining and quarrying
    - 45. Construction

27. Manufacture of basic metal
    - 10. Mining of coal and lignite; extraction of peat
    - 28. Manufacture of fabricated metal products, except machinery and equipment
    - 29. Manufacture of machinery and equipment n.e.c.
    - 31. Manufacture of electrical machinery and apparatus n.e.c.
    - 35. Manufacture of other transport equipment
    - 37. Recycling

29. Manufacture of machinery and equipment n.e.c.
    - 11. Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying
    - 14. Other mining and quarrying
    - 34. Manufacture of motor vehicles, trailers and semi-trailers

30. Manufacture of office machinery and computers
    - \-

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Table B.9: The list of buyer industries - continued

List of buyer industries by 2-digit industry	
31. Manufacture of electrical machinery and apparatus n.e.c.	
	18. Manufacture of wearing apparel; dressing and dyeing of fur
	29. Manufacture of machinery and equipment n.e.c.
	32. Manufacture of radio, television and communication equipment and apparatus
	33. Manufacture of medical, precision and optical instruments, watches and clock
	34. Manufacture of motor vehicles, trailers and semi-trailers
	35. Manufacture of other transport equipment
32. Manufacture of radio, television and communication equipment and apparatus	
	30. Manufacture of office machinery and computers
	31. Manufacture of electrical machinery and apparatus n.e.c.
	33. Manufacture of medical, precision and optical instruments, watches and clock
34. Manufacture of motor vehicles, trailers and semi-trailers	
	50. Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel

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Table B.10: The average number of firms per case in different industry categories

Average number of firms per case within 10km agglomeration

	All	Local services	Competitors	Buyers	Suppliers
Treated locations	602	111	10	35	84
Control locations	361	71	11	42	54

I include firms used in the analysis, i.e. with median employment of 5 or more, omitting outliers with very large sales, firms with a closing plant and foreign-owned large firms in the control settlements. I use the baseline version where I match a single control to each case.

Table B.11: Descriptive statistics of firms

Variable	Mean	Standad deviation	Number of observations
sales (1000HUF)	450,915	4,325,328	796,655
employment (capita)	35	266	782,759
per capita yearly wage (1000 HUF)	552	549	714,197
value added per capita (1000 HUF)	2,502	11,402	733,660
total factor productivity	11,587	263,081	719,239
export sales (1000 HUF)	119,340	1,868,755	686,861
exitor dummy	0.10	0.30	797,551
age (years)	8.9	7.4	797,551
capital to labor ratio	6,111	297,261	757,124

Descriptive statistics are based on the largest sample of firms used in the analysis: all firms within the 30 km agglomeration of treated and control cities, when I assign multiple controls to each case. As in the analysis, I exclude the firms of the closing plants and the foreign-owned large firms in the control cities. I also exclude firms with sales in the highest 0.5 percentile. I only include firms with a median employment of at least five. Age is winsorized from above at 65.

Table B.12: Heterogeneity of the effect by the size of local firms

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated x After(1-3) x Size(5-20)	-0.076*	-0.031	-0.019*	-0.007	-0.007	-0.001
	(0.040)	(0.029)	(0.010)	(0.009)	(0.005)	(0.003)
Treated x After(1-3) x Size(20-100)	-0.046	-0.023	0.005	0.011	-0.020	-0.008
	(0.035)	(0.021)	(0.022)	(0.009)	(0.019)	(0.005)
Treated x After(1-3) x Size(100-500)	0.068	0.010	-0.001	-0.011	0.042	0.001
	(0.112)	(0.091)	(0.050)	(0.025)	(0.027)	(0.013)
Treated x After(1-3) x Size(500-)	0.639	0.582*	-0.021	0.014	0.219	0.022
	(0.422)	(0.300)	(0.081)	(0.022)	(0.267)	(0.017)
Treated x After(4-5) x Size(5-20)	-0.057	-0.022	-0.031	-0.002	0.006	-0.005
	(0.058)	(0.040)	(0.021)	(0.022)	(0.008)	(0.004)
Treated x After(4-5) x Size(20-100)	-0.126**	-0.070	0.006	0.010	-0.044	0.004
	(0.052)	(0.042)	(0.029)	(0.016)	(0.030)	(0.007)
Treated x After(4-5) x Size(100-500)	-0.039	-0.033	-0.010	-0.025	0.044	0.012
	(0.124)	(0.133)	(0.063)	(0.032)	(0.041)	(0.018)
Treated x After(4-5) x Size(500-)	0.623	0.542*	0.281	0.198	0.116	0.016
	(0.545)	(0.299)	(0.247)	(0.199)	(0.315)	(0.018)
Size group dummies in interactions	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	359,826	353,768	326,784	330,158	353,607	332,702
Number of unique firms	26,434	26,512	25,914	26,142	26,527	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Size(5-20) is an indicator of those firms which had 5-20 employees 2 years before the closure. Size(20-100), size(100-500) and size(500-) are defined in a similar way. All the other right-hand side variables are included only in interactions with the size group dummies. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

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Table B.13: The number of cases by different categorizations

		Number of cases per categories			
		Unemployment rate in the 30 km agglomeration 2 years before the plant closure			
		< median		>= median	
Working-age population of the city 1 year before the plant closure	< 40,000	14		15	
	>= 40,000	5		7	
		Export share of the closing plant 2 years before the closure			
		< 50%		>= 50%	
Employment of the closing plant	< 300	10		14	
	>= 300	3		11	
		Existed > 10 years		Was foreign > 10 years	
Plant is embedded to the local economy		27		21	
		German	UK & NL	Mediterranean	Other
Groups by the country of the owner		19	9	6	4

Table B.14: Differences in the plant closure effect by the characteristics of the closing plant

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated x After(1-3)	-0.069***	-0.047***	-0.026**	-0.023***	-0.006	0.001
	(0.024)	(0.017)	(0.012)	(0.007)	(0.010)	(0.003)
Treated x After(4-5)	-0.099***	-0.088***	-0.013	-0.025**	0.004	-0.002
	(0.029)	(0.024)	(0.016)	(0.011)	(0.013)	(0.004)
Treated x After(1-3) x HighExpShare	-0.020	0.027	0.016	0.023**	-0.017	0.003
	(0.038)	(0.026)	(0.019)	(0.011)	(0.016)	(0.005)
Treated x After(4-5) x HighExpShare	-0.014	0.045	-0.006	0.021	-0.024	0.007
	(0.053)	(0.037)	(0.028)	(0.024)	(0.023)	(0.007)
Number of observations	328,604	322,860	298,490	301,525	322,823	303,817
Number of unique firms	25,816	25,894	25,306	25,533	25,903	
Treated x After(1-3)	-0.055**	-0.023	-0.017	-0.011*	-0.008	0.002
	(0.027)	(0.016)	(0.012)	(0.006)	(0.011)	(0.003)
Treated x After(4-5)	-0.080**	-0.055**	-0.015	-0.008	-0.000	0.002
	(0.033)	(0.022)	(0.014)	(0.010)	(0.012)	(0.004)
Treated x After(1-3) x LargePlant	-0.019	-0.023	0.017	0.009	0.006	0.001
	(0.036)	(0.022)	(0.016)	(0.010)	(0.011)	(0.004)
Treated x After(4-5) x LargePlant	0.001	0.013	0.002	-0.003	-0.001	-0.004
	(0.055)	(0.034)	(0.028)	(0.019)	(0.018)	(0.006)
Number of observations	359,826	353,768	326,784	330,158	353,607	332,702
Number of unique firms	26,434	26,512	25,914	26,142	26,527	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. HighExpShare is an indicator of those cases where the closing plant's export share was more than 50% 2 years before the closure. LargePlant is a dummy for cases where the closing plant has more than 300 employees. Interactions of the case group dummy with all the other right-hand side variables are also included. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Column (6) includes firm-year-level characteristics as log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

Table B.15: Differences in the plant closure effect by the share of the closing plant in the local economy

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.:		Log sales			Log employment	
Case group:	baseline	plant share> median	plant share> 15% of 10km employment	baseline	plant share> median	plant share> 15% of 10km employment
Treated x After(1-3)	-0.061***	-0.041	-0.054***	-0.030**	-0.015	-0.033***
	(0.020)	(0.025)	(0.019)	(0.012)	(0.018)	(0.012)
Treated x After(4-5)	-0.077**	-0.033	-0.058**	-0.049**	-0.022	-0.046**
	(0.030)	(0.034)	(0.027)	(0.019)	(0.025)	(0.020)
Treated x After(1-3) x Group		-0.040	-0.052		-0.024	0.034
		(0.038)	(0.076)		(0.030)	(0.060)
Treated x After(4-5) x Group		-0.070	-0.102		-0.026	0.004
		(0.055)	(0.072)		(0.038)	(0.068)
Treated, time period and case group dummies, also in interactions	YES	YES	YES	YES	YES	YES
Firm FE, case FE, calendar year FE	YES	YES	YES	YES	YES	YES
Observations	359,826	359,826	359,826	353,768	353,768	353,768
Number of unique firms	26,434	26,434	26,434	26,512	26,512	26,512

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Group indicator refers to those cases where the share of the closing plant in the local economy is larger than the median share in columns (2) and (5) or larger than 15% in columns (3) and (6). Share is defined as the size of the closing plant compared to the total employment of all other firms within 10 km of the plant. Case group dummies are also interacted with all other indicators. Fixed effects for firm, case and calendar year are also included. The unit of observation is firm-year-case. Standard errors in parentheses are clustered by city. *** p<0.01 ** p<0.05 * p<0.1.

