The London School of Economics and Political Science

Doctoral Thesis

Essays on worker mobility, firm organisation and the political economics of elections

Alessandro Sforza

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A thesis submitted to the London School of Economics for the degree of Doctor of Philosophy.

Declaration of Authorship

I certify that the thesis I have presented for examination for the PhD degree of the London School of Economics and Political Science is solely my own work unless otherwise clearly indicated.

I warrant that this authorisation does not, to the best of my belief, infringe the rights of any third party.

I declare that this thesis consists of approximately 40,000 words.

Statement of cojoint work

Two out of the four chapters that form this thesis involve conjoint work.

Chapter 2 was co-authored with Giordano Mion and Luca David Opromolla. Overall, my contribution amounts to 50% of the paper.

Chapter 3 was co-authored with Lorenzo Caliendo, Fernando Parro, and Luca David Opromolla. Overall, my contribution amounts to 50% of the paper.

Abstract

This thesis looks at different aspects of workers mobility, firms organization and the political economy of elections. In the first chapter, I analyse—both theoretically and empirically—the effect of an exogenous credit supply shock to the organization of the firm. The understanding of these mechanisms is fundamental to rationalize the real economic consequences of an aggregate negative shock at the micro level and to understand how the organization of the firm can be the target of specific policies that can attenuate the impact of capital shortage on the real economy. The second chapter considers knowledge as a key determinant to the competitiveness and the success of a firm. I start from the idea that firms and their managers acquire knowledge via a variety of different channels, which are often difficult to track down and quantify. By matching employer-employee data with trade data at the firm level-which is itself a novelty in the trade literature-the chapter sheds light on the nexus between the export experience acquired by managers in previous firms and their current firm performance. The third chapter embeds labor mobility in multi-country dynamic version of an Eaton and Kortum framework to explain how migration, together with trade, affects the welfare of natives and migrants in different regions in Europe. In the last chapter, I look at the effect of higher turnout on political outcomes. I exploit the exogenous variation in weather conditions on the day of elections and the geography of a country—Italy—to instrument for turnout. Results of the instrumental variable combined with a first difference model explain how a larger political participation affects the electoral outcome.

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Happiness is only real when it is shared.

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To my grandparents, my life compass. And to Leo…

Chapter 1

Shocks and the organization of the firm: who pays the bill?

What happens to firms' organizational structure when they are hit by a negative shock? By matching employer-employee data with firm loans and bank balance sheets, I study firms' reactions to a credit shock–the global financial crisis—and compare it to a trade shock—the entry of China in the WTO. When hit by a credit supply shock, firms reduce employment of higher-skilled workers more than lower-skilled production workers, while no adjustment is found on the wages. In contrast, a trade shock affects the hierarchy of the firm from the bottom to the top: firms rescale the organization and reduce employment at all levels. Results support the existence of heterogenous complementarities between capital and skills along the hierarchy of the firm: a shock to credit hits workers in the middle of the hierarchy, while a trade-induced demand shock affects the scale of the firm, hence all skills proportionally.

1.1 Introduction

Firms are usually treated as homogeneous entities when studying the transmission of shocks to the real economy. They are allowed to vary by size, productivity and shape, but the within-firm structure is considered homogenous. This paper shows that the organization of the firm is crucial to understand differences in aggregate responses to different shocks. The way a firm organize has been shown to have an important impact on the distribution of wages in the economy, as well as productivity,[1] but we have little empirical evidence and understanding of firm reorganizations in response to shocks. A key question is: what happens to firms' organizational structure when they are hit by a negative shock and how does the firm adjust and reorganize?

This is the first paper to causally identify the effect of a credit shock on the organization of the firm. To measure the impact of lack of liquidity on the organizational structure of the firm, I exploit the differential exposure to the financial crisis of Portuguese banks and the detailed bank-firm credit network to instrument for firms' credit supply. Moreover, I compare firms' reactions to a credit supply shock—the global financial crisis—to their reaction to a trade shock—the entry of China in the WTO—and provide a simple mechanism to interpret the different findings.

Results show that firms react differently to a credit shock than a trade shock. Both induce the firm to cut overall employment, but the organization of the firm reacts differently across the two shocks. When hit by a negative credit supply shock firms shrink more the middle of the hierarchy, reducing employment of higher-skill workers more than lower-skill production workers at the bottom. In contrast, when hit by a negative trade shock the reduction is more pronounced for lower-skill production workers and less pronounced as we rise along the hierarchy of the firm.[2] The empirical findings highlight a novel heterogeneity in the

[1] See for example (Liberti, 2017), (Garicano, 2000), (Garicano and Rossi-Hansberg, 2004) (Hubbard and Garicano, 2007), (Ichniowski et al., 1997), (Black and Lynch, 1997), (Bloom et al., 2012), (Caliendo et al., 2015a).

[2] In both cases, there is no adjustment on wages: presumably, the contractual rigidities of the Portuguese labour market allow little downward adjustments on the salaries. In line with this, I show that labour market rigidities play an important role: firms with a higher share of workers

degree of complementarity between working capital and each of the hierarchical layers. A shock to one specific input of production—working capital—translates into a stronger reduction of higher-skill workers, rather than production workers, while top managerial positions are not affected. In contrast, a trade induced demand shock affects the scale of the firm, therefore firms layoff in all layers.

Measuring firms' organization and how firms react to different shocks is challenging. The empirical estimation builds on a novel dataset that brings together a matched employer-employee, bank lending registry, and bank balance sheets over 16 years for Portugal. Crucially, observing the task complexity of each occupation allows to precisely map workers into the hierarchy of the firm. I follow (Caliendo et al., 2015b) and define layers to be representative of the vertical organization of the firm, with top managers, middle managers, supervisors and production workers.[3] Moreover, the length of the panel allows me to analyse firms' organizational reaction to a credit and a trade shock in the same economy. Following (Paravisini et al., 2015b), the analysis of the credit shock is based on two different pillars: I construct a firm-level instrument for the supply of credit to the firm that combines information on the firm's credit relationships with the bank's exposure to the foreign interbank market. In addition, I exploit the panel dimension of the data by looking at the change in credit supply before and after the Lehman collapse, which generated the biggest freeze in the interbank borrowing market in recent years. In the second part of the paper, I examine how exposure to rising competition from China affects the organization choice of Portuguese firms. To analyze the effect of the trade shock on Portuguese firms, I

on temporary contracts before the crisis have a stronger reaction to negative shocks by reducing employment more.

[3]Using the theory in (Caliendo and Rossi-Hansberg, 2012), (Caliendo et al., 2015b) use French manufacturing firms to describe how wages and the number of employees change when the firm reorganize by adding layers. They show that the probability of adding a layer is increasing in value added and that firms adding layers decrease average salaries in the layer by changing the skill composition of workers employed in that layer. They provide several directions for further research, mainly by looking at exogenous shocks that lead the firm to reorganize.

construct a sectoral measure of import penetration of Chinese exports to high-income economies excluding Portugal (as in (Autor et al., 2014a)) to instrument for the drop in sales upon China's entry in the WTO.

The empirical estimates return elasticities of organization to credit; a 10% drop in the supply of credit predicts a 2% drop in the ratio of team leaders to production workers, which in turns implies an increase in the span of control that team leaders have over production workers. However, the observed increase in the span of control can be driven by an increase in the number of production workers, by a decrease in the number of team leaders, or by a decrease of both, with the decrease in the number of team leaders being more pronounced than the decrease in the number of production workers. I find that the latter mechanism drives the results. Employment of high skilled workers and team leaders drops by 1.75% with a 10% drop in credit, while the elasticity of production workers to a 10% drop in credit is 1.4%.

The transmission of a financial shock from banks to the real economy has been widely documented, but very little is known on the heterogeneous effects of a credit shock along the workers' tasks and skills distribution. The work by (Chodorow-Reich, 2014) documents the effects of a credit supply shock on the employment level of firms connected to more or less healthy banks, but cannot speak to the heterogeneous effects at the worker level due to data availability. (Greenstone et al., 2014) look at the effect of credit reduction to small firms in the US. They exploit geographical variation in the distribution of the local branches of US banks to look at the effect of credit reduction on employment in counties differentially exposed to the shock. The recent paper by (Berton et al., 2017) uses the methodology described in (Greenstone et al., 2014) to show that a negative credit supply shock has an impact on firms' employment in one Italian region—Veneto—and the effect is heterogenous, and mostly concentrated among less educated workers. [4] I build on this literature and open the black box of the firm, showing how the organization responds to a negative credit supply shock and what the implications are for the different categories of workers.

Do firms react differently to a demand and a credit shock? A large literature in economics has documented the firms' employment response to a trade shock that increases the level of domestic competition, and reduces demand for both exporters as well as domestic producers. The paper by (Autor et al., 2014a) for example, analyzes the effect of exposure to international trade on earnings and employment of U.S. workers, from 1992 through 2007. The authors show that industry shocks to import competition in the aftermath of China's entry in the WTO and rise as a global exporter mostly affected workers in exposed industries and that earning losses were larger for individuals with low initial wages, low initial tenure, and low attachment to the labour force. Moreover, the paper documents that high wage workers suffered less because of a higher ability to move across employers, and eventually move out of manufacturing. These findings reveal that import shocks unevenly affect workers along the skill distribution, being tougher for blue collars than for white collars; however, the firm level mechanisms determining the worker level outcomes in terms of cumulated earnings is still unclear.

[4] Focusing on exporters, (Amiti and Weinstein, 2011) look at the effect of financial crisis on Japanese exporters, while (Foley and Manova, 2015) explain that firms face more stringent capital constraints because of higher up-front expenses to enter foreign markets, higher variable costs related to delayed payments, shipment duties and freights, currency fluctuations and contractual risks. Moreover, (Chor and Manova, 2012) show that international commerce becomes more sensitive to financial conditions during crises. In a similar vein, (Paravisini et al., 2015b) look at the effect of bank credit shocks on the export behavior of Peruvian firms. They look at bank pre-crisis ratios of foreign funding to assets and use the share of firm credit from banks with foreign exposure above the median as an instrument for the intensity of the financial shock to firms. They find that capital shortage has a bigger effect on the intensive margin—quantity exported in a destination-product market—than on the extensive margin—entry or exit of firms. Other scholars focused on measuring the effect of banks' exposure to the financial shock on their credit supply. In this respect, (Jiménez et al., 2011) is one of the first papers to show how to link bank exposure to financial shocks and firm credit supply while (Iyer et al., 2014) use Portuguese data and show how banks with a high exposure to the interbank borrowing market reduced their credit supply growth.