Table B.16: Differences in the plant closure effect by the industry of the closing plant

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated x After(1-3)	-0.063*	-0.042*	-0.025	-0.002	-0.003	0.002
	(0.038)	(0.024)	(0.020)	(0.010)	(0.011)	(0.004)
Treated x After(1-3) x Food	-0.012	-0.017	0.007	-0.020*	-0.000	0.000
	(0.037)	(0.034)	(0.025)	(0.011)	(0.010)	(0.006)
Treated x After(1-3) x Textile&Leather	-0.052	0.006	0.018	-0.010	-0.039*	-0.003
	(0.051)	(0.035)	(0.029)	(0.020)	(0.023)	(0.006)
Treated x After(1-3) x Machinery&Equipment	0.043	0.042	0.020	0.009	0.011	0.001
	(0.053)	(0.037)	(0.024)	(0.017)	(0.016)	(0.006)
Treated x After(4-5)	-0.096	-0.046	-0.016	0.001	-0.017	0.006
	(0.091)	(0.052)	(0.031)	(0.025)	(0.034)	(0.011)
Treated x After(4-5) x Food	0.009	-0.061	0.017	-0.016	0.030	-0.007
	(0.089)	(0.056)	(0.036)	(0.027)	(0.034)	(0.011)
Treated x After(4-5) x Textile&Leather	-0.053	-0.011	0.005	-0.007	-0.028	-0.006
	(0.095)	(0.056)	(0.034)	(0.027)	(0.033)	(0.010)
Treated x After(4-5) x Machinery&Equipment	0.026	0.039	-0.033	-0.021	0.023	0.002
	(0.093)	(0.055)	(0.034)	(0.027)	(0.036)	(0.010)
Time period dummies	YES	YES	YES	YES	YES	YES
Treated x Far-away period dummies	YES	YES	YES	YES	YES	YES
Industry group dummies in interactions	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	359,826	353,768	326,784	330,158	353,607	332,702
Number of unique firms	26,434	26,512	25,914	26,142	26,527	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Food, Textile&Leather and Machinery&Equipment indicate cases with a closing plant in the corresponding industry. The other right-hand side variables are also interacted with the industry group dummies. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

Table B.17: Differences in the plant closure effect by the owner of the closing plant

VARIABLES	(1) log sales	(2) log employment	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated x After(1-3)	-0.071	-0.048**	0.000	0.003	0.030**	0.004
	(0.054)	(0.021)	(0.018)	(0.010)	(0.012)	(0.005)
Treated x After(4-5)	0.024	-0.014	-0.035	-0.043	0.075**	0.004
	(0.065)	(0.048)	(0.046)	(0.029)	(0.033)	(0.012)
Treated x After(1-3) x German-speaking	0.039	0.034	-0.019	-0.006	-0.045	-0.002
	(0.049)	(0.029)	(0.022)	(0.012)	(0.028)	(0.006)
Treated x After(4-5) x German-speaking	-0.063	-0.016	0.023	0.033	-0.088*	-0.003
	(0.068)	(0.053)	(0.050)	(0.041)	(0.047)	(0.014)
Treated x After(1-3) x UK & the Netherlands	-0.059	-0.013	-0.010	-0.030**	-0.048***	-0.004
	(0.058)	(0.029)	(0.024)	(0.013)	(0.018)	(0.007)
Treated x After(4-5) x UK & the Netherlands	-0.180**	-0.088	0.003	0.025	-0.079**	0.003
	(0.079)	(0.055)	(0.049)	(0.034)	(0.037)	(0.013)
Treated x After(1-3) x Mediterranean	0.025	0.036	0.002	0.006	-0.036	-0.002
	(0.070)	(0.041)	(0.026)	(0.014)	(0.026)	(0.007)
Treated x After(4-5) x Mediterranean	-0.092	-0.036	0.022	0.041	-0.087*	-0.002
	(0.081)	(0.073)	(0.053)	(0.032)	(0.047)	(0.013)
Time period dummies	YES	YES	YES	YES	YES	YES
Treated x Far-away period dummies	YES	YES	YES	YES	YES	YES
Foreign dummy in interactions	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	334,980	329,436	304,092	307,301	328,871	309,317
Number of unique firms	25,417	25,491	24,921	25,130	25,482	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. German-speaking, UK & the Netherlands and Mediterranean are indicators for a closing plant with owners from specific country groups. German-speaking refers to Germany, Austria and Switzerland, Mediterranean refers to Italy, Greece and Cyprus. Owner group dummies are also interacted with all other indicators. Fixed effects for firm (or 2-digit industry instead in column (6)), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

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Table B.18: Different characteristics of plant closures by country group

Case group by the owner:		German-speaking	UK & the Netherands	Mediterranean	Others
Number of cases		18	9	6	8
Industry share	Food & tobacco	0.22	0.44	0.33	0.13
	Machinery & equipment	0.28	0.11	0.17	0.13
	Paper & materials	0.11	0	0.17	0.38
	Textile & shoe	0.39	0.44	0.33	0.38
Average years of operation		12.2	13.7	11.5	11.8
Average years of operation as foreign		10	11.4	10	10
Share of cases where plant size compared to the employment within 10km < 15%		0.68	0.78	0.83	0.88
Share of cases where city size < 40,000		0.79	0.67	0.67	0.63
Share of cases with above median pre-closure unemployment rate		0.53	0.56	0.5	0.63

German-speaking group refers to owners from Germany, Austria and Switzerland. Mediterranean group refers to owners from Italy, Greece and Cyprus. Others refer to owners from Taiwan, the USA and multinationals without a clear source country. The employment within 10 km agglomeration is calculated one year before the plant closure and excludes the closing plant. City size and pre-closure unemployment rate also refer to data one year before the plant closure.

Table B.19: Comparing OLS and Poisson estimates by size groups for the aggregation

	(1)	(2)	(3)	(4)
Sample	All firms	Firms existing before the closure		
Dep. var.:	Log employment			Employment
Regression:	OLS			Poisson
Treated x After(1-3)	-0.031***	-0.032**	-0.027***	-0.052**
	(0.012)	(0.012)	(0.010)	(0.025)
Treated x After(1-3) x Size(20-100)	0.006	0.007	0.010	0.046
	(0.024)	(0.025)	(0.021)	(0.031)
Treated x After(1-3) x Size(100-)	0.100	0.101	0.077	0.123
	(0.067)	(0.068)	(0.059)	(0.077)
Treated x After(4-5)	-0.037**	-0.035*	-0.025*	-0.016
	(0.018)	(0.020)	(0.015)	(0.028)
Treated x After(4-5) x Size(20-100)	-0.040	-0.045	0.000	0.003
	(0.041)	(0.043)	(0.034)	(0.041)
Treated x After(4-5) x Size(100-)	0.041	0.035	0.008	0.119
	(0.101)	(0.103)	(0.093)	(0.114)
Treated, time period and case group dummies, also in interactions	YES	YES	YES	YES
Case and year FE	YES	YES	YES	YES
Firm FE	YES	YES	NO	NO
Observations	372,121	276,514	276,514	276,514
Number of unique firms	27,787	15,090		

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. In columns (2)-(4) only firms already existing before the plant closure are included. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Size(20-100) refers to firms with 20-100 employees two years before the closure, Size(100-) refers to firms with more than 100 employees. Size group dummies are also interacted with all other indicators. Fixed effects for firm in column (1)-(2), case and calendar year are also included. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(3) standard errors are clustered by city, in cloumn (4) I show robust standard errors. *** p<0.01 ** p<0.05 * p<0.1.

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Table B.20: Baseline estimates, controlling for pre-trend differences

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated	0.019	-0.036	-0.021	0.012	-0.011	0.002
	(0.074)	(0.035)	(0.036)	(0.014)	(0.024)	(0.002)
Treated x Trend	-0.009*	-0.007**	-0.001	-0.001	0.000	0.001**
	(0.005)	(0.003)	(0.003)	(0.002)	(0.002)	(0.001)
Treated x After	-0.032**	-0.004	-0.011	-0.007	-0.009*	0.001
	(0.016)	(0.010)	(0.012)	(0.007)	(0.005)	(0.004)
Treated x Trend x After	0.001	-0.002	-0.001	0.001	0.002	-0.002*
	(0.008)	(0.005)	(0.004)	(0.003)	(0.003)	(0.001)
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	215,248	213,011	196,210	200,808	211,906	201,259
Number of unique firms	21,687	21,685	21,044	21,402	21,692	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Observations are included only in the period [t-6,t+5], where t denotes the year of the plant closure.Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. After indicates the period [t+1,t+5]. The baseline time period is [t-6,t]. Trend is a simple time trend. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

Table B.21: Heterogeneous estimates by industry group, controlling for pre-trend differences

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	log sales	log empl	log labor productivity	log per capita wage	log TFP	exit
Treated x After	-0.031	0.006	-0.003	-0.007	-0.012	0.003
	(0.024)	(0.015)	(0.016)	(0.008)	(0.009)	(0.004)
Treated x After x Trend	0.001	-0.002	-0.001	0.001	0.002	-0.002*
	(0.008)	(0.005)	(0.004)	(0.003)	(0.003)	(0.001)
Treated x After x LocalServices	-0.070	-0.049*	-0.047*	-0.002	0.001	-0.007
	(0.043)	(0.026)	(0.025)	(0.015)	(0.016)	(0.006)
Treated x After x Competitor	0.093	0.148	-0.050	-0.034	0.020	-0.029*
	(0.131)	(0.105)	(0.062)	(0.038)	(0.069)	(0.015)
Treated x After x Supplier	-0.068	-0.098*	0.006	-0.001	-0.017	0.001
	(0.054)	(0.055)	(0.027)	(0.024)	(0.021)	(0.006)
Treated x After x Buyer	0.062	0.038	0.060*	-0.024	0.049**	0.004
	(0.085)	(0.053)	(0.036)	(0.023)	(0.025)	(0.008)
Treated x After x Trend	-0.070**	-0.037	-0.011	-0.014	0.002	0.001
	(0.035)	(0.027)	(0.018)	(0.012)	(0.013)	(0.004)
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	215,248	213,011	196,210	200,808	211,906	201,259
Number of unique firms	21,687	21,685	21,044	21,402	21,692	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Observations are included only in the period [t-6,t+5], where t denotes the year of the plant closure. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. After indicates the period [t+1,t+5]. The baseline time period is [t-6,t]. Trend is a simple time trend. LocalServices indicates firms providing local services. Buyer and Supplier indicate firms operating in the buyer or supplier industries of the closing plant. Competitor indicates firms operating in the same industry as the closing plant. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

Table B.22: Baseline estimates, excluding EU accession and crisis years

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated	0.027	0.014	0.009	0.010	-0.002	-0.001
	(0.024)	(0.012)	(0.011)	(0.008)	(0.007)	(0.002)
Treated x After(1-3)	-0.047*	-0.033**	-0.010	-0.010	-0.001	0.005
	(0.025)	(0.015)	(0.016)	(0.007)	(0.009)	(0.003)
Treated x After(4-5)	-0.081**	-0.064***	-0.019	-0.007	0.007	0.003
	(0.033)	(0.023)	(0.017)	(0.011)	(0.011)	(0.004)
Time period dummies	YES	YES	YES	YES	YES	YES
Treated x Far-away period dummies	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	165,076	162,410	149,905	151,236	162,501	152,682
Number of unique firms	13,682	13,721	13,410	13,523	13,714	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. I exclude those cases where the plant closure occured during the crisis (2008-2009) or around the EU accessior (2003-2004). Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