(Guadalupe and Wulf, 2008) is one of the first papers to systematically look at the firms' internal organizational reaction to a trade shock. Along these lines, (Friedrich, 2015) empirically estimates the effect of trade shocks on wage inequality, decomposing inequality using the lenses of organizational models. He uses matched employer-employee data from Denmark to show that wage variation across hierarchical layers constitutes a systematic component of overall wage inequality. Moreover, the paper exploits a trade shock to Danish exporters in 2005 - the Cartoon crisis - to causally estimate how a drop in demand influences within firm wage inequality. My results confirm the findings of (Autor et al., 2014a), showing that the effect of a trade shock is more pronounced among lower-skill workers and decreases with the task complexity of the occupation. Moreover, I add on this literature by showing that these findings are consistent with a firm reorganization mechanism: when hit by a negative trade shock, firms shift to a different production scale and adjust their structure, laying off workers proportionally along the hierarchy, to minimize the costs associated with the new demand level.

Finally, a growing literature in economics explores how the organizational structure of the firm determines its performance.[5] Empirical studies are exploiting the increasing availability of matched employer-employee data, as well as information on managerial practices to describe the organization of the firm (see (Bloom et al., 2011a)). Theoretical contributions have provided a set up to empirically study the nexus between firms' organization and productivity (see (Caliendo and Rossi-Hansberg, 2012) among others). This paper complements these works by showing causal evidence on the nexus between credit and organization as well as between trade and organization.

The rest of the paper is organized as follows. Section 3.4 describes the data

[5](Caliendo et al., 2015b) explore the importance of production hierarchies in the French context, while (Caliendo et al., 2015a) investigate the effect of organizations on productivity in the Portuguese economy.

used in the analysis, the mapping of workers in management layers and other firm level measures of organization. Section 1.3 presents the analysis on the reaction of firm organization to the credit shock and section 1.3.6 discusses the results through the lenses of a simple theoretical framework. Section 1.4 presents the analysis for the trade shock and discuss how the organizational reaction differs across the two shocks. Section 1.5 reports additional margins of adjustment and placebo tests of the identification strategy. Finally, section 1.6 concludes.

1.2 Data and descriptives

An important innovation of this article is to link datasets of loans and within firm organization to observe organizational changes of firms borrowing from different banks. The analysis draws on a unique dataset constructed using Portuguese data that brings together four different data sources: a matched employer-employee dataset virtually covering the entire population of firms and their workers in Portugal, a firm balance sheet dataset, a bank-firm loans dataset and a bank's balance sheet dataset. The dataset covers manufacturing and services firms of continental Portugal for the years 1997-2013.[6]

Employer-employee data come from *Quadros de Pessoal* (henceforth, QP), a data set made available by the Ministry of Employment of Portugal that draws on a compulsory annual census of all firms in Portugal employing at least one worker. The data set has been widely used in the labour literature and contains information on 350,000 firms and 3 million employees.[7] Reported data cover the

[6]Information for the year 2001 for the matched employer-employee dataset was not collected so my sample excludes the year 2001. For the moment, I constraint my sample between 2003 and 2013.

[7]See for example (Blanchard and Portugal, 2001) which compares the US and Portuguese labour market looking at the unemployment duration and worker flows, (Cabral and Mata, 2003) who study the evolution of the firm size distribution, (Mion and Opromolla, 2014) who show that the export experience acquired by managers in previous firms leads their current firm towards higher export performance, and commands a sizable wage premium for the manager or (Mion et al., 2016) who look at how the knowledge a manager acquires spills over the new firm.

firm itself, each of its plants and each worker employed by the firm. Variables available in the data set include the firm's location, industry, total employment, and sales. The worker-level data cover information on all personnel working for the reporting firms in a reference week in October of each year. They include information on occupation, earnings, and hours worked (normal and overtime). The information on earnings includes the base wage (gross pay for normal hours of work), seniority-indexed components of pay, other regularly paid components, overtime work, and irregularly paid components.

The second dataset is *Central do Balancos* (henceforth, CB), a repository of yearly balance sheet data providing economic and financial information on non-financial corporations operating in Portugal. This dataset contains information on all the firms in the Portuguese economy from 2006 onwards.[8] The data contains information on firm sales, material assets, cost of materials and third party supplies and services.

The third dataset is *Central de Responsabilidades de CrÈdito* (henceforth, CRC), a data base made available by Bank of Portugal containing all the credit exposures above 50 euros reported monthly by the universe of Portuguese credit institutions. The Reporting is mandatory and the objective is to increase the information set available to participating institutions to improve the risk assessment of potential borrowers. For each borrower, the dataset includes information on the number of banking relationships, total outstanding debt with each single institution and loan status (regular credit, overdue, written-off or renegotiated).[9]

[8]Before 2005 CB was biased towards large firms; however, the value added and sales coverage was high. For instance, in 2003 firms in the CB dataset accounted for 88.8% of the national account total of non-financial firms' sales.

[9]Potential credit refers to all the credit not yet materialized, Overdue credits are credits for which the financial institution has a positive expectation of being reimbursed, Written-off credits are credits for which the financial institution has no expectation of being reimbursed and renegotiated credits are credits for which conditions have been renegotiated between the two parties. Before 2009, the dataset does not include information on collaterals or credit duration.

The fourth dataset is *Balanco das institucoes monetarias and financeira* (henceforth, BBS), a repository of monthly balance sheet data for all the financial institutions in Portugal. The dataset includes information on the instruments and the counterparts of each transaction in the assets and liabilities for all the financial institutions in Portugal. For each bank or financial institution in a month, the dataset reports information on the transactions divided by maturity (for example, credits up to 1 year maturity, credits with maturity between 1 and 2 years, deposits with 90 days maturity, deposits up to 1 year maturity) the type of the counterpart (Central banks, banks, other financial intermediator, local government, regional government, national government and others), the location of the counterpart (aggregate of countries outside the Eurozone which includes Lithuania, Austria, Belgium, Cyprus, Slovenia, Slovak Republic, Spain, Estonia, Finland, France, Greece, Netherlands, Ireland, Italy, Latvia, Luxembourg, Malta and Portugal).

1.2.1 From individual classification to firm level variables

Table 1.1 reports descriptives for 2005; manufacturing and services firms in my sample have on average 29 employees, and a wage bill of 522,801 euros. Firms have on average 1.23 layers of management, with the average salary in the top layer being 3.5 times higher than the average salary in the bottom layer.

In the bottom panel of table 1.1, I present descriptive statistics for credit and firm-bank relationships. On average, firms borrow 208,165 euros as working capital (as an average across firms and years), while 294,582 for long term investments. Interestingly, Portuguese firms on average have 2.2 bank relationship; this will provide useful variation to identify the credit supply shock and construct a firm level instrument for the shock.

To construct the occupational structure at the firm level I use the information contained in the matched employer-employee dataset. Each worker, in each year, has to be assigned to one of the 9 categories following a (compulsory) classification of workers defined by the Portuguese law.[10] Classification is based on the task performed and skill requirements, and each category can be considered as a level in a hierarchy defined in terms of increasing responsibility and task complexity. The 9 levels' hierarchy defined by the Portuguese law is detailed and is rarely found in its entirety in a Portuguese firm. To make the classification more representative of the reality of the Portuguese production network, I group some of the categories according to the description of the tasks performed and the wage distribution. I assign "Top executives (top management)" to occupation 3; "Intermediary executives (middle management)" and "Supervisors, team leaders" to occupation 2; "Higher-skilled professionals" and "Skilled professionals" to occupation 1; and the remaining employees, including "Semi-skilled professionals", "Non-skilled professionals", and "Apprenticeship" to occupation 0. This classification provides a good picture on the hierarchical organization of the firm and allows me to partition the available categories into management layers. The great majority of the firms in the sample satisfy a hierarchy—see table 1.2—and firms with a more complex organizational structure employ more workers, pay higher salaries and use more external credit—both long and short term—to finance their activity as it is clear from table 1.3.

I follow (Caliendo et al., 2015b) in translating the number of different occupations present in a firm into layers of management. A firm reporting c occupational categories will be said to have $L = c - 1$ layers of management: hence, in the data I will have firms spanning from 0 to 3 layers of management. In terms of layers within a firm I do not keep track of the specific occupational categories but simply rank them. Hence a firm with occupational categories 2 and 0 will have 1

[10] I use the Portuguese classification (Decreto Lei 121/78 of July 2nd 1978)

layer of management, and its organization will consist of a layer 0 corresponding to some skilled and non-skilled professionals, and a layer 1 corresponding to intermediary executives and supervisors.[11]

Figure 1.1 shows the distribution of sales by organization type. Firms with a higher number of management layers have a higher volume of sales. Table 1.3 shows how the hourly wage and the hours worked are increasing in the number of management layers. Moreover, the last two columns of the table show that a positive relationship exists also between the number of management layers and credit—both short and long term.

1.3 Credit & organizations

In this section I document how the internal organization of the firm respond to a credit shock—the financial crisis in 2009. First, section 1.3.1 describes a methodology that combines an instrument for credit supply and a difference in difference that allows to disentangle the effect of credit supply shock from the contemporaneous drop in demand. The identification of the credit supply shock follows the methodology described by (Paravisini et al., 2015b). The richness of the data allows to open the black box of the firm and look within the organization of labour of each firm before and after the credit shock. In section 1.3.6 I discuss the results and propose a simple mechanims to interpret them. To test the proposed mechanism, section 1.4 presents the analysis of firms' organizational reaction to the exposure of the increase in Chinese competition that followed China's entry in the WTO in 2001. The methodology follows the work by (Autor et al., 2013a) and

[11] A potential concern of this methodology is that firms can have layers with occupations that are not adjacent in the rank. In my sample however, 70% of the firms have adjacent layers and the share goes up to 85% if I use hours worked as a weighting factor. I perform the estimations using the categorization of occupation that define the managerial layers without filling non-adjacent occupations with the occupation above in the rank and results hold. Results using occupation can be found in the online appendix.

construct a measure of Chinese import penetration to instrument for the increase in competition for Portuguese producers.

1.3.1 The credit shock

The global financial crisis affected Portugal enormously and through different channels. In a very first phase, the Portuguese economy was almost untouched by the events happening in the US; the housing market did not suffer any bubble and the financial markets did not react to the first signs of financial distress in June 2007.[12] The tension in the interbank borrowing market started to be extremely high in September 2008, when Lehman Brothers filed for Bankruptcy.

The Portuguese banking system relied heavily on foreign interbank funding to finance loans to individuals and firms because of a low aggregate saving rate of the Portuguese economy.[13] Figures 1.3 and 1.4 show respectively the drop in total short term credit in the Portuguese economy and the drop in total foreign interbank borrowing of Portuguese banks. The decline in the total amount of short term credit in the economy is remarkable (around 50%)[14] and although some of the drop of credit may be due to a drop in demand[15], the magnitude of the interbank borrowing decline suggests a potential important role played by the supply channel. The two factors together, drop in supply and demand, created an unprecedented tension in the labour market leading to extremely high unemployment levels; total unemployment rose up to 15% from 5% in 1998, while youth unemployment rose up to around 43% from an initial level of 13% in 1998.

[12]The first episode of distress is the rescue by the investment bank Bear Stearns of a subsidiary edge fund that had invested heavily in subprime mortgages in the US. See (Lourenço and Rodrigues, 2015) for evidence on the evolution of the Portuguese housing market.

[13]See the BIS dataset on the specific dependence of Portuguese banks (see www.bis.org/statistics/about_banking_stats.htm)

[14]The liquidity crisis was unexpected across all European countries and not related to Portuguese institutions.

[15]Demand certainly played an important role as well: both domestic and foreign demand for Portuguese goods decreased sharply in the aftermath of Lehman collapse, and this led to a decrease in production and consumption.

Three characteristics make the financial crisis unique and important to study as a shock to the real economy: first, bank credit represent the major source of external financing for enterprises in Europe. The structure of the economy in many European countries is dominated by small and medium sized enterprises that do not reach a sufficient scale to access the financial market directly by issuing corporate bonds.[16] Second, lending relationships between firms and banks are stable overtime, making it very difficult for firms to switch bank.[17] Finally, the 2008-9 financial crisis began outside the corporate loan sector. These characteristics help designing an empirical methodology to causally identify the effect of a credit supply shock by making the shock orthogonal to the loan portfolio of the firms in the economy and by ensuring that firms are heterogeneously hit by the credit shock.

1.3.2 The empirical model

Studying the effect of a decrease in credit supply on firm level outcomes is challenging. The identification problem arises naturally because the amount of credit received by the firm is an equilibrium outcome between the amount of credit demanded by the firm and the amount the bank supplies. To address this concern, I follow (Paravisini et al., 2015b) and rely on two complementary methodologies: first, I instrument for the supply of credit, using shocks to the balance sheet of the banks lending to firm i. Second, to avoid to incur in a biased estimation due to non-random matching of firms and banks, I use the firm-bank network observed in a year out of the sample and I control for the unobserved heterogeneity in the

[16]The Survey on Access to finance for Small and Medium enterprises of the ECB shows how SMEs use bank credit as main source of liquidity and financing; indeed, only 7% of the firms in Europe use the equity market to finance their activity. Moreover, the structural difference in firms' access to the financial market between US and Europe helps explaining why the banking system in Europe is 2.5 times the GDP, while in the US is only 0.7 times.

[17]See (Bonfim and Dai, 2012) for evidence on relationship lending in Portugal.

cross-section with firm fixed effects.[18] Moreover, I allow demand shocks to be varying across sectors and year and include sector-time fixed effect to account for this possibility and isolate the variation that comes from the credit supply shock only.

As a result, the estimation compares within firm variation in the hierarchical organization, accounting for time varying sectoral demand shocks. Intuitively, I compare the change in employment and organization of two identical firms producing leather shoes, but one happens to be linked to a negatively affected bank out of the n bank links the firm has, while the other has a lender portfolio that is not affected. The identification assumption is that factors other than bank credit that may affect the labour composition of the firm organization of leather shoes producers are not related to the debt composition of their bank; in other words, the debit composition of the bank affects labour choices of the firm only trough credit after accounting for firm heterogeneity in the matching. The identification assumption could be violated if a firm's bank affiliation is correlated with (i) labour demand for a specific product or (ii) non-credit firm-level shocks (e.g. firms' direct dependence on (foreign) funding not mediated by banks).

The latter concern can be immediately ruled out by two different observations. First, the Portuguese corporate bond market is very limited in size; very few firms issue bonds to finance their activity, while the great majority of firms rely on banks' loan.[19] Secondly, the average Portuguese firm in the sample has 20 employees; firms are too small to consider issuing bonds as a valid alternative to finance their activity. With respect to the first concern, if banks specialize

[18]In the appendix, I account for bank specialization in lending to firms in sector s following (Paravisini et al., 2015a). Suppose that a specific bank specializes in lending to firms producing leather shoes; then, if a trade shock hits all the firms in the leather shoes sector at the same time during the crisis, I wont be able to disentangle the trade shock from the credit supply shock. In section 1.5 I estimate the model using 2005 as a placebo shock. The exercise confirms that firms connected to different banks are on parallel trends before the drop in credit supply in 2009.

[19]Looking at the ECB survey on access to finance for enterprises, only 7% of the firms in the Portuguese economy report equity as a source of financing.

in lending to firms producing a specific product and a dramatic demand shock affects that product at the same time as the credit shock, the inclusion of 2 digit sector-time fixed effects might not be enough to capture demand shocks. In fact, the inclusion of sector-time fixed effects captures credit demand variation only if changes in firms' credit demand are in expectations equally spread across all banks lending to the firm. In the appendix, I investigate whether banks specialize in a sector following the methodology in (Paravisini et al., 2015b) and I find that accounting for bank specialization in a 2 digit sector does not change the estimates.

The objective is to estimate the elasticity (η) of the organization (L) to credit (C) and I do so using the following specification:

$$L_{ist} = \eta * ln(C_{it}) + \delta_i + \gamma_{st} + \epsilon_{ist} \tag{1.1}$$

In the baseline estimates, L_{ist} measures the span of control across two adjacent layers of firm i in sector s at time t, C_{it} is the sum of all outstanding credit of firm i at time t, δ_i is a set of firm fixed effects accounting, for example, for managerial ability in firm i or for time invariant firm characteristic that might determine the bank-firm matching, γ_{st} accounts for unobserved heterogeneity of sector s at time t, such as sector level demand shocks or changes in production costs due to increase in intermediates input costs.

I estimate equation 1.1 using shocks to the banks' balance sheet lending to firm i to instrument for the amount of credit granted to firm i at time t.

1.3.3 Interbank borrowing shock and credit supply

When the crisis hit the Portuguese banks in 2009, the dry up in liquidity reduced dramatically the funds available to the financial institutions. Moreover, because of a low aggregate saving rate in the economy, Portuguese banks heavily relied on foreign interbank borrowing to give credit to firms.[20]

The hypothesis behind the IV is that the contraction in credit supply in 2009 was larger for banks that relied more on foreign interbank funding before the crisis. To test this assumption, I use the following model:.

$$ln(C_{ibt}) = \beta f(FD_b) * Post_t + \theta_{ib} + \mu_{it} + \epsilon_{ibt} \tag{1.2}$$

where C_{ibt} is the average outstanding debt of firm i with bank b before and after the shock ($t = Pre, Post$), Pre and $Post$ are the 5 years before and after 2009. FD_b is the share (or a function) of foreign interbank funding over total asset of bank b measured in 2003 while $Post_t$ is a dummy taking value *1* if the period is after 2009. θ_{ib} and μ_{it} are firm-bank and firm-time fixed effects, aiming to capture all the time invariant heterogeneity in the demand and supply of credit (the former) and all the firm specific evolution of credit demand (the latter). The coefficient β measures how credit supply changes with foreign interbank funding, under the assumption that shocks to firms' demand of credit are on average equally spread across banks.

Equation 1.2 returns the *within-firm* estimator which compares the change in the amount of lending by banks with different dependence on foreign interbank funding to the *same firm*, before and after the interbank shock (2009).

I use the years from 2004 to 2013 to estimate equation 1.2 in first differences, defining the pre-period to be from 2004 to 2008 and the post period from 2009 to 2013. I estimate the following equation that identifies the credit supply shock at bank level:

[20] See the BIS dataset on the dependence of Portuguese banks www.bis.org/statistics/about_banking_stats.html.

$$ln(C_{ibpost}) - ln(C_{ibpre}) = \beta f(FD_b) + \mu'_{it} + \epsilon_{ib} \tag{1.3}$$

FD_b is the value of interbank borrowing over total assets for bank b measured in a year out of the sample, 2003, μ'_{it} are *before-after* differences in firm fixed effects. I also inspect the relationship between foreign funding and credit supply described in equation 1.3 non parametrically in the appendix.

In table 1.7 I show the results of the estimation of equation 1.3 using different specification for the the interbank dependence. In column 1 I report results of the estimation of equation 1.3 using a linear function of the foreign interbank borrowing $FD = f(FD)$. Column 2 shows the correlation between short term credit and an indicator equal to 1 if the banks exposure to the to foreign interbank borrowing market is above the median, while column 3 reports the coefficient for banks with exposure above the average. In all the specifications, standard errors are clustered at bank level. The coefficients are all significant and, focusing on column 1, a magnitude of -1.831 implies that a one-percentage-point increase in the fraction of foreign funding before the crisis predicts a 1.831-percentage-point additional decline in credit supply, which in turn is a very big effect. Results in table 1.7 show that the same firm borrowing from 2 different banks faces a substantial drop in credit supply after 2009 from the bank that is more exposed to the interbank borrowing market. The within firm estimation confirms that the exposure of the bank to the foreign interbank borrowing market is an important determinant for the reduction in credit supply to firms.

1.3.4 Instrument and First Stage

Results in section 1.3.3 confirm the importance of bank balance sheet in predicting credit supply reductions: a higher exposure to the foreign interbank borrowing market leads to a higher reduction in the supply of credit by the bank. To estimate the effect of a credit supply shock to the organization of the firm, I construct a firm level instrument using shocks to the balance sheet of the banks, namely the variation in banks dependence to the foreign interbank market. I construct the firm level instrument in two steps: first, I use the average foreign dependence of the firm's banks, weighted by the fraction of credit from each bank, to instrument for credit supply:

$$Z_i = \sum_b w_{ib} * FD_b \tag{1.4}$$

In equation 1.4, w_{ib} is the share of bank b in total credit of firm i, and FD_b is the foreign dependence on bank b, defined as the exposure to foreign interbank borrowing market over total assets. I allow FD_b to be a linear function, an indicator function equal to one if the bank exposure to foreign interbank funding is 10% percent above the mean among all banks, or a non linear function.