Table B.23: Heterogeneous estimates by industry group, excluding EU accession and crisis years

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	log sales	log empl	log labor productivity	log per capita wage	log TFP	exit
Treated x After(1-3)	-0.028	0.005	-0.002	-0.010	0.005	0.002
	(0.026)	(0.018)	(0.014)	(0.010)	(0.010)	(0.004)
Treated x After(1-3) x LocalServices	-0.016	-0.059*	-0.044	0.005	-0.004	0.001
	(0.037)	(0.031)	(0.029)	(0.016)	(0.013)	(0.008)
Treated x After(1-3) x Competitor	0.056	0.092	-0.086	-0.060	-0.020	-0.007
	(0.134)	(0.109)	(0.068)	(0.058)	(0.046)	(0.021)
Treated x After(1-3) x Supplier	-0.089	-0.173***	0.068***	0.033	-0.026	0.001
	(0.064)	(0.043)	(0.024)	(0.026)	(0.027)	(0.009)
Treated x After(1-3) x Buyer	-0.068	0.021	-0.101**	-0.025	-0.057*	0.005
	(0.108)	(0.068)	(0.043)	(0.022)	(0.031)	(0.012)
Treated x After(4-5)	-0.052	-0.021	-0.023	-0.008	0.012	0.003
	(0.034)	(0.031)	(0.018)	(0.013)	(0.017)	(0.005)
Treated x After(4-5) x LocalServices	-0.026	-0.079**	-0.042	0.023	-0.016	-0.009
	(0.065)	(0.035)	(0.034)	(0.024)	(0.018)	(0.010)
Treated x After(4-5) x Competitor	-0.074	0.048	0.005	0.038	-0.042	0.030
	(0.171)	(0.120)	(0.067)	(0.078)	(0.091)	(0.027)
Treated x After(4-5) x Supplier	-0.182***	-0.210***	0.045	0.017	-0.023	0.015
	(0.069)	(0.055)	(0.040)	(0.031)	(0.025)	(0.011)
Treated x After(4-5) x Buyer	0.010	0.089	0.040	-0.066**	-0.021	-0.019
	(0.155)	(0.111)	(0.064)	(0.033)	(0.034)	(0.014)
Time period dummies	YES	YES	YES	YES	YES	YES
Treated x Far-away period dummies	YES	YES	YES	YES	YES	YES
Industry group dummies in interactions	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	165,076	162,410	149,905	151,236	162,501	152,682
Number of unique firms	13,682	13,721	13,410	13,523	13,714	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. I exclude those cases where the plant closure occured during the crisis (2008-2009) or around the EU accession (2003-2004). LocalServices indicates firms providing local services. Buyer and Supplier indicate firms operating in the buyer or supplier industries of the closing plant. Competitor indicates firms operating in the same industry as the closing plant. The other right-hand side variables are also interacted with the industry group dummies. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

Table B.24: Baseline estimates, excluding indebted plants

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated	0.007	0.002	0.004	-0.003	-0.003	-0.002
	(0.009)	(0.007)	(0.005)	(0.003)	(0.004)	(0.002)
Treated x After(1-3)	-0.070***	-0.041***	-0.006	-0.007	-0.002	0.003
	(0.023)	(0.012)	(0.010)	(0.005)	(0.007)	(0.002)
Treated x After(4-5)	-0.072**	-0.060***	-0.012	-0.009	0.007	0.004
	(0.030)	(0.020)	(0.015)	(0.009)	(0.011)	(0.003)
Time period dummies	YES	YES	YES	YES	YES	YES
Treated x Far-away period dummies	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	323,548	318,182	293,684	296,863	317,745	298,933
Number of unique firms	25,025	25,097	24,532	24,744	25,105	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. I exclude those cases where indebtedness played an important role in the closure. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

Table B.25: Heterogeneous estimates by industry group, excluding indebted plants

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated x After(1-3)	-0.067**	-0.031*	0.000	-0.004	-0.002	0.001
	(0.030)	(0.017)	(0.012)	(0.006)	(0.008)	(0.003)
Treated x After(1-3) x LocalServices	-0.023	-0.036	-0.012	-0.007	-0.002	0.000
	(0.029)	(0.022)	(0.021)	(0.011)	(0.010)	(0.006)
Treated x After(1-3) x Competitor	0.181	0.234**	-0.099	-0.038	-0.018	-0.031*
	(0.134)	(0.093)	(0.065)	(0.038)	(0.043)	(0.016)
Treated x After(1-3) x Supplier	-0.054	-0.072*	0.010	-0.001	-0.021	-0.005
	(0.044)	(0.042)	(0.027)	(0.019)	(0.015)	(0.007)
Treated x After(1-3) x Buyer	0.067	0.052	-0.024	0.009	0.016	0.010
	(0.069)	(0.043)	(0.035)	(0.017)	(0.019)	(0.008)
Treated x After(4-5)	-0.066*	-0.047	-0.011	-0.009	0.011	0.005
	(0.035)	(0.030)	(0.018)	(0.011)	(0.011)	(0.004)
Treated x After(4-5) x LocalServices	-0.017	-0.026	-0.031	0.029	-0.020	-0.010
	(0.048)	(0.032)	(0.031)	(0.022)	(0.014)	(0.008)
Treated x After(4-5) x Competitor	0.153	0.228**	-0.025	0.002	-0.018	-0.008
	(0.156)	(0.111)	(0.066)	(0.062)	(0.069)	(0.023)
Treated x After(4-5) x Supplier	-0.057	-0.110**	0.013	-0.013	-0.036**	0.004
	(0.061)	(0.054)	(0.034)	(0.032)	(0.017)	(0.009)
Treated x After(4-5) x Buyer	0.005	0.057	0.034	-0.043	0.021	-0.010
	(0.111)	(0.083)	(0.047)	(0.030)	(0.025)	(0.011)
Time period dummies	YES	YES	YES	YES	YES	YES
Treated x Far-away period dummies	YES	YES	YES	YES	YES	YES
Industry group dummies in interactions	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	NO
Case FE	YES	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO	YES
Firm-year-level characteristics	NO	NO	NO	NO	NO	YES
Number of observations	323,548	318,182	293,684	296,863	317,745	298,933
Number of unique firms	25,025	25,097	24,532	24,744	25,105	

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. I exclude those cases where indebtedness played an important role in the closure. LocalServices indicates firms providing local services. Buyer and Supplier indicate firms operating in the buyer or supplier industries of the closing plant. Competitor indicates firms operating in the same industry as the closing plant. The other right-hand side variables are also interacted with the industry group dummies. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6)), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

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Table B.26: Baseline estimates with multiple controls

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) exit
Treated	0.010	0.005	0.007	0.003	-0.000
	(0.008)	(0.007)	(0.004)	(0.004)	(0.001)
Treated x After(1-3)	-0.036**	-0.015	-0.016**	-0.005	0.001
	(0.016)	(0.009)	(0.008)	(0.005)	(0.002)
Treated x After(4-5)	-0.036	-0.021	-0.016	-0.010	0.003
	(0.023)	(0.018)	(0.012)	(0.008)	(0.002)
Time period dummies	YES	YES	YES	YES	YES
Treated x Far-away period dummies	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Case FE	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO
Firm-year-level characteristics	NO	NO	NO	NO	NO
Number of observations	1,052,303	1,034,647	955,048	964,780	969,656

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Multiple control cities are used, weighted by the inverse distance of the propensity score estimates from the treated propensity scores. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

Table B.27: Heterogeneous estimates by industry group with multiple controls

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) exit
Treated x After(1-3)	-0.024	-0.010	-0.006	-0.003	-0.002
	(0.018)	(0.014)	(0.010)	(0.005)	(0.002)
Treated x After(1-3) x LocalServices	-0.057**	-0.021	-0.026	-0.005	0.003
	(0.023)	(0.019)	(0.019)	(0.010)	(0.005)
Treated x After(1-3) x Competitor	0.159	0.161**	-0.064	-0.017	-0.019
	(0.104)	(0.077)	(0.061)	(0.029)	(0.014)
Treated x After(1-3) x Supplier	-0.024	-0.035	0.010	-0.006	0.000
	(0.033)	(0.035)	(0.021)	(0.014)	(0.005)
Treated x After(1-3) x Buyer	0.032	0.032	-0.012	0.017	0.006
	(0.050)	(0.039)	(0.032)	(0.017)	(0.007)
Treated x After(4-5)	-0.017	-0.012	-0.011	-0.007	0.003
	(0.025)	(0.021)	(0.015)	(0.010)	(0.003)
Treated x After(4-5) x LocalServices	-0.076*	-0.022	-0.024	0.004	-0.008
	(0.042)	(0.030)	(0.030)	(0.020)	(0.006)
Treated x After(4-5) x Competitor	0.133	0.144	0.028	-0.019	0.018
	(0.124)	(0.099)	(0.051)	(0.043)	(0.019)
Treated x After(4-5) x Supplier	-0.030	-0.069	0.007	-0.017	0.005
	(0.038)	(0.042)	(0.022)	(0.025)	(0.007)
Treated x After(4-5) x Buyer	-0.004	0.045	0.020	-0.014	-0.001
	(0.064)	(0.056)	(0.034)	(0.027)	(0.009)
Time period dummies	YES	YES	YES	YES	YES
Treated x Far-away period dummies	YES	YES	YES	YES	YES
Industry group dummies in interactions	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Case FE	YES	YES	YES	YES	YES
Calendar year FE	YES	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO	NO
Firm-year-level characteristics	NO	NO	NO	NO	NO
Number of observations	1,052,303	1,034,647	955,048	964,780	969,656

Sample: firms within a 10 km radius agglomeration, with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. Multiple control cities are used, weighted by the inverse distance of the propensity score estimates from the treated propensity scores. LocalServices indicates firms providing local services. Buyer and Supplier indicate firms operating in the buyer or supplier industries of the closing plant. Competitor indicates firms operating in the same industry as the closing plant. The other right-hand side variables are also interacted with the industry group dummies. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