I the second step, I interact the instrument with the $Post_t$ dummy:

$$Z_{iPost} = Z_i * Post \tag{1.5}$$

The first stage regression of equation 1.2 is estimated using the following specification after taking first differences at both sides:[21]

$$ln(C_{iPost}) - ln(C_{iPre}) = \beta Z_i + \gamma_s' + \nu_i \tag{1.6}$$

[21]The $Post$ dummy is equal to one for the years from 2009 to 2013, while it is equal to zero for the years from 2004 to 2008. The foreign dependence of each bank b as well as the weights, defined as the share of bank b credit to firm i over total credit of firm i are calculated in a pre-sample year, namely 2003.

where $\gamma_s' = \gamma_{post} - \gamma_{pre}$ is the first difference of sector fixed effects controlling for factors that affect the sector in which the firm operates.[22]

In the first stage I test if the firm level instrument is correlated with the total amount of credit received by the firm; moreover, constructing the instrument with the firm-bank links in a out of the sample year, 2003, and estimating equation 1.6 at firm level accounts for the concern of firms switching lenders in reaction of the negative shock.[23]

Results shown in table 1.8 confirm the relevance of the instrument. In columns 1 and 2 respectively, I define exposure to the foreign interbank borrowing market using a dummy equal to one if the exposure of the bank is above the median or the above the mean of the exposure of all banks in the year 2003; in column 3 I use a linear function of FD, while column 4 reports results using a third degree polynomial. All specifications show that the exposure to the foreign interbank borrowing market predicts a decrease in credit; I use the linear function of FD as defined in column 3 throughout the rest of the paper.[24]

1.3.5 From Credit to Workers

In the second stage I look at the effect of the instrumented credit supply shock on the organization of the firm. I estimate equation 1.1 by first differencing so to eliminate the firm fixed-effects:

$$ln(L_{isPost}) - ln(L_{isPre}) = \eta * [ln(C_{iPost}) - ln(C_{iPre})] + \gamma_s' + \epsilon_{is}' \tag{1.7}$$

[22] Estimating equation 1.6 in first differences allows me to eliminate firm fixed effects.

[23] (Iyer et al., 2014) show that firms in Portugal do not switch bank when hit by a credit supply shock.

[24] In the appendix I show results of the estimation of equation 1.6 by quartiles of the distribution of the instrument to captures how the change in credit supply varies with different exposures to the shock. Results confirm the intuition that the correlation between the instrument and the change in short term credit increases in magnitude with the exposure of the firm to the shock.

In equation 1.7 the sector fixed-effects $\gamma'_s = \gamma_{sPost} - \gamma_{sPre}$ capture demand shocks specific to a sector s. The change in the amount of credit received by firm i, $[ln(C_{iPost}) - ln(C_{iPre})]$ is instrumented with Z_{iPost} defined in equation 1.5.

A formal test of the change in the hierarchical shape of the firm can be performed by constructing measures of span of controls defined as the ratio of number of workers in two adjacent layers. In table 1.9 I present the results for the estimation of equation 1.7 where the dependent variable is the change in the log ratio of workers in layer $L+1$ on workers in layer L. In columns from 1 to 3, the dependent variable is respectively the change in the ratio of team leaders to production workers, middle managers to team leaders and top managers to middle managers. When hit by a negative credit supply shock, firms shrink by reducing the ratio of team leaders to production workers (column 1) while the span of control ratios for the layers at the top of the hierarchy are unaffected by a reduction in the supply of credit (columns 2 and 3). The coefficients in table 1.9 are elasticities of the spans of control to credit. A 10% drop in the supply of credit predicts a drop in the ratio of team leaders to production workers of 2%, which in turns implies an increase in the span of control (column 1).

However, the observed increase in the span of control can be driven by an increase in the number of production workers, by a decrease in the number of team leaders, or by a decrease of both, with the decrease in the number of team leaders being more pronounced than the decrease in the number of production workers. To better understand which of the above mechanisms is driving the results, I estimate equation 1.7 focusing on each layer in the production structure. This procedure allows to draw a portrait of firms adjustment to the credit supply shock. Table 1.10 presents the results of the estimation of equation 1.7 for each management layer of the firm: in panel A I look at the number of workers in each layer and I find the biggest elasticity for the middle layers—employment of high skilled workers drops by 1.75% with a 10% drop in credit (column 1). Production workers at the bottom of the hierarchy are less affected by the shock (column 2), while non significant results are found for managerial layers at the top of the hierarchy (columns 3 and 4).[25] These findings are consistent with the results in table 1.9 and highlight that the increase in the span of control observed in coulum 1 is driven by a decrease in both team leaders and production workers, with the drop in the former being more pronounced than the latter. In panel B of table 1.10, I look at the intensive margin of adjustment within each layer, namely the average salary of the workers in each layer of the production hierarchy. No effect is found on wages for any of the layers; this is however not surprising given the high level of unionization of the Portuguese labour market that impedes any downward adjustment in the salaries (see (Addison et al., 2015) for evidence on unionization and wage rigidity in Portugal).

Finally, I estimate equation 1.7 at firm level and check that the aggreagate results are in line with the literature on the effect of credit shocks on employment (see for example (Chodorow-Reich, 2014)). Results are presented in table 1.11: when hit by a negative credit supply shock, firms shrink by reducing the number of workers and the total wage bill as well as the number of management layers. Indeed, the elasticity of number of workers and wage bill to a 10% drop in the supply of short term credit is respectively of 1.82% and 1.99%.[26] Comparing the elasticities obtained with the instrumental variable procedure to the ones obtained from the OLS estimation of equation 1.2, we notice a remarkable difference

[25]In the appendix I show the estimation of equation 1.7 for the groups of occupations used to construct the hierarchical structure of the firm. Results confirm and reinforce the findings of table 1.10: a 10% reduction in short term credit is associated with a 3.82% reduction of employment of high skilled production workers, while no effect is found on lower-skilled production workers neither on top managers.

[26]Results are in line with the findings of (Caliendo et al., 2015b) and(Caliendo et al., 2015a): firms systematically change the internal organization by reducing overall employment and the total wage bill as well as the number of managerial layers.

in the magnitude. The IV returns bigger coefficients and highlight the importance of instrumenting for credit supply to account for the attenuation bias generated by the contemporaneous drop in demand for firm credit.[27]

Two considerations are in order: first, in line with the previous literature on the real effects of the credit shock, I find that firms shrink in response to a drop in the supply of credit by reducing the number of workers employed and the overall wage bill, as well as the number of management layers. Second, firms change their organization by laying off more in the middle layers than at the very top or at the bottom of the hierarchy: high skill workers and team leaders pay the highes bill of reorganizational responses to the credit crisis.

These results further highlight the importance of credit in determining the optimal organizational structure of the firm. In section 1.3.6 I provide a simple mechanism to interpret and rationalize these findings, while in section 1.4 I test the validity of the mechanism by showing how firm organizations react to a trade shock.

1.3.6 Interpretation of the results

Models of firm organization—both knowledge-based hierarchies or incentive-based hierarchies—suggest that the optimal number of hierarchy layers increases with production scale. These models interpret managers as fixed costs that reduce marginal costs by making workers more productive; additional managers will decrease average costs if production scale is sufficiently large. Adding hierarchical layers has implications for the wage distribution within firms because higher-level managers receive high wages due to their productive effect on a large range of workers. At the same time, wages decrease for workers at the production level because managers can be considered either as problem solvers whose

[27] The direction of the bias is discussed in detail in the appendix.

knowledge reduces skill requirements of workers or supervisors whose monitoring substitutes for wage incentives to prevent shirking. Both demand and credit available affect production scale, but as shown in the previous section firms respond to credit shocks by adjusting their internal structure in a very specific way.

The firm level response to the credit shocks is consistent with a working capital-layer complementarity mechanism: a decrease in the amount of working capital available to the firm has a differential effect on different layers, depending on how much each layer is complementary with the working capital available to the firm.[28] The different elasticities shown in table 1.10 suggest that the degree of complementarity is higher for the layer that includes higher-skill workers and team leaders, while it is lower for production workers. This result is confirmed in table 1.9, where the ratio in column 1 shows that the reduction in team leaders is more pronounced than the reduction in production workers. A formal test of the mechanism requires detailed information on the working capital use by layer, which is not available in the Portuguese firm level data.[29] However, In the next section I test if a different type of shock—a trade induced demand shock—affects the organization of the firm consistentently with the mechanism described above.

1.4 The trade shock

Do firms react differently when hit by a trade shock? Is the reaction consistent with the working capital layer complementarity mechanism described in section 1.3.6? In this section, I exploit the entry of China in the WTO and its rise as a global producer and exporter to understand and measure how Portuguese firms

[28] See (Krusell et al., 2000a) for a detailed description of the capital skill complementarity mechanism in a general equilibrium framework.

[29] As part of this research agenda, I am planning to conduct a firm level survey to gather additional information on working capital usage.

adjust their internal organization in response to an increase in competition and a drop in demand.

On the 11th of November 2001, China joined the World Trade Organization (WTO); the process of accession started some years before, but only from the end of 2001 WTO countries opened their markets to the Chinese exports without charging extremely high tariffs. The entry of China in the WTO exposed Portuguese firms to an unprecedented degree of competition, both in the internal market and on the export markets. On the internal market, Chinese exports were cheaper and potentially substitutes of products traditionally produced by Portuguese firms. On the export markets, the inflow of Chinese products increased the degree of competition for Portuguese exporters. The combination of the two factors together generated a drastic drop in demand for Portuguese firms, both exporters and non-exporters; together with the drop in demand for products, firms also reduced the demand for credit.

I extend the sample to the years from 1998 to 2004 and add 2 digit sectoral level trade data to estimate the impact of exposure to Chinese import competition on the organization of the firm. To account for possible correlation between industry imports and industry domestic demand or productivity shocks, I follow (Autor et al., 2013a) and instrument for the change in Portuguese imports from China using import growth in other high-income countries within 20 harmonized industries.[30] Key to the identification strategy is that China's rise as a global produced was driven by rapid improvements in the production structure of the country, including technology, infrastructure and urbanization, all contributing to a fast and unprecedented growth in total factor productivity (TFP).[31]

[30]The sectoral definition in the matched employer-employee dataset is harmonized 2 digit CAE classification and does not allow further level of detail. Moreover, data on firm-level trade transactions are not available to merge in combination with the other datasets used in this project.

[31]See (Hsieh and Klenow, 2009) and (Brandt et al., 2012) for evidence on China's total factor productivity growth.

The theoretical intuition of the mechanism can be explained using a simple model with two sectors, one exposed to the trade shock and one that is not. As in the specific factor model, non labour factors are immobile across sectors, while in the long run labour is mobile between sectors and can freely relocate across regions. If productivity growth abroad causes product demand to fall for the exposed sectors at home, firms will have a drop in the total sales and consequently reduce labour demand. This in turn will cause a drop in nominal wages and force some workers to relocate to non-exposed sectors. However, frictions in moving labour between industries can slow the adjustments in the short run; nominal wages in the exposed sector will remain below those in non exposed industries during the transition until the economy fully adjust to the shock. The way firm adjust their organizational structure during the transition determines the aggregate employment outcomes.