Table B.28: Baseline estimates in the 10-20 km agglomeration

VARIABLES	(1) log sales	(2) log empl	(3) log labor productivity	(4) log per capita wage	(5) log TFP	(6) exit
Treated x After(1-3)	0.005	0.003	-0.004	-0.004	-0.003	-0.000
	(0.019)	(0.011)	(0.010)	(0.006)	(0.005)	(0.002)
Treated x After(4-5)	0.023	0.005	0.007	-0.001	-0.008	-0.003
	(0.024)	(0.015)	(0.013)	(0.008)	(0.007)	(0.003)
Number of observations	368,143	361,951	332,611	337,580	359,457	337,697
Number of unique firms	21,298	21,375	20,866	21,050	21,349	
Treated x After(1-3)	0.029	0.017	0.013	-0.003	0.005	-0.002
	(0.022)	(0.012)	(0.012)	(0.006)	(0.006)	(0.003)
Treated x After(4-5)	0.043	0.023	0.015	-0.007	0.000	-0.005
	(0.032)	(0.017)	(0.015)	(0.009)	(0.011)	(0.004)
Treated x After(1-3) x LocalServices	-0.037	-0.017	-0.017	-0.018	0.004	0.002
	(0.034)	(0.029)	(0.025)	(0.016)	(0.009)	(0.006)
Treated x After(1-3) x Competitor	-0.125	-0.126*	-0.030	0.035	-0.077**	-0.015
	(0.087)	(0.065)	(0.060)	(0.032)	(0.032)	(0.017)
Treated x After(1-3) x Supplier	-0.039	0.002	-0.052*	0.013	-0.033*	0.003
	(0.042)	(0.040)	(0.028)	(0.021)	(0.017)	(0.007)
Treated x After(1-3) x Buyer	-0.054	-0.042	0.031	-0.003	-0.003	0.013
	(0.057)	(0.049)	(0.042)	(0.022)	(0.018)	(0.009)
Treated x After(4-5) x LocalServices	-0.054	-0.051	0.006	-0.001	0.010	0.003
	(0.051)	(0.034)	(0.034)	(0.018)	(0.014)	(0.007)
Treated x After(4-5) x Competitor	0.030	-0.180	0.071	0.028	-0.060	-0.007
	(0.171)	(0.120)	(0.077)	(0.047)	(0.046)	(0.019)
Treated x After(4-5) x Supplier	-0.026	0.018	-0.050	0.023	-0.043	0.010
	(0.061)	(0.053)	(0.042)	(0.028)	(0.032)	(0.009)
Treated x After(4-5) x Buyer	-0.004	-0.024	0.050	0.019	0.001	-0.004
	(0.089)	(0.079)	(0.076)	(0.026)	(0.030)	(0.011)
Number of observations	368,143	361,951	332,611	337,580	359,457	337,697
Number of unique firms	21,298	21,375	20,866	21,050	21,349	

Sample: firms within a 10-20 km radius agglomeration (excluding the 10 km radius agglomeration), with a median level of employment of at least 5, excluding very large firms, firms with a closing plant and foreing-owned large firms in the control locations. LocalServices indicates firms providing local services. Buyer and Supplier indicate firms operating in the buyer or supplier industries of the closing plant. Competitor indicates firms operating in the same industry as the closing plant. The other right-hand side variables are also interacted with the industry group dummies. Treated is an indicator of firms being located in the 10 km agglomeration of the closing plant. I include four separate time period dummies: After(1-3), After(4-5) and two Far-away period dummies. The baseline time period is [t-6,t], where t denotes the year of the plant closure. Far-away periods refer to separate dummies for the period more than 6 years before and more than 5 years after the closure. After(1-3) denotes the period [t+1,t+3] and After(4-5) denotes the period [t+4,t+5]. I also include Far-away time period dummies interacted with the Treated dummy. Fixed effects for firm (or 2-digit industry instead in column (6), case and calendar year are also included. Firm-year-level characteristics include log employment, age, log capital/labor ratio, log per capita wage, log TFP and yearly exporter status. The unit of observation is firm-year-case. Standard errors are in parentheses. In columns (1)-(4) standard errors are clustered by city, in cloumn (5) I show bootstrap standard errors and in column (6) standard errors are clustered by firm. *** p<0.01 ** p<0.05 * p<0.1.

10.14754/CEU.2016.10

Appendix C

Appendix for Chapter 3

Figure C.1: Industry composition of all firms and importers by destination, separately for new importers

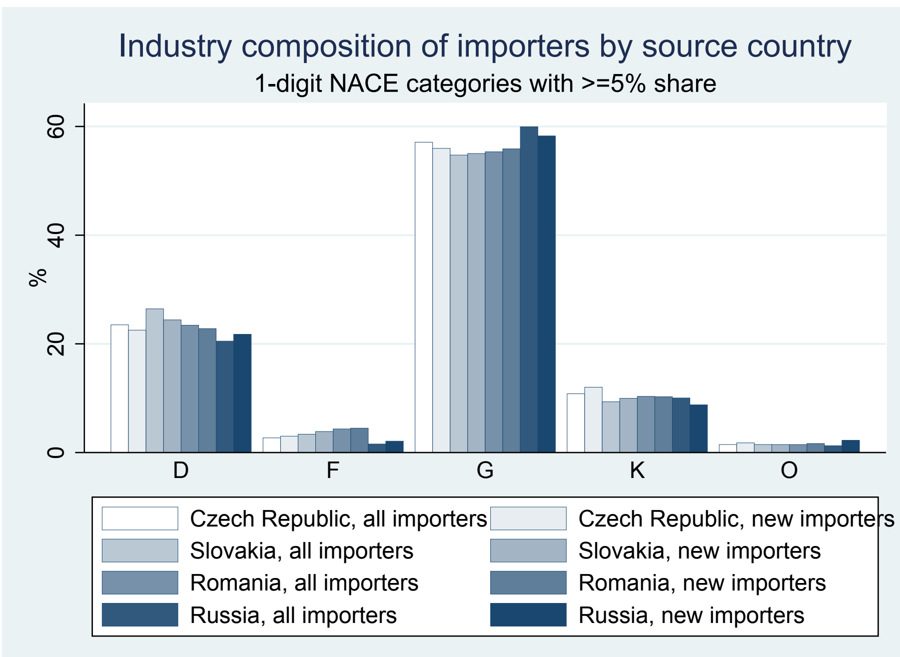

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Figure C.2: Industry composition of all firms and importers by destination, separately for new importers, manufacturing

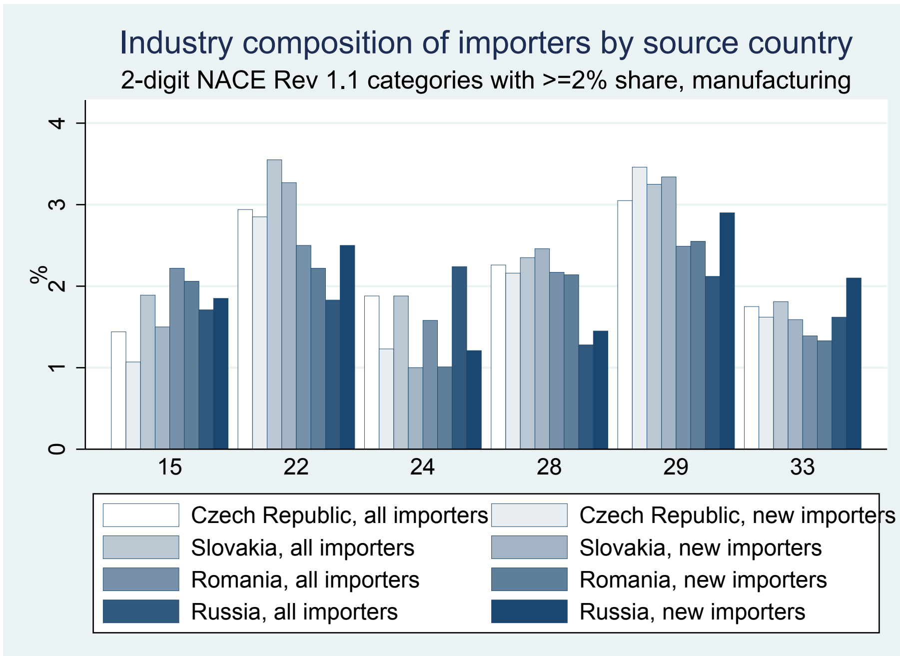

Figure C.3: Industry composition of all firms and importers by destination, separately for new importers, trade and business

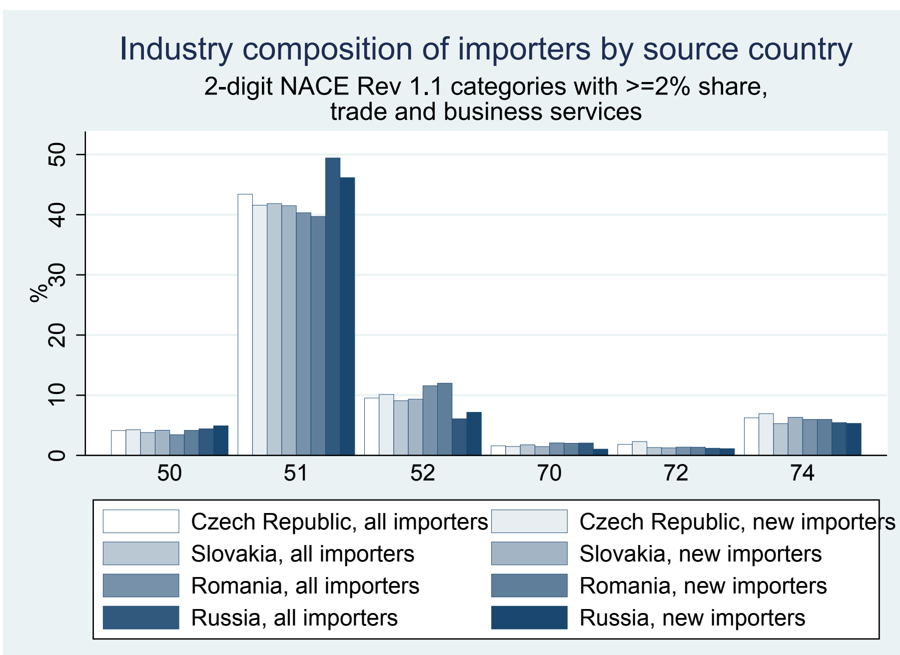

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Table C.1: Descriptive statistics, separately by the source country of importers

Sample: firms located in Budapest.