Empirically, I follow (Autor et al., 2014a) and define a measure of trade exposure as the change in the import penetration ratio for a Portuguese industry over the period 1995 to 2004 as:

$$\Delta IP_{s,t} = \frac{\Delta M_{s,t}^{Pt,China}}{Y_{s,95} + M_{s,95} - E_{s,95}} \tag{1.8}$$

where for a Portuguese sector s, $\Delta M_{s,t}^{PT,CHINA}$ is the change in imports from China over the period 1995 to 2004 and $Y_{s,95} + M_{s,95} - E_{s,95}$ is the initial absorption measured as industry shipments $Y_{s,95}$ plus industry imports $M_{s,95}$ minus industry exports $E_{s,95}$. Trade data are available from 1995 onwards and this justifies the choice of 1995 as the base year to compute changes in import penetration.[32]

[32] The empirical estimation will use values of import penetration from 1998 to 2004.

Changes in import penetration as defined in equation 1.8 can be in part contaminated by demand shocks to Portuguese industries. To isolate the supply-driven component of the Chinese import shock, I construct a measure of trade exposure as:

$$\Delta IP_{s,t}^{Other} = \frac{\Delta M_{s,t}^{Other,China}}{Y_{s,95} + M_{s,95} - E_{s,95}} \tag{1.9}$$

where $\Delta IP_{s,t}^{Other}$ is the change in imports from China from 1995 to 2004 in non-Portugal other OECD countries.[33] The motivation and identifying assumption for the import penetration measure as defined in equation 1.9 is that OECD economies are similarly exposed to the rise of Chinese imports but the industry import demand shocks are weekly correlated across them.[34]

To measure the organizational reaction of firms to a drop in firms' sales, I would estimate the following equation:

$$ln(L_{it}) = \beta ln(Sales_{it}) + \theta_{st} + \mu_i + \epsilon_{it} \tag{1.10}$$

where L_{it} is a measure of organization of firm i at time t as defined in section 1.2.1, θ_{st} are sector-time fixed-effects and μ_i are firm fixed-effects. I estimate equation 1.10 using the Chinese trade shock and the measure of import penetration defined in equation 1.9 to instrument for the change in sales at the firm level after the entry of China in the WTO.

The hypothesis behind the instrument is that firms in more affected sectors

[33]Details on the construction of the import penetration measure and the list of countries included can be found in the appendix.

[34]In the appendix I show results using the instrument computed using only import penetration from China to the U.S. to avoid that demand shocks in other countries can be correlated with demand shocks to Portuguese producers. The rationale is that US is a small exporting market for Portuguese manufacturers, and it is very unluckily that a drop in demand in sector s in the U.S. market directly affects Portuguese exporters in a relevant manner.

have a more pronounced drop in sales than firms in less affected ones holding conditional on firm characteristics and business cycle fluctuations. The identification assumption of the instrument is that the exposure of Portuguese firms to import penetration in sector s affects the organization of the firm and its employment in each hierarchical layer only through the change in firm's sales once accounting for time invariant firm specificities. The estimate of the coefficient β of equation 1.10 returns the elasticity of the organization of the firm to a change in sales induced by a change in import penetration from China.

I estimate equation 1.10 after taking first differences for the periods 1998-2001 and 2002-2004.[35] The first stage is:

$$ln(Sales_{iPost}) - ln(Sales_{iPre}) = \beta \left[IP^{Other}_{sPost} - IP^{Other}_{sPre}\right] + \epsilon_{it} \qquad (1.11)$$

where $IP^{Other}_{sPost} - IP^{Other}_{sPre}$ is the average change in import penetration from China to other non-Portugal countries between the Pre period defined as the years from 1998 to 2001 and the $Post$ period defined as the years from 2002 to 2004. [36]

The second stage is:

$$ln(L_{isPost}) - ln(L_{isPre}) = \beta \left[ln(Sales_{iPost}) - ln(Sales_{iPre})\right] + \epsilon_{it} \qquad (1.12)$$

[35] When analyzing the firm reorganization in response to the China shock, the sample is constraint to the years from 1998 to 2004 to exclude the great financial crisis. On the contrary, the firm response to a credit shock is estimated with a sample that goes from 2004 to 2013.

[36] Following the methodology described in (Autor et al., 2014a), the average import penetration in sector s in each period of the two stacked periods is defined as $\frac{1}{T}\sum_{j=1}^{J} IP_j$ where T is the number of years in each stacked period and J are the countries in $Other$ used to construct the instrument.

where $ln(Sales_{iPost}) - ln(Sales_{iPre})$ is instrumented using $IP^{Other}_{sPost} - IP^{Other}_{sPre}$ and $ln(L_{isPost}) - ln(L_{isPre})$ are measures of the change in the organization of the firm as described in section 1.2.1. Table 1.12 reports the baseline results of the OLS estimation of equation 1.12 at firm level. A drop in log sales is correlated with the shrinkage of the organization, both in terms of number of workers in the firm (column 1), the total wage bill (columns 2 and 3) and the number of management layers; moreover, firms reduce employment in all layers as well as the wage bill (see table 1.13).

Table 1.16 presents the results for the instrumental variable estimation of equation 1.12 where the change in sales between the Pre and the $Post$ 2001 is instrumented using the change in import penetration as defined in equation 1.9. In the first column I report the result of the first stage regression (equation 1.11): a increase in import penetration from China in other countries predicts a significant reduction in the the log sales for the firms in the affected sectors in Portugal. In columns from 2 to 5, the table presents the estimations of the firm level adjustments to a change in sales. A 10% reduction in sales predicts a 15.7% reduction in employment and a 16% reduction in the total wage bill. Zooming inside the firm I find that firms reduce employment in all layers of the hierarchy except at the very top level (panel A of table 1.15) Moreover, some adjustments are found also on the wages; indeed, firms reduce the average wages both in the bottom layer (production workers) and in the mid-managerial layer (panel B of table 1.15).[37] In line with papers looking at employment effects of negative trade shocks (see for example (Autor et al., 2013a), (Autor et al., 2013b) and (Autor et al., 2014a)),

[37]The wage rigidities in the Portuguese labour market suggest that firms adjust the average wage in the layer by changing the composition of workers in the layers, hence firing the most expensive(most tenured) ones. This is in line with the mechanisms found by (Caliendo et al., 2015b) for French exporters.

workers at the bottom of the hierarchy are more affected by a negative shock. Indeed, I find that the elasticity of employment decreases in magnitude going up in the hierarchy, with lower values for managers at the top of the pyramid. In table 1.14 I formally test how a drop in sales induced by an increase in import penetration from China changes the span of controls across adjacent layers in the firm. The pattern of reorganization is clear from the estimates presented in table 1.14: the ratio of team leaders per production workers increases with a drop in sales, suggesting that the firm reduces the demand for workers at the bottom of the hierarchy more than in the layer of team leaders. Moreover, firms decrease middle managers more than top managers (see column 3). This is consistent with the framework described in section 1.3.6, where firms react to a negative demand shock by adjusting the scale and the composition of the work force laying off proportionally in each layer of the hierarchical organization.

1.5 Robustness

How do contract types play a role in the firms' adjustment process to negative shocks? How do the results change constraining the sample to manufacturing only? In this section I explore the duality in contract types in the Portuguese economy to provide evidence of the role played by contract flexibility in allowing firms to reorganize more or less than less flexible counterparts. Moreover, I perform a set of robustness on the identification strategy and the results obtained in the previous sections.

Contract types

In a perfectly flexible and functioning labour market, firms could potentially reorganize their production in reaction of a shock without any constraint. However, with labour market frictions, reorganizations can be more problematic. The Portuguese legislation presents a wide contractual portfolio to choose from when a firm decides to hire a new employee, but the two main categories are permanent contracts and temporary contracts representing more than 95% of the entirety of contract types in the sample. The main characteristic of permanent contracts in southern European countries (Portugal, Italy, Spain and France) is the high degree of protection for the employee; indeed, the costs of firing a worker with a permanent contract are very high for the firm which is only willing to bear the costs in extreme situations. On the other hand, temporary contracts present very little protection for the workers.

The existence of a dual labour market - with permanent and temporary contracts - creates heterogeneity across firms when looking at reorganizations: firms with a high share of permanent contracts face higher frictions to reorganization which can ultimately lead to a sub-optimal outcome, while firms that rely more on temporary contracts can freely adjust to market changes in a more dynamic way.

I exploit the heterogeneity in contract types and construct a measure of firm *flexibility* that splits firms into flexible and non flexible. I define the following measure of firm *flexibility:*

$$Flex = \frac{Temporary_{i,2003}}{Total_{i,2003}} > \sum_{i=1,N} \frac{\frac{Temporary_{2003}}{Total_{2003}}}{N} \tag{1.13}$$

The dummy *Flex* is constructed using pre-sample variation in intensity in temporary contracts. For each firm in 2003 I measure the share of temporary contracts over the total of temporary and permanent contracts and I define the dummy *flex* to be equal to 1 if the firm share is above the mean of the sample (I will refer to this groups as of "flexible firms").[38]

I estimate equation 1.7 interacting the variable *flex* with the supply of credit both in the first stage and then in the second stage. Tables 1.17 and 1.18 report results of the estimation at the firm level (table 1.17) and layer level (table 1.18). Surprisingly, the coefficients of the interaction between the change in credit $\Delta ln(C_i)$ and the variable *flex* in all columns of table 1.17 have a lower magnitude that the coefficients for the change in credit $\Delta ln(C_i)$; flexible firms on average reduced employment and their wage bill less than their less flexible counterparts in the 5 years after the financial crisis. This apparently counterintuitive result aligns with the idea that flexibility increases the variance of firm employment by exacerbating immediate reaction to negative downturns, but also rehiring once out of the negative conjuncture. Table 1.18 reinforces the results from table 1.10: when looking inside the firm, the adjustment on the quantity of workers employed is bigger in the middle layers, even more when the firm is flexible. Flexible firms decrease less their total employment level 5 years after a negative credit supply shock; however, they adjust their internal organization by reducing the number of managers and middle managers more than non flexible firms, while the adjustment on the production workers side do not change across the two groups of firms. [39]

Placebo test of the parallel trends

A potential concern with the identification strategy presented in section 1.3.2 is that firms connected to bad or good banks might be on different trends before the

[38]The average share of temporary contracts in my sample in the year 2003 is 20%.