	All firms	All importers in 1994-2003 from				New importers in 1994-2003 from			
		Czech Republic	Slovakia	Romania	Russia	Czech Republic	Slovakia	Romania	Russia
Number of firms	212,859	5807	4534	3554	2010	4625	3411	2676	1349
Average age	5.4	8.1	8.2	8.0	8.3	5.6	5.6	5.9	5.9
Average employment	8.6	104	118	124	193	46	79	87	80
Average export share	0.04	0.12	0.12	0.15	0.21	0.12	0.12	0.14	0.20
Average log total factor productivity	2.85	2.48	2.47	2.43	2.43	2.51	2.53	2.41	2.53
Average labor productivity	2822	6754	5678	5200	6784	7012	6213	5457	7588
Share of foreign-owned	0.13	0.35	0.30	0.28	0.36	0.36	0.32	0.31	0.39
Share of state-owned	0.005	0.016	0.018	0.019	0.028	0.010	0.014	0.012	0.022
Distinct addresses	79,097	5403	4617	3689	2242	3534	2772	2248	1161
Number of import transactions by hs6		171,897	124,581	81,266	38,744				
- share of consumer goods (BEC 1, 6)		16%	12%	34%	8%				
- share of industrial supplies (BEC 2, 3)		39%	43%	44%	43%				
- share of capital goods (BEC 41, 51, 52)		15%	15%	9%	14%				
- share of parts and accessories (BEC 42, 53)		27%	28%	11%	34%				

Table C.2: The yearly number of firms and importers per country

year	Number of firms				
	total	already importing from			
		Slovakia	Czech Republic	Romania	Russia
1992	38,342			363	168
1993	50,982	758	753	563	509
1994	63,592	1,225	1,175	754	675
1995	74,516	1,599	1,642	956	822
1996	86,702	1,905	2,029	1,127	937
1997	99,858	2,185	2,489	1,381	1,025
1998	113,366	2,410	2,916	1,631	1137
1999	122,407	2,588	3,304	1786	1,231
2000	133,031	2,784	3,683	2,018	1,292
2001	142,433	2,955	3,948	2,211	1,338
2002	148,574	3,095	4,207	2,382	1,365
2003	153,941	3,311	4,506	2,620	1,386

Table C.3: The share of firms with different patterns of imports

	Share of firms importing	
	all imports	successful imports
from neither countries	95.02%	98.46%
only from the Czech Republic	1.26%	0.45%
only from Slovakia	0.79%	0.19%
only from Romania	0.83%	0.16%
only from Russia	0.40%	0.09%
only from the Czech Republic and Slovakia	0.61%	0.26%
only from the Czech Republic and Romania	0.18%	0.07%
only from the Czech Republic and Russia	0.09%	0.04%
only from Slovakia and Romania	0.11%	0.03%
only from Slovakia and Russia	0.05%	0.02%
only from Romania and Russia	0.05%	0.01%
from all countries but the Czech Republic	0.03%	0.01%
from all countries but Slovakia	0.04%	0.01%
from all countries but Romania	0.10%	0.04%
from all countries but Russia	0.25%	0.09%
from all countries	0.18%	0.06%

Successful imports: importing at least twice in a three-year long period

Table C.4: The share of imported value in different BEC categories, firms grouped by the highest value BEC group in total imports

BEC caterory in which the firm imports the most	Average share of BEC category in the total yearly imported value				Number of firms
	1, 6	2, 3	42, 53	41, 51, 52	
1, 6	0.95	0.03	0.01	0.01	2,743
2, 3	0.02	0.96	0.01	0.01	4,019
42, 53	0.01	0.04	0.91	0.04	1,382
41, 51, 52	0.03	0.03	0.04	0.90	1,699
All firms	0.28	0.43	0.14	0.16	8,679

BEC 1, 6: Food and beverage, consumer goods; BEC 2, 3: Industrial supplies, fuels and lubricants; BEC 41, 51, 52: Capital goods, transport equipment; BEC 42, 53: Parts and accessories.

Table C.5: The share of firms by the number of neighbors in the same and neighboring buildings

Number of peers (n)	Percent of firms in 2003 with n peers in		
	same building	neighbor building	cross-street building
0	22	31	50
1	13	14	12
2	9	8	7
3	7	6	5
4	6	5	4
5	5	4	3
6	5	4	3
7	4	3	2
8	3	3	2
9	3	3	2
10	2	2	1
more	19	16	10
Average number of peers	8.4	5.2	3.3

Table C.6: The share of observations with different patterns of experienced neighbors, and the share of importers within each category

Time period: 1994-2003	Share of firm-year-country observations by neighbor categories		Share of observations in the neighbor category where the firm imports from the country	
	country-specific experience	experience about any of the four countries	country-specific experience	experience about any of the four countries
no neighbors	76.43%	58.06%	1.21%	1.09%
only export experience	6.01%	6.57%	2.16%	1.87%
only import experience	5.72%	5.79%	3.96%	2.37%
only owned from country	1.94%	4.02%	1.26%	1.09%
export and import, but no ownership	7.04%	13.91%	5.61%	3.90%
export and ownership, but no import	0.80%	2.00%	1.49%	1.19%
import and ownership, but no export	0.52%	1.71%	2.24%	1.77%
all three experience types	1.54%	7.94%	5.20%	3.34%
only geographic neighbors	19.14%	33.14%	2.81%	2.11%
only person-connected neighbors	0.47%	0.56%	9.40%	5.27%
only ownership-connected neighbors	2.31%	3.45%	5.91%	4.16%
geographic and person-connected neighbors, but no ownership-connected	0.19%	0.49%	11.90%	7.02%
geographic and ownership-connected neighbors, but no person-connected	1.28%	3.77%	8.67%	5.65%
person-connected and ownership-connected neighbors, but no geographic	0.11%	0.24%	15.69%	8.32%
all three types of connections	0.07%	0.30%	14.49%	8.86%

Table C.7: The share of importers by the number of peers and importing peers in the same building, looking at some percentiles

Number of neighbors in same building	Share of importers	Number of observations
all neighbors		
0 (=p25)	1.40%	1,287,236
2 (=p50)	1.58%	506,844
6 (=p75)	1.71%	209,608
12 (=p90)	2.32%	70,356
importer neighbors		
0 (=p90)	1.41%	4,473,618
1 (=p95)	4.40%	267,858
2 (=p99)	6.79%	58,037

Unit of observation: firm-country-year

Table C.8: The share of importers from a given destination with or without having neighbors with country-specific experience

Share of firms which start to import	Firm has neighbors with import experience in the same building		Firm has neighbors with import experience in neighboring building (+/-2)	
	only from country C	from any other country but C	only from country C	from any other country but C
only from country C	47.54%	18.33%	35.95%	21.90%
from any other country but C	52.46%	51.47%	64.05%	78.10%

Share of firms which start to import	Firm has neighbors with import experience in person-connected firms		Firm has neighbors with import experience in ownership-connected firms	
	only from country C	from any other country but C	only from country C	from any other country but C
only from country C	42.11%	19.83%	57.50%	14.95%
from any other country but C	57.89%	80.17%	42.50%	85.05%

Weighted average across the four countries, with the number of observations in a country as weights. Sample: firms starting to import from at least one of the countries and having at least one neighbor of the given type with import experience.

Table C.9: The effect of peers with country-specific experience on the probability of starting to import from the same country, by the observed firm's and the peer's industry

Sample: not yet importers until the previous year
Dependent variable: importer

	Grouped by industry of the	
	firm	neighbor
	(1)	(2)
Cross-street importer neighbor x Industry A-C	0.00216	0.000240
	(0.00447)	(0.00268)
Cross-street importer neighbor x Industry D	0.000788	0.00132**
	(0.00122)	(0.000639)
Cross-street importer neighbor x Industry E-F	0.000803	0.00143
	(0.00107)	(0.00121)
Cross-street importer neighbor x Industry G	0.00181**	0.000379
	(0.000842)	(0.000509)
Cross-street importer neighbor x Industry H-I	0.000620	-0.00203
	(0.00104)	(0.00139)
Cross-street importer neighbor x Industry J-K	0.000423	-0.000631
	(0.000358)	(0.000753)
Cross-street importer neighbor x Industry L-Q	0.000497	-0.000743
	(0.000495)	(0.00186)
Neighbor-building importer neighbor x Industry A-C	0.00782*	0.00468
	(0.00473)	(0.00439)
Neighbor-building importer neighbor x Industry D	0.00385***	0.00119*
	(0.00107)	(0.000610)
Neighbor-building importer neighbor x Industry E-F	0.000333	0.00175
	(0.000782)	(0.00125)
Neighbor-building importer neighbor x Industry G	0.00179**	0.00138***
	(0.000720)	(0.000469)
Neighbor-building importer neighbor x Industry H-I	0.00119	0.000271
	(0.000783)	(0.000901)
Neighbor-building importer neighbor x Industry J-K	0.000199	0.000792
	(0.000301)	(0.000623)
Neighbor-building importer neighbor x Industry L-Q	-0.000193	0.000877
	(0.000396)	(0.00141)
Same-building importer neighbor x Industry A-C	-0.00203	0.000240
	(0.00284)	(0.00198)
Same-building importer neighbor x Industry D	0.00515***	0.00296***
	(0.00117)	(0.000686)
Same-building importer neighbor x Industry E-F	0.00158	0.00261**
	(0.00105)	(0.00132)
Same-building importer neighbor x Industry G	0.00605***	0.00236***
	(0.000864)	(0.000513)
Same-building importer neighbor x Industry H-I	0.00202**	-1.62e-05
	(0.000978)	(0.00108)
Same-building importer neighbor x Industry J-K	0.000987***	0.00224***
	(0.000364)	(0.000698)

...

Table C.10: The effect of peers with country-specific experience on the probability of starting to import from the same country, by the observed firm's and the peer's industry - cont.

Sample: not yet importers until the previous year Dependent variable: importer	Grouped by industry of the firm (1)	 neighbor (2)
...		
Same-building importer neighbor x Industry L-Q	0.000966* (0.000544)	0.00144 (0.00144)
Person-connected importer neighbor x Industry A-C	-0.00473*** (0.00180)	-0.00938 (0.00579)
Person-connected importer neighbor x Industry D	0.00379 (0.00490)	0.000500 (0.00234)
Person-connected importer neighbor x Industry E-F	0.00392 (0.00453)	-0.00180 (0.00126)
Person-connected importer neighbor x Industry G	-0.000500 (0.00331)	0.00368 (0.00261)
Person-connected importer neighbor x Industry H-I	-0.00627** (0.00314)	-0.00511 (0.00340)
Person-connected importer neighbor x Industry J-K	-0.00214 (0.00149)	-0.00280 (0.00171)
Person-connected importer neighbor x Industry L-Q	-0.00187 (0.00339)	0.00821 (0.0120)
Owner-connected importer neighbor x Industry A-C	0.00674 (0.00496)	-0.00171 (0.00208)
Owner-connected importer neighbor x Industry D	0.00950*** (0.00200)	0.00198* (0.00108)
Owner-connected importer neighbor x Industry E-F	0.00428* (0.00225)	0.000895 (0.00182)
Owner-connected importer neighbor x Industry G	0.0101*** (0.00145)	0.00437*** (0.000986)
Owner-connected importer neighbor x Industry H-I	0.00387** (0.00196)	0.00366* (0.00196)
Owner-connected importer neighbor x Industry J-K	0.000246 (0.000850)	0.00150 (0.00121)
Owner-connected importer neighbor x Industry L-Q	-0.000287 (0.00172)	0.00309 (0.00228)
Firm-year FE	YES	YES
Country-year FE	YES	YES
Nr. of observations	3,778,517	3,778,517

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific import experience in the previous year. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. Industry X dummy in the interaction terms refers to the observed firm operating in industry X in column (1) and having a peer from the specific industry in column (2). All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

Table C.11: The effect of high-productivity peers by the productivity of the firm, using below and above median productivity groups

Sample: not yet importers until the previous year with data on productivity
Dependent variable: Importer

	(1)	(2)	(3)	(4)
Cross-street importer neighbor	0.000528	-0.00113**	0.000258	-0.000763
	(0.000503)	(0.000573)	(0.000623)	(0.000773)
Neighbor-building importer neighbor	0.000977**	0.000131	-0.000176	-0.000502
	(0.000412)	(0.000467)	(0.000499)	(0.000585)
Same-building importer neighbor	0.00394***	0.00130**	0.00166***	0.000711
	(0.000500)	(0.000540)	(0.000584)	(0.000664)
Person-connected importer neighbor	0.000938	-0.00343	0.000359	-0.00271
	(0.00170)	(0.00226)	(0.00210)	(0.00293)
Owner-connected importer neighbor	0.00829***	0.00538***	0.00826***	0.00740***
	(0.000918)	(0.00117)	(0.00130)	(0.00170)
Cross-street importer neighbor X		0.00299***		0.00185
High-productivity firm		(0.000972)		(0.00128)
Neighbor-building importer neighbor X		0.00152*		0.000595
High-productivity firm		(0.000791)		(0.000989)
Same-building importer neighbor X		0.00445***		0.00168
High-productivity firm		(0.000901)		(0.00107)
Person-connected importer neighbor X		0.00761**		0.00552
High-productivity firm		(0.00346)		(0.00443)
Owner-connected importer neighbor X		0.00484***		0.00153
High-productivity firm		(0.00175)		(0.00252)
High-productivity cross-street importer			0.000448	-0.000746
neighbor			(0.000955)	(0.00118)
High-productivity neighbor-building			0.00234***	0.00139
importer neighbor			(0.000774)	(0.000921)
High-productivity same-building importer			0.00422***	0.00119
neighbor			(0.000856)	(0.000992)
High-productivity person-connected			0.00151	-0.00197
importer neighbor			(0.00323)	(0.00413)
High-productivity owner-connected			3.26e-05	-0.00405*
importer neighbor			(0.00169)	(0.00216)
High-productivity cross-street importer				0.00212
neighbor X High-productivity firm				(0.00199)
High-productivity neighbor-building				0.00166
importer neighbor X High-productivity				(0.00148)
High-productivity same-building importer				0.00476***
neighbor X High-productivity firm				(0.00151)
High-productivity person-connected				0.00540
importer neighbor X High-productivity				(0.00640)
High-productivity owner-connected				0.00624*
importer neighbor X High-productivity				(0.00328)
Firm-year FE	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES
Observations	1,715,142	1,715,142	1,715,142	1,715,142

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year and the firm has productivity data. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific import experience in the previous year, separately for high-productivity neighbors and also interacted with high-productivity firm dummies. High-productivity firms are the ones above the median TFP of the given 2-digit industry. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

Table C.12: The effect of high-productivity peers by the productivity of the firm, using productivity quartiles

Sample: not yet importers until the previous year with data on productivity
Dependent variable: importer

	Having a peer with productivity in				Having a peer with productivity in			
	any range	2nd quartile	3rd quartile	4th quartile	any range	2nd quartile	3rd quartile	4th quartile
Peer group: cross-street building					Peer group: person-connected firms			
Productivity of the firm in								
any range	-0.00178	-9.15e-05	0.00100	-0.00138	0.00234	0.00800	0.00162	-0.0116**
	(0.00111)	(0.00207)	(0.00179)	(0.00152)	(0.00300)	(0.0119)	(0.00467)	(0.00592)
2nd quartile	0.00306*	-0.00337	-0.00343	-0.000618	-0.0118**	-0.00304	-0.00254	0.0191***
	(0.00160)	(0.00283)	(0.00232)	(0.00258)	(0.00533)	(0.0176)	(0.0143)	(0.00722)
3rd quartile	0.00282	-0.00352	0.000531	0.000693	0.00760	-0.0257	-0.0115	0.0134
	(0.00187)	(0.00308)	(0.00294)	(0.00297)	(0.00582)	(0.0163)	(0.0103)	(0.0120)
4th quartile	0.00434**	-0.00325	3.90e-05	0.00325	-0.00466	0.00147	0.0117	0.0164**
	(0.00190)	(0.00342)	(0.00317)	(0.00293)	(0.00509)	(0.0157)	(0.0100)	(0.00827)
Peer group:neighbor building					Peer group: owner-connected firms			
Productivity of the firm in								
any range	-0.000306	-0.00147	-0.000168	0.00179	0.00662***	-0.00366	-0.00548*	-0.00552*
	(0.000864)	(0.00179)	(0.00158)	(0.00148)	(0.00245)	(0.00466)	(0.00303)	(0.00300)
2nd quartile	0.000483	0.00156	0.00208	-0.00268	0.00308	-0.00155	0.00215	0.00265
	(0.00124)	(0.00223)	(0.00249)	(0.00204)	(0.00376)	(0.00554)	(0.00453)	(0.00496)
3rd quartile	0.000614	-0.000284	0.000815	0.000755	-0.000789	0.00574	0.00928*	0.0136**
	(0.00157)	(0.00283)	(0.00259)	(0.00254)	(0.00383)	(0.00648)	(0.00515)	(0.00536)
4th quartile	-0.000450	0.00283	0.00607**	0.00302	0.00434	-0.000423	0.00260	0.00862*
	(0.00155)	(0.00314)	(0.00288)	(0.00264)	(0.00361)	(0.00569)	(0.00480)	(0.00452)
Peer group: same building								
Productivity of the firm in								
any range	0.000101	0.00212	0.000470	-0.000205				
	(0.000981)	(0.00203)	(0.00154)	(0.00175)				
2nd quartile	0.000275	-0.00140	0.000444	0.00487**				
	(0.00144)	(0.00251)	(0.00226)	(0.00236)				
3rd quartile	0.00119	-0.00349	0.000276	0.00696***				
	(0.00155)	(0.00304)	(0.00244)	(0.00253)				
4th quartile	0.00324*	0.00125	0.00362	0.00800***				
	(0.00181)	(0.00325)	(0.00259)	(0.00275)				
Firm-year FE	YES							
Country-year FE	YES							
Observations	1,715,142							

The table shows the coefficient estimates of a single regression. Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year and the firm has productivity data. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors in a specific productivity quartile with country-specific import experience in the previous year, also interacted by productivity quartile dummies of the firm. Firms in the lowest productivity quartile having neighbors in the lowest productivity quartile form the baseline. Quartiles of TFP estimates by 2-digit industry are used for productivity. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

Table C.13: The effect of peers with country-specific experience on the probability of starting to import from the same country, by the type of the good the peer imported

Sample: not yet importers until the previous year Dependent variable: Importer	(1)
Cross-street importer neighbor	-0.000320 (0.000634)
Cross-street importer neighbor importing differentiated good	0.000478 (0.000632)
Cross-street importer neighbor importing reference-priced good	0.000879 (0.000582)
Neighbor-building importer neighbor	-0.000296 (0.000695)
Neighbor-building importer neighbor importing differentiated good	0.000633 (0.000700)
Neighbor-building importer neighbor importing reference-priced good	0.000631 (0.000486)
Same-building importer neighbor	-0.000263 (0.000607)
Same-building importer neighbor importing differentiated good	0.00230*** (0.000598)
Same-building importer neighbor importing reference-priced good	0.00190*** (0.000579)
Person-connected importer neighbor	0.000421 (0.00161)
Person-connected importer neighbor importing differentiated good	0.000723 (0.00163)
Person-connected importer neighbor importing reference-priced good	-0.000327 (0.00160)
Owner-connected importer neighbor	0.00361*** (0.00106)
Owner-connected importer neighbor importing differentiated good	0.00179* (0.00102)
Owner-connected importer neighbor importing reference-priced good	-9.03e-05 (0.000878)
Neighbors with export and owner experience	YES
Firm-year FE	YES
Country-year FE	YES
Observations	3,778,517

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific experience in the previous year. An importer neighbor refers to a peer with country-specific import experience. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. Separate indicators are included for experienced neighbors importing differentiated or reference-priced goods. Goods are categorized following the classification of Rauch. Controls for neighbors with country-specific export or ownership experience are also included. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

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Table C.14: The effect of neighbors with country-specific experience on the probability of starting to import a certain type of product from the same country conditional on importing from all four countries for the first time, separately for neighbors importing the same product type

Sample: first ever importers
Dependent variable: Importer

	(1)
Cross-street importer neighbor	-0.0714**
	(0.0359)
Cross-street same-product importer neighbor	0.0183
	(0.0345)
Neighbor-building importer neighbor	-0.00478
	(0.0326)
Neighbor-building same-product importer neighbor	0.0879***
	(0.0284)
Same-building importer neighbor	-0.0560***
	(0.0187)
Same-building same-product importer neighbor	0.161***
	(0.0185)
Person-connected importer neighbor	-0.101*
	(0.0594)
Person-connected same-product importer neighbor	0.340***
	(0.0574)
Owner-connected importer neighbor	-0.149***
	(0.0401)
Owner-connected same-product importer neighbor	0.416***
	(0.0259)
Firm-year FE	YES
Country-year FE	YES
Observations	3,821,755