[39]The share of workers with temporary contracts in each layer is respectively 21% for production workers, 13% for team leaders, 8% for middle managers and 9% for top managers. This further highlights that the reaction of the firm is not entirely driven by the contractual composition of the workers in each layer of production, but rather by an economic mechanism that drives these adjustments.

shock.[40] One way to test the validity of the parallel trend assumption when using shift-share type instrument in combination with a time varying shock is to define a placebo timing for the shock.[41] In this section I present a test of the parallel trend imposing the shock to happen in 2005 instead of 2009.

I estimate the following first stage regression:

$$ln(C_{iPost}) - ln(C_{iPre}) = \beta Z_i + \gamma_s' + \nu_i \tag{1.14}$$

where Pre is defined in the years 2004 and 2005 and $Post$ is defined in 2006 and 2007. Using the years between 2004 and 2007 allows me to look at *normal* periods with no shock in the time period; I define the placebo shock to happen in 2005 and estimate the first stage defined in equation 1.14. Table 1.19 present a not statistically significant coefficient with an f-test below 1. The placebo confirms that in normal times there is no difference in the supply of credit to firms linked to more or less exposed banks conditional on time invariant firm characteristic and sector-time demand shocks. The result in table 1.19 provides strong evidence to support of the random matching of firms and banks in 2003 conditional on firms' time invariant characteristics; indeed, the identification strategy correctly isolates a channel from banks to firms that is driven by a variation in bank's exposure to the foreign interbank borrowing market that is exogenous to the firm and to the link between firms and banks.

[40] The potential endogeneity of the matching between firms and banks in the pre-sample is accounted for by the firm fixed-effects. If highly productive firms are matched with highly productive banks in a specific year (2003), the inclusion of firm fixed-effects controls for any differences across the two groups. However, firm fixed-effects cannot account for the possibility that the matching in the pre-sample places firms on different trajectories.

[41] An alternative is to modify the instrument using randomly generated weights and test if the instrument has predictive power in the first stage.

Constraining the sample to manufacturing

A potential concern with the identification strategy presented in section 1.3.2 and most importantly when comparing the reaction of the firm across the two different shocks, the credit shock and the trade shock, is to have a sample of firms that are hit by both shocks. Indeed, studying the demand drop induced by the rise of China as a global producer and exporter of manufacturing products, constraints the sample to be only of manufacturers.

To this end, I perform the estimations of sections 1.3.1 and 1.4 constraining the sample on the 15 manufacturing sectors only. In tables 1.20 to 1.22 I report the results for the estimation of the effect of the credit shock on the manufacturing firms only. Tables 1.20 and 1.21 confirm that the main finding of the paper holds when conditioning the sample on manufacturing firms; firms react to a credit shock by shrinking, but they do so especially in the middle of the organization by reducing the number of high skill workers and team leaders more than production workers.[42] Moreover, in tables 1.23 and 1.24 I report the estimate of the China shock on the manufacturing firms only. Results confirm that the firm readjust mainly at the bottom, cutting production workers mainly. Indeed, when conditioning on manufacturing firms, I find that the adjustment happens only at the bottom of the hierarchy, while no effect is found on managerial positions of any level. This further strenghten the mechanism described in section 1.3.6: credit is complementary with workers, but the degree of complementarity is heterogeneous across the layers of the hierarchy of the firm. A credit shock has a differential effect on different layers depending on the degree of complementarity, namely the elasticity of the workers in the layer to a change in working capital available

[42]The list of sectors does not include construction both when using the full sample in the main analysis and when constraining the sample to manufacturing only. The reason is that the construction sector had a dramatic drop in the aftermath of the financial crisis of 2009, with a dramatic increase in sectoral unemployment rate; including construction would hugely increase the estimates and drive most of the findings.

to the firm. On the other hand, a trade shock that shifts the demand faced by the firm, leads to a decrease in the quantity produced, which for a manufacturing firm—with flatter organizational structures—immediately translates into a drop in demand for low skill production workers.

Dynamics: permanent or temporary shock?

The organizational choice of the firm is the results of a complex process: first, the enterpreneur observes the level of demand for the product she want to produce and then decides how to organize production. Obviously, the investement in the organizational structure by adding a layer of management depends on the scale of the output, and it does not immediately respond to minor changes to the demand level or input costs.[43] Changes in the organization are associated with permanent shocks: the firm is only willing to pay the fixed cost of adding a new management layer if the demand is expected to stay on a higher level for more than one period. On the other hand, the cost of restructuring by skrinking the organization will be incurred by the firm if the shift in the production possibility is permanent.[44]

A possible way to test the persistence of the shock is to look at the evolution of the coefficient one year, two years, three years, four years and five years after the shock. In graph 1.5, I plot the coefficients obtained by constraining the post period to one, two, three, four and five years in equation 1.7. The observed pattern is reassuring and confirms the results of tables 1.9 and 1.10: firms immediately react to the credit shock by laying off high skill workers and production workers, and they consistently do so over the five years of the post period. This

[43] This is especially relevant in economies with labour markets rigidities, which augment the costs of hiring as well as the costs of firing workers.

[44] Besides the costs of firing, when firms re-organize by decreasing the number of workers employed, they take into account the future costs of searching and hiring new workers when the shock is reversed.

confirms the persistence of the credit shock, and also help explaining why we observe substantial firm reorganizations.

Long term credit

Section 1.3.6 describes a simple mechanism that links working capital financed through short term credit to the organization of the firm, proposing a novel working-capital layer complementarity. Moreover, section 1.4 shows that a demand shock induces a different adjustment to the organization of the firm, while section 1.5 confirms that the differential adjustment does not depend on the transitory nature of the credit shock. A formal test of the mechanisms requires detailed information on the working capital use by layer, which is not available in the Portuguese firm level data.[45]

A further step in understanding the mechanism can be done using credit maturities: if long term credit has a similar effect on the organization, it would invalidate the idea behind the mechanism. In this section, I test what is the effect of a drop in supply of long term credit on the organization of the firm. Table 1.26 presents the estimates of equation 1.7 using credit with maturity above one year. Results confirm that long term credit does not have any effect in predicting the number of workers, the wage bill and the number of layers of the firm. Long term credit is mainly used to finance long term investments in structures and or plant expansions, so it is difficult to link with the investments in the labour component of the organization of the firm.

[45]This paper is part of a broader reseach agenda that aims at understanding how the organization of the firm affects firm performance. Future research aims at collecting new survey data on the of working capital by layer, information technology used in the firm and R&D expenditures.

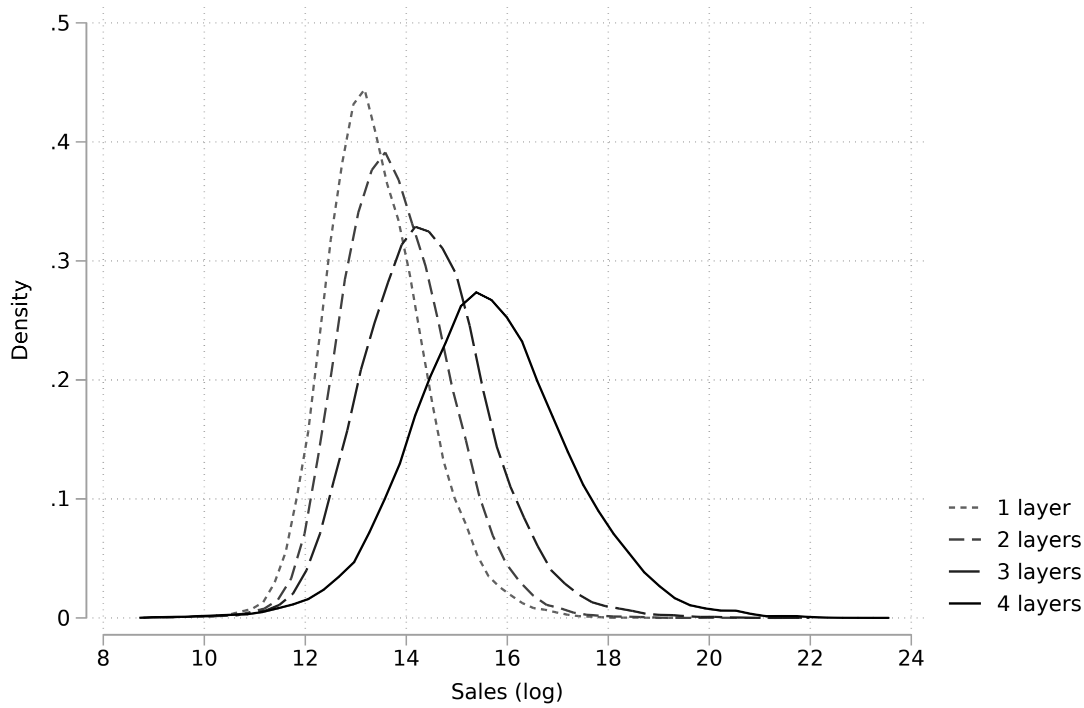
1.6 Conclusion

This paper estimates the elasticity of the organization of the firm to credit supply shock and compares the organizational reaction of the firm to a trade shock, namely the China shock. I find that a reduction to the supply of short term credit affects the size of the firm and the organization of the workforce. Moreover, when faced with a restriction in credit, firms adjust their hierarchies by reducing the number of layers. In particular, firms shrink more in the middle of the production hierarchy when hit by a credit shock, while the adjustment is proportional when firms react to a trade shock; this reaction is consistent with a working capital layer complementarity mechanism that forces the firm to adjust more on the high skill production workers in reaction to a shrinkage in the availability of working capital. These effects reveal the importance of credit channels to the determination of the organization of the firm and calls for further investigation to understand the welfare effects of such reorganizations.

I follow (Paravisini et al., 2015b) and use an estimation strategy that exploits the exposure of banks to the foreign interbank borrowing market to instrument for the supply of credit. Moreover, the drop in the liquidity available in the interbank market in the aftermath of Lehman bankruptcy provides an exogenous shock to study the differential change in credit supply to more and less exposed firms in the Portuguese economy. I reinforce the validity of the empirical strategy by performing a set of robustness to check the validity of the instrument and the importance of labour contracts.

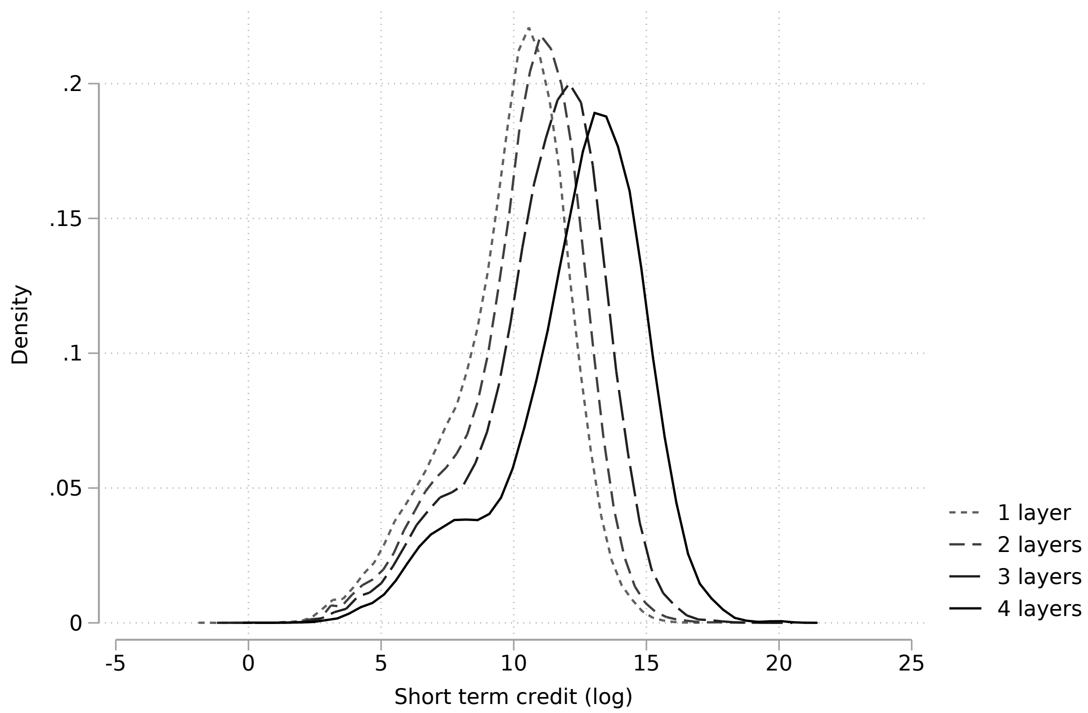
The overall picture points at the importance of credit in the transmission of shocks from banks to the real economy. When hit by a negative credit supply shock firms shrink more in the middle of the hierarchy, reducing employment of higher-skill workers more than lower-skill production workers at the bottom of the hierarchy. In contrast, when hit by a negative trade shock the reduction is more pronounced for lower-skill production workers and decreases proportionally going up to managerial positions. The empirical findings highlight a novel heterogeneity in the degree of complementarity between working capital and each hierarchical layers. A shock to one specific input of production—working capital—translates into a stronger reduction of higher-skill workers than of production workers, while top managerial positions are not affected. Consistent with the framework, a trade induced demand shock affects the scale of the firm, hence firms layoff proportionally in all layers. Further investigation is needed to better understand the mechanism and provide a formal empirical test of its functioning.

FIGURE 1.1: Distribution of firms' hierarchy by sales



Notes: This figure report kernel density estimates of the distribution of log sales by number of layers in the firm. One density is estimated for each group of firms with the same number of layers.

FIGURE 1.2: Distribution of firms' hierarchy by credit

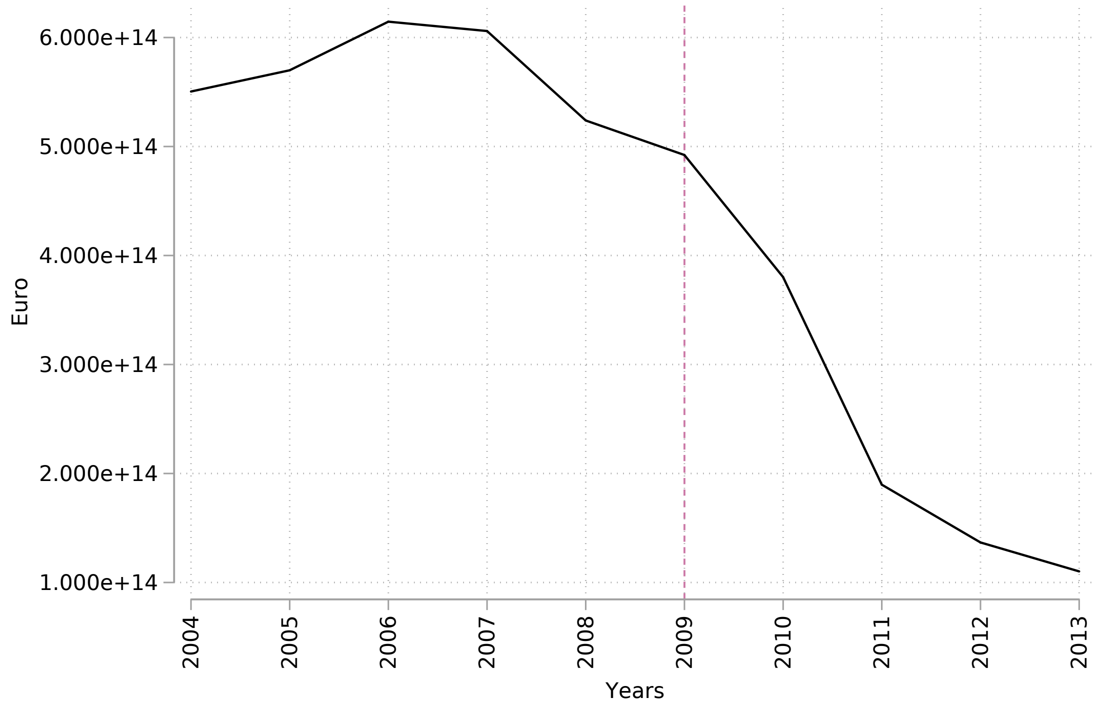


Notes: This figure report kernel density estimates of the distribution of log short term credit by number of layers in the firm. One density is estimated for each group of firms with the same number of layers.

FIGURE 1.3: Credit shock

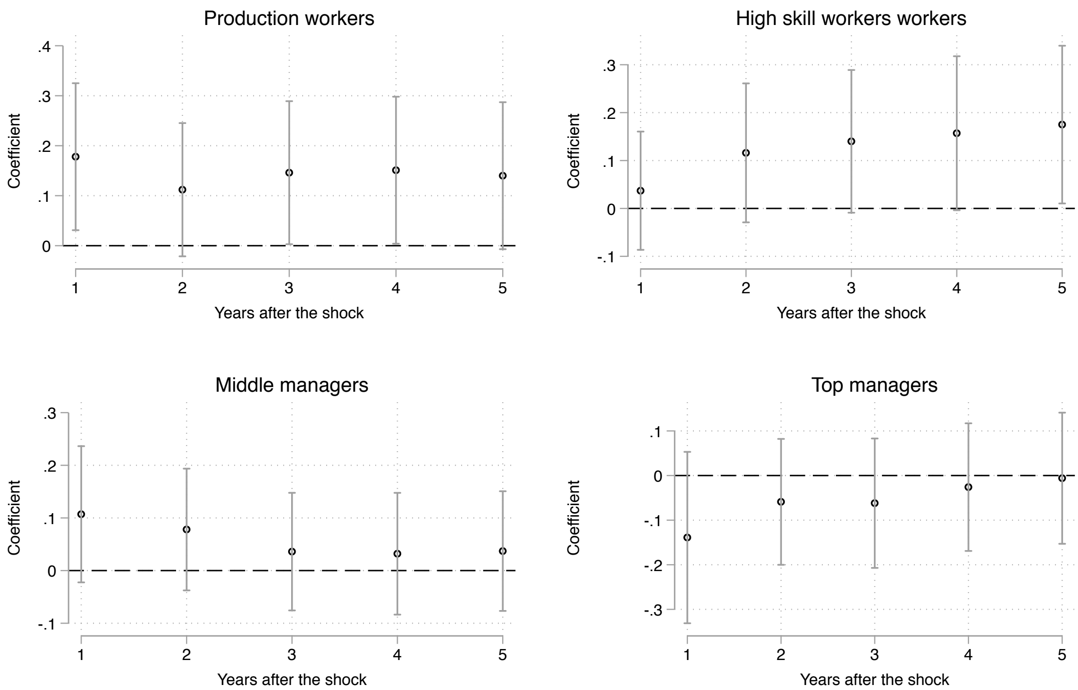
Notes: This figure report the total amount of short term credit with maturity up to one year lended lended in the Portuguese economy for the firms and banks in the sample. The red dotted vertical line in correspondence to year 2009 is the Lehman shock. Values on the vertical axis are in Euros.

FIGURE 1.4: Interbank market shock



Notes: This figure report the total exposure of Portuguese banks to the foreign interbank borrowing market. The red dotted vertical line in correspondence to year 2009 is the Lehman shock. Values on the vertical axis are in Euros.

FIGURE 1.5: Dynamics



Notes: This figure report the evolution of the estimated elasticities (and the corresponding confidence interval) of each layer to credit, respectively 1, 2, 3, 4 and 5 years after the shock in 2009. Values on the vertical axis are in percentages.

TABLE 1.1: Firm-level descriptives

	Mean	*S.d*	*Min*	*Max*	*Firm-year*
Wage bill	522,801	4066829	5615.441	2.93e+08	1,471,063
# workers	30.28	191.25	1	15359	1,471,063
Tot. Sales	6,648,312	6.20e+07	5011.533	1.05e+10	1,471,063
# management layers	1.24	1.07	0	3	1,471,063
Tot. credits	294,582	3,488,805	0	1.03e+09	1,471,063
Short term Credit	208,165	2,280,285	0	7.11e+08	1,471,063
Bank x firm	2.23	1.57	1	8	1,471,063

Notes: This table reports descriptive statistics for all the variables used in the regressions. All the values in the table are an average over all the firms in the sample and all the years, from 2004 to 2013. The wage bill is calculated adding the monthly base and overtime wages plus regular benefits and multiplying by 14. I apply a trimming of the top and bottom 0.5 per cent within each year. A firm wage bill is the sum of the annual wages of all its workers. The number of workers is the sum total number of workers in the firm in the year. A firm reporting c occupational categories will be said to have $L = c - 1$ layers of management: hence, in our data we will have firms spanning from 0 to 3 layers of management (as in (Caliendo et al., 2015a)). In terms of layers within a firm we do not keep track of the specific occupational categories but simply rank them. Hence a firm with occupational categories 2 and 0 will have 1 layer of management, and its organization will consist of a layer 0 corresponding to some skilled and non-skilled professionals, and a layer 1 corresponding to intermediary executives and supervisors. Short term credit computed summing all the bank credit with maturity up to 1 year for a firm in a given calendar year. Bank per firm is the number of bank relationships each firm has.