Sample: firms with all four countries in the year the firm started to import from the first of the four countries. The unit of observation is firm-country-year-product category. Using the BEC classification 4 product categories are created: consumer goods (BEC 1, 6), industrial supplies (BEC 2, 3), capital goods (BEC 41,51, 52) and parts and accessories (BEC 42 and 53). The dependent variable is an indicator for the firm importing the given product type from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific import experience in the previous year. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. Separate indicator variables are included for experienced neighbors importing a good in the regarded product category. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

Table C.15: The effect of peers with country-specific experience on the probability of starting to import from the same country, looking at successful entry and the effect of successful peers separately

Sample: not yet importers until the previous year

Dependent variable:	Imports in t			Imports twice in [t,t+2]		
	(1)	(2)	(3)	(4)	(5)	(6)
Cross-street importer neighbor	0.000316 (0.000244)	0.000124 (0.000251)		0.000131 (0.000194)	0.000114 (0.000202)	
Neighbor-building importer neighbor	0.000392* (0.000204)	0.000222 (0.000209)		0.000104 (0.000147)	7.11e-05 (0.000152)	
Same-building importer neighbor	0.00214*** (0.000259)	0.00173*** (0.000263)		0.000743*** (0.000198)	0.000491** (0.000197)	
Person-connected importer neighbor	0.000996 (0.000920)	0.000896 (0.000930)		-0.000215 (0.000698)	-0.000189 (0.000703)	
Owner-connected importer neighbor	0.00511*** (0.000492)	0.00438*** (0.000499)		0.00196*** (0.000369)	0.00143*** (0.000356)	
Cross-street successful importer neighbor		0.000932* (0.000520)	0.00104** (0.000510)		-1.26e-05 (0.000371)	5.55e-05 (0.000358)
Neighbor-building successful importer neighbor		0.00103* (0.000524)	0.00121** (0.000508)		0.000142 (0.000340)	0.000194 (0.000329)
Same-building successful importer neighbor		0.00244*** (0.000533)	0.00341*** (0.000521)		0.00146*** (0.000448)	0.00174*** (0.000440)
Person-connected successful importer neighbor		6.43e-05 (0.00281)	0.000684 (0.00277)		-0.00130 (0.00178)	-0.00135 (0.00179)
Owner-connected successful importer neighbor		0.00439*** (0.00111)	0.00695*** (0.00109)		0.00313*** (0.000946)	0.00399*** (0.000943)
Neighbors with export and owner experience	YES	YES	YES	YES	YES	YES
Firm-year FE	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES
Observations	3,778,517	3,778,517	3,778,517	3,051,413	3,051,413	3,051,413
Baseline hazard	0.0025	0.0025	0.0025	0.001	0.001	0.001

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. The unit of observation is firm-country-year. The dependent variable in columns (1)-(3) is an indicator for starting to import in the given year. The dependent variable in columns (4)-(6) is an indicator for starting to import successfully, i.e. the variable is 1 if the firm imports from the country at least twice in the period [t,t+3] where t is the current year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific experience in the previous year. An importer neighbor refers to a peer with country-specific import experience. A successful importer neighbor refers to a peer importing from the country at least twice in the period [t-2,t]. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. Controls for neighbors with country-specific export or ownership experience are also included. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building. Baseline hazard refers to the share of importers (columns (1)-(3)) or successful importers (columns (4)-(6)) in the estimation sample.

Table C.16: The effect of the length of peer experience on the probability of starting to import from the same country

Sample: not yet importers until the previous year
Dependent variable: Importer

Specification:	Total number of years	Number of recent years
	(1)	(2)
Cross-street importer neighbor	0.000115	2.68e-05
	(0.000268)	(0.000275)
Neighbor-building importer neighbor	0.000242	0.000171
	(0.000213)	(0.000216)
Same-building importer neighbor	0.00171***	0.00140***
	(0.000272)	(0.000269)
Person-connected importer neighbor	0.00116	0.00115
	(0.000990)	(0.000956)
Owner-connected importer neighbor	0.00471***	0.00437***
	(0.000511)	(0.000506)
Longest additional import experience of cross-street importer neighbors	0.000178	0.000188
	(0.000156)	(0.000139)
Longest additional import experience of neighbor-building importer neighbors	0.000236*	0.000225**
	(0.000121)	(0.000106)
Longest additional import experience of same-building importer neighbors	0.000612***	0.000687***
	(0.000141)	(0.000118)
Longest additional import experience of person-connected importer neighbors	0.000132	0.000139
	(0.000349)	(0.000273)
Longest additional import experience of owner-connected importer neighbors	0.000693***	0.000807***
	(0.000228)	(0.000204)
Firm-year FE	YES	YES
Country-year FE	YES	YES
Observations	3,778,517	3,778,517

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific import experience in the previous year, and the length of additional import experience in number of years. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. Length of the peers' import experience is measured in column (1) using all years when the peer imported from the country. Column (2) uses only recent countinuous experience, allowing for single-year gaps in the import history of the peers, but counting only the number of years with actual import. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

Table C.17: The effect of the number of peers with country-specific experience on the probability of starting to import from the same country

Sample: not yet importers until the previous year
Dependent variable: Importer

	(1)	(2)	(3)	(4)
Cross-street importer neighbor	0.000280	0.000289		0.000273
	(0.000253)	(0.000252)		(0.000247)
Neighbor-building importer neighbor	0.000253	0.000264		0.000315
	(0.000201)	(0.000200)		(0.000198)
Same-building importer neighbor	0.00172***	0.00175***		0.00178***
	(0.000253)	(0.000253)		(0.000245)
Person-connected importer neighbor	0.00125	0.00127		0.00126
	(0.000916)	(0.000916)		(0.000914)
Owner-connected importer neighbor	0.00508***	0.00508***		0.00525***
	(0.000501)	(0.000501)		(0.000493)
2 cross-street importer neighbors	-0.000102	-0.000327		
	(0.000587)	(0.000593)		
2 neighbor-building importer neighbors	0.00173***	0.00141**		
	(0.000657)	(0.000712)		
2 same-building importer neighbors	0.00343***	0.00189***		
	(0.000653)	(0.000603)		
2 person-connected importer neighbors	0.00105	0.000535		
	(0.00225)	(0.00242)		
2 owner-connected importer neighbors	0.00207*	0.00144		
	(0.00113)	(0.00117)		
3 cross-street importer neighbors		0.000457		
		(0.00118)		
3 neighbor-building importer neighbors		0.00259**		
		(0.00116)		
3 same-building importer neighbors		0.00726***		
		(0.00130)		
3 person-connected importer neighbors		0.00570		
		(0.00586)		
3 owner-connected importer neighbors		0.00376**		
		(0.00175)		
Number of cross-street importer neighbors			0.000143	-6.05e-05
			(0.000174)	(0.000289)
Number of neighbor-building importer neighbors			0.000525***	0.000942***
			(0.000166)	(0.000359)
Number of same-building importer neighbors			0.00201***	0.00215***
			(0.000273)	(0.000481)
Number of person-connected importer neighbors			0.00139*	0.00127
			(0.000779)	(0.00159)
Number of owner-connected importer neighbors			0.000282***	9.65e-05
			(8.08e-05)	(7.71e-05)
Firm-year FE	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES
Observations	3,778,517	3,778,517	3,778,517	3,778,517

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. The first set of right-hand side variables are indicators for the firm having different types of neighbors with country-specific import experience in the previous year. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. Columns (1) and (2) include additional indicators for having at least 2 (in column (1)) or exactly 2 and at least 3 (in column (2)) experienced peers. Column (3) and (4) include measures of the number of experienced peers, which is the total number per group in column (3) and the number of experienced peers above 1 in column (4). All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

Table C.18: The effect of peers with country-specific experience on the probability of starting to import from the same country, robustness checks

Sample: not yet importers until the previous year
Dependent variable: Importer

	Baseline	Linked firms not excluded	No owner from the 4 countries
	(1)	(2)	(3)
Cross-street exporter neighbor	-0.000173	-0.000257	-0.000161
	(0.000230)	(0.000254)	(0.000234)
Neighbor-building exporter neighbor	0.000340*	0.000707***	0.000327
	(0.000204)	(0.000271)	(0.000206)
Same-building exporter neighbor	0.000254	0.000453	0.000218
	(0.000218)	(0.000288)	(0.000218)
Person-connected exporter neighbor	0.00244**	0.00353***	0.00230**
	(0.00101)	(0.00117)	(0.00101)
Owner-connected exporter neighbor	0.00134***		0.00125***
	(0.000403)		(0.000407)
Cross-street importer neighbor	0.000316	0.000254	0.000364
	(0.000244)	(0.000267)	(0.000248)
Neighbor-building importer neighbor	0.000392*	-0.000121	0.000394*
	(0.000204)	(0.000261)	(0.000208)
Same-building importer neighbor	0.00214***	0.00204***	0.00210***
	(0.000259)	(0.000362)	(0.000264)
Person-connected importer neighbor	0.000996	0.00482***	0.000921
	(0.000920)	(0.00129)	(0.000917)
Owner-connected importer neighbor	0.00511***		0.00508***
	(0.000492)		(0.000496)
Cross-street neighbor owned from the country	0.000221		0.000213
	(0.000289)		(0.000289)
Neighbor-building neighbor owned from the country	-0.000185		-0.000149
	(0.000201)		(0.000201)
Same-building neighbor owned from the country	0.000566**		0.000281
	(0.000261)		(0.000264)
Person-connected neighbor owned from the country	0.00159		0.000646
	(0.00214)		(0.00178)
Ownership-connected neighbor owned from the country	-0.000435		-0.00118
	(0.000693)		(0.000746)
Firm-year FE	YES	YES	YES
Country-year FE	YES	YES	YES
Nr. of observations	3,778,517	1,340,498	3,718,711

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. The unit of observation is firm-country-year. Column (1) shows the baseline specification. Column (2) doesn't control for country-specific experience of firms in the same ownership network, and doesn't exclude firms with ownership links from spatial and person-connected neighbors. Column (4) exclude those firms from the regression which have owers from any of the four countries. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific experience in the previous year. An exporter or importer neighbor refers to a peer with country-specific export or import experience. A neighbor owned from the country refers to a peer who ever had an owner from the given country. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

Table C.19: The effect of peers with country-specific experience on the probability of starting to import from the same country, using different definitions for people connecting firms

Sample: not yet importers until the previous year

Dependent variable: Importer	Connecting person definition		
	from signing right to owner	any connection	signing right in both firms
	(1)	(2)	(3)
Cross-street exporter neighbor	-0.000173 (0.000230)	-0.000173 (0.000230)	-0.000173 (0.000230)
Neighbor-building exporter neighbor	0.000340* (0.000204)	0.000342* (0.000204)	0.000343* (0.000204)
Same-building exporter neighbor	0.000254 (0.000218)	0.000251 (0.000218)	0.000250 (0.000218)
Person-connected exporter neighbor	0.00244** (0.00101)	-2.94e-05 (0.000570)	0.000710 (0.000843)
Owner-connected exporter neighbor	0.00134*** (0.000403)	0.00136*** (0.000403)	0.00136*** (0.000403)
Cross-street importer neighbor	0.000316 (0.000244)	0.000317 (0.000244)	0.000314 (0.000244)
Neighbor-building importer neighbor	0.000392* (0.000204)	0.000387* (0.000204)	0.000389* (0.000204)
Same-building importer neighbor	0.00214*** (0.000259)	0.00212*** (0.000259)	0.00212*** (0.000259)
Person-connected importer neighbor	0.000996 (0.000920)	0.00268*** (0.000604)	0.00423*** (0.000940)
Owner-connected importer neighbor	0.00511*** (0.000492)	0.00507*** (0.000491)	0.00508*** (0.000491)
Cross-street neighbor owned from country	0.000221 (0.000289)	0.000223 (0.000289)	0.000222 (0.000289)
Neighbor-building neighbor owned from country	-0.000185 (0.000201)	-0.000187 (0.000201)	-0.000189 (0.000200)
Same-building neighbor owned from country	0.000566** (0.000261)	0.000561** (0.000261)	0.000558** (0.000261)
Person-connected neighbor owned from country	0.00159 (0.00214)	0.00171 (0.00177)	0.00233 (0.00287)
Ownership-connected neighbor owned from country	-0.000435 (0.000693)	-0.000449 (0.000693)	-0.000432 (0.000693)
Firm-year FE	YES	YES	YES
Country-year FE	YES	YES	YES
Nr. of observations	3,778,517	3,778,517	3,778,517

Sample: firm-country pairs in those years when the firm has not imported from the country until the previous year. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific experience in the previous year. An exporter or importer neighbor refers to a peer with country-specific export or import experience. A neighbor owned from the country refers to a peer who ever had an owner from the given country. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Column (1) uses those managers who had a signing right in the previous firm and are owners in the new firm. Column (2) uses managers with any connections to both firms (signing right, supervisory board or ownership). Column (3) uses those managers who have signing right in both firms. Ownership-connected neighbor refers to a peer in the same ownership network. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

Table C.20: The effect of peers with country-specific experience on the probability of importing from the same country, using alternative samples

Dependent variable: imports that year

Sample:	all firms	first ever importers	not yet importers	importers, but not recently
	(1)	(2)	(3)	(4)
Cross-street exporter neighbor	-0.000566	-0.00159	1.47e-05	0.0144
	(0.000695)	(0.0261)	(0.000200)	(0.0563)
Neighbor-building exporter neighbor	0.000240	0.0430*	0.000349**	-0.00897
	(0.000507)	(0.0236)	(0.000168)	(0.0431)
Same-building exporter neighbor	0.000896*	0.0159	0.000250	0.0116
	(0.000523)	(0.0185)	(0.000187)	(0.0295)
Person-connected exporter neighbor	0.00723**	0.140***	0.00217**	0.0131
	(0.00291)	(0.0457)	(0.000933)	(0.101)
Owner-connected exporter neighbor	0.00570***	0.0699***	0.00106***	0.0298
	(0.00107)	(0.0259)	(0.000373)	(0.0379)
Cross-street importer neighbor	0.00173**	0.00249	8.03e-05	-0.0120
	(0.000695)	(0.0270)	(0.000203)	(0.0577)
Neighbor-building importer neighbor	0.000707	0.0172	0.000203	-0.0215
	(0.000540)	(0.0237)	(0.000177)	(0.0481)
Same-building importer neighbor	0.00766***	0.0882***	0.00159***	0.00799
	(0.000765)	(0.0185)	(0.000224)	(0.0299)
Person-connected importer neighbor	0.0478***	0.0563	0.000942	-0.0102
	(0.00435)	(0.0649)	(0.000822)	(0.124)
Owner-connected importer neighbor	0.0208***	0.220***	0.00430***	0.0220
	(0.00146)	(0.0271)	(0.000456)	(0.0368)
Cross-street neighbor owned from country	0.000288	0.0426	0.000101	0.0561
	(0.000841)	(0.0414)	(0.000250)	(0.0919)
Neighbor-building neighbor owned from country	0.00136***	-0.0493	-0.000211	0.00785
	(0.000476)	(0.0366)	(0.000172)	(0.0889)
Same-building neighbor owned from country	0.00317***	0.112***	0.000533**	-0.00223
	(0.000732)	(0.0348)	(0.000225)	(0.0544)
Person-connected neighbor owned from country	0.0116	0.155	0.00157	0.406***
	(0.00710)	(0.222)	(0.00194)	(0.144)
Ownership-connected neighbor owned from country	0.00585**	0.0644	-0.000163	0.0260
	(0.00241)	(0.0740)	(0.000599)	(0.0846)
Firm-year FE	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES
Nr. of observations	3,845,272	23,404	3,663,512	49,639

Sample in column (1): all firm-country pairs in all years; in column (2): firms with all four countries in that year when the firm started to import for the first time from one of the four countries; in column (3): firms with all four countries in those years when the firm has not imported from any of the countries until the previous year; in column (4): firm-country pairs in those years when the firm has already imported from the country before but the firm imports at most once in the period [t-2;t] where t is the current year. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm importing from the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific experience in the previous year. An exporter or importer neighbor refers to a peer with country-specific export or import experience. A neighbor owned from the country refers to a peer who ever had an owner from the given country. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.

Table C.21: The share of importers from the given country in the building, k years after the firm with country-specific import experience moved in

Years after the firm moved in	Mover with experience for c		Mover without experience for d
	Share of importers from		
	country c	country c'	country d
k=0	0%	0%	0%
k=1	0.69%	0.30%	0.23%
k=2	1.36%	0.66%	0.48%
k=3	2.11%	1.40%	0.77%

Sample in columns (1) and (2): firms in buildings with no importer from country c in the year when a firm with import experience from country c moved into the building. Sample in column (3): firms in buildings with no importer from country d in the year when a firm withot having import experience from country d moved into the building. Country c' in column (2) is any country in buildings with an experienced mover in which the mover had no import experience before and no firm in the building imported from there in the year of the move either.

Table C.22: Descriptive statistics for the number of addresses and firms having a mover and having no previous country-specific import experience

	Number of		
	address-year pairs	address-year-country triplets	affected firms
Total	538,018	2,152,076	212,859
With a mover	58,397	233,588	105,214
With a mover having previous import experience	3,683	5,424	18,163
... from Slovakia	1,584	1,584	8,907
... from the Czech Republic	1,966	1,966	11,362
… from Romania	1,081	1,081	6,696
… from Russia	793	793	4,798
Without any import experience from a country in t and t-1, apart from the mover in t			
… total	376,496	1,417,228	184,978
… also having a mover	31,757	109,816	87,754
… also having an experienced mover	1,575	2,092	8,951

Affected firms denote those firms which are on a given type of address, excluding the movers themselves, except from the total number of firms. A mover is defined as a firm changing its address within Budapest from one year to another. An address without any import experience means that all the firms being present in the same or neighboring buildings in years t-1 or t are without import experience from the country up to that year. The only exceptions might be the movers relocating to the address in year t.

Table C.23: The effect of peers with country-specific experience on the probability of starting to export to the same country

Sample: not yet exporters until the previous year
Dependent variable: Exporter

	(1)	(2)	(3)	(4)	(5)
Cross-street exporter neighbor	0.000413			0.000410	0.000463*
	(0.000256)			(0.000255)	(0.000256)
Neighbor-building exporter neighbor	0.000396**			0.000389**	0.000371*
	(0.000196)			(0.000195)	(0.000201)
Same-building exporter neighbor	0.00172***			0.00170***	0.00159***
	(0.000246)			(0.000246)	(0.000248)
Person-connected exporter neighbor		0.00305***		0.00277***	0.00257***
		(0.000915)		(0.000912)	(0.000911)
Owner-connected exporter neighbor			0.00493***	0.00488***	0.00471***
			(0.000486)	(0.000485)	(0.000487)
Cross-street importer neighbor					-0.000274
					(0.000251)
Neighbor-building importer neighbor					9.81e-05
					(0.000182)
Same-building importer neighbor					0.000458**
					(0.000230)
Person-connected importer neighbor					0.00136
					(0.00109)
Owner-connected importer neighbor					0.000879**
					(0.000430)
Cross-street neighbor owned from country					-0.000126
					(0.000302)
Neighbor-building neighbor owned from country					-5.54e-05
					(0.000222)
Same-building neighbor owned from country					0.000569*
					(0.000295)
Person-connected neighbor owned from country					0.00627
					(0.00387)
Ownership-connected neighbor owned from country					0.00110
					(0.000783)
Firm-year FE	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES
Nr. of observations	3,772,739	3,772,739	3,772,739	3,772,739	3,772,739

Sample: firm-country pairs in those years when the firm has not exported to the country until the previous year. The unit of observation is firm-country-year. The dependent variable is an indicator for the firm exporting to the country in the given year. Right-hand side variables are indicators for the firm having different types of neighbors with country-specific experience in the previous year. An exporter or importer neighbor refers to a peer with country-specific export or import experience. A neighbor owned from the country refers to a peer who ever had an owner from the given country. Same building refers to the building of the firm, cross-street refers to building number +/-1 and neighbor building refers to building number +/-2. Person-connected neighbor refers to a peer which had a manager who became an owner in the firm of interest. Ownership-connected neighbor refers to a peer in the same ownership network. All specifications include firm-year and country-year fixed effects. Standard errors in parentheses are clustered by building.