TABLE 1.2: Percentage of firms that satisfy hierarchy in wages

# layers	$w_L^l \leq w_L^{l+1}$ all l	$w_L^0 \leq w_L^1$	$w_L^1 \leq w_L^2$	$w_L^2 \leq w_L^3$
1	0.82	0.82		
2	0.70	0.85	0.85	
3	0.61	0.90	0.87	0.82

Notes: This table reports the fraction of firms that satisfy a hierarchy in hours, grouping firms by their number of layers of management (# number of layers). Hours N_L^l is the number of hours reported in layer l in an L layers of management firm. For $L = 1, 2, 3$, and $l = 0, ..., L - 1$ we say that a firm satisfies a hierarchy in hours between layers number l and $l + 1$ in a given year if $N_L^l \geq N_L^{l+1}$, i.e. if the number of hours worked in layer l is at least as large as the number of hours worked in layer $l + 1$; moreover, we say that a firm satisfies a hierarchy at all layers if $N_L^l \geq N_L^{l+1}$ $\forall l = 0, ..., L - 1$, i.e. if the number of hours worked in layer l is at least as large as the number of hours in layer $l + 1$, for all layers in the firm. Following these definitions, the top panel reports, among all firms with $L = 1, 2, 3$ layers of management, the fraction of those that satisfy a hierarchy in wages at all layers (first column), and the fraction of those that satisfy a hierarchy in wages between layer l and $l + 1$, with $l = 0, ..., L - 1$ (second to fourth column). All the values in the table are an average over all the firms in the sample and all the years, from 2004 to 2013

TABLE 1.3: Firm-level descriptives by number of layers

		Mean				
# layers	*Firm-year*	*Sales*	*Hours*	*Hourly wage*	*Short term credit*	*Long term credit*
0	6,830	1,856,666	36,014	5.36	83,927	322,388
1	31,518	3,389,909	43,170	5.73	163,575	462,767
2	50,637	6,912,070	67,747	6.66	337,968	782,710
3	47,454	28,893,688	235,215	7.81	1,386,366	2,585,667

Notes: This table reports descriptive statistics by number of layers. Each row shows the average sales, hours worked, hourly wage and short term (maturity below 1 year) and long term (maturity above 1 year) credit for firms with a certain hierarchical structure ($L = 0, 1, 2, 3$). All the values in the table are an average over all the firms in the sample and all the years, from 2004 to 2013.

TABLE 1.4: Distribution of layers at $t+1$ conditional on layers at t

		# of layers in $t+1$					
		Exit	0	1	2	3	Total
	0	32.16	45.20	18.85	3.44	0.35	100.00
# layers t	1	27.55	6.20	52.78	12.20	1.27	100.00
	2	21.41	1.06	12.80	55.96	8.77	100.00
	3	13.74	0.21	2.00	14.48	69.57	100.00
	New	87.26	2.62	5.46	3.41	1.24	100.00

Notes: This table reports the distribution of the number of layers of management at time t+1, grouping firms according to the number of layers of management at time t. Among all firms with L layers of management (L = 0,...,3) in any year from 2003 to 2012, the columns report the fraction of firms that have layers 0, ..., 3 the following year (from 2004 to 2013), or are not present in the dataset, Exit. The table also reports, in the bottom row, the distribution of the new firms by their initial number of layers. The elements in the table sum to 100% by row.

TABLE 1.5: Credit shock OLS - firm level

	(1)	(2)	(3)	(4)
Δ ln	*# workers*	*wage bill*	*wage bill det.*	*# layers*
Δ ln (Credit)	0.038***	0.040***	0.041***	0.012***
	(0.003)	(0.003)	(0.003)	(0.001)
Observations	13,618	13,618	13,618	13,618
Sector FE	Yes	Yes	Yes	Yes

Notes: This table reports the resultsof the within firm estimation of equation 1.2. The independent variable, $\Delta ln(Credit)$ is the log change of short term credit with maturity up to one year between a pre-period, namely from 2004 to 2009 and a post period, from 2009 to 2013. The dependent variables are log changes of the averages before and after the shock. The number of workers employed in the firm is the total amount of workers employed by the firm in the calendar year, the wage bill is the total amount of wages (base plus overtime) payed by the firm in each calendar year, the wage bill de-trended is the total amount of workers employed by the firm in the calendar year de-trended using a standard linear de-trending methodology to take out normal business cycle variation, while the number of layers is the number of management layers in the firm. A firm reporting c occupational categories will be said to have L = c − 1 layers of management: hence, in our data we will have firms spanning from 0 to 3 layers of management (as in (Caliendo et al., 2015a)). Robust standard errors in parenthesis.

TABLE 1.6: Credit shock OLS - layer level

Panel A: change in the number of workers in each layer				
	(1)	(2)	(3)	(4)
Δ ln (number)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
Δ ln (C_i)	0.026***	0.041***	0.025***	0.016***
	(0.004)	(0.005)	(0.004)	(0.005)

Panel B: change in the average wage in each layer				
	(1)	(2)	(3)	(4)
Δ ln (wage)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
Δ ln (C_i)	0.002*	0.001	0.002	0.001
	(0.001)	(0.001)	(0.002)	(0.003)
Observations	13,618	13,119	10,322	5,253
Firm FE	Yes	Yes	Yes	Yes

Notes: This table reports the results of the within firm estimation of equation 1.7 at the layer level. The independent variable, *Δ ln* (C_i) is the log change of short term credit with maturity up to one year between a pre-period, namely from 2004 to 2009 and a post period, from 2009 to 2013. In panel A I look at the quantities, and the dependent variables are log changes of the averages number of workers in each managerial layer before and after the shock, while in panel B I look at the prices and the dependent variable is the average wage in each managerial layer. The production workers are workers dealing with simple well defined tasks, mainly manual or mechanical (no intellectual work) with low complexity, usually routine and sometimes repetitive. Workers in layer 1, namely higher-skill workers or team leaders, deal with complex or delicate tasks, usually not repetitive, and defined by the superiors. Middle managers deal with the organization and adaptation of the guidelines established by the superiors and directly linked with the executive work while workers in the top layer are in charge of the definition of the firm general policy or consulting on the organization of the firm; strategic planning; creation or adaptation of technical, scientific and administrative methods or processes. Robust standard errors in parenthesis.

TABLE 1.7: Identification of the credit supply shock

	Δ *ln* (C_{ib})		
	(1)	*(2)*	*(3)*
FD_b	-1.831***		
	(0.108)		
$FD_b > p50(FD_b)$		-0.616***	
		(0.02)	
$FD_b > mean(FD_b)$			-0.480***
			(0.02)
Observations	36,459	36,459	36,459
R^2	0.467	0.475	0.470
Firm FE	Yes	Yes	Yes

Notes: This table reports the estimation of equation 1.3 in first differences for the period 2004-2013. FD_b is the measure of foreign dependence of bank b to the interbank borrowing market as a share of total assets of the bank in a pre-sample year, 2003. I estimate 1.3 both using a linear function of FD, FD_b as well as indicators for banks that have an exposure to the foreign interbank borrowing market above the median of the banks in 2003, $FD_b > p50(FD_b)$ or above the mean of the banks in 2003, $FD_b > mean(FD_b)$. The dependent variable, $\Delta ln(Credit)$ is the log change of short term credit with maturity up to one year between a pre-period, namely from 2004 to 2009 and a post period, from 2009 to 2013. Robust standard errors in parenthesis.

TABLE 1.8: Credit shock - first stage

	$\Delta\, ln\ (C_i)$			
	(1)	(2)	(3)	(4)
$\sum_b w_{ib} * \{FD_b > p50(FD_b)\}$	-0.107***			
	(0.027)			
$\sum_b w_{ib} * \{FD_b > mean(FD_b)\}$		-0.143***		
		(0.020)		
$\sum_b w_{ib} * FD_b$			-1.233***	3.25***
			(0.204)	(0.90)
$\sum_b w_{ib} * FD_b^2$				-17.56***
				(3.63)
$\sum_b w_{ib} * FD_b^3$				14.72***
				(3.41)
Observations	12,657	12,657	12,657	12,657
F-Statistic	10.17	15.77	36.38	35.40
Firm FE	Yes	Yes	Yes	Yes

Notes: This table reports the estimation of the first stage as defined in equation 1.6 in first differences for the period 2004-2013. FD_b is the measure of foreign dependence of bank b to the interbank borrowing market as a share of total assets of the bank in a pre-sample year, 2003. I estimate 1.6 both using a linear function of FD, FD_b as well as indicators for banks that have an exposure to the foreign interbank borrowing market above the median of the banks in 2003, $FD_b > p50(FD_b)$ or above the mean of the banks in 2003, $FD_b > mean(FD_b)$. w_{ib} are the shares of funding from each bank over the total loans of firm i. The dependent variable, $\Delta ln(Credit)$ is the log change of short term credit with maturity up to one year between a pre-period, namely from 2004 to 2009 and a post period, from 2009 to 2013. Robust standard errors in parenthesis.

TABLE 1.9: Credit shock IV - span of control

	(1)	(2)	(3)
Δ *ln*	$\frac{\textit{Team leaders}}{\textit{Prod. workers}}$	$\frac{\textit{Middle manager}}{\textit{Team leaders}}$	$\frac{\textit{Top manager}}{\textit{Middle manager}}$
Δ *ln* $\widehat{C}_i$	0.215*	-0.156	0.065
	(0.129)	(0.118)	(0.124)
Observations	11,123	8,506	5,533
Sector FE	Yes	Yes	Yes

Notes: This table reports the results of the within firm estimation of equation 1.7. The independent variable, Δ *ln* $\widehat{C}_i$ is the predicted change in credit to firm i instrumented using a linear function of FD, FD_b to construct the instrument. The dependent variables are log changes of the averages before and after the shock. The ratios are computed using the total number of workers in each occupation category. In column 1 the dependent variable is the log change in the ratio of team leaders to production workers; in column 2 is the log change in the ratio of middle managers to team leaders; in column 3 is the log change in the ratio of top managers to middle managers. Robust standard errors in parenthesis.

TABLE 1.10: Credit shock IV - layer level

Panel A: change in the number of workers in each layer				
	(1)	(2)	(3)	(4)
Δ ln (number)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
Δ ln $\widehat{C_i}$	0.140*	0.175**	0.037	-0.006
	(0.075)	(0.084)	(0.058)	(0.075)
Panel B: change in the average wage in each layer				
	(1)	(2)	(3)	(4)
Δ ln (wage)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
Δ ln $\widehat{C_i}$	0.01	0.032	0.022	-0.016
	(0.013)	(0.028)	(0.030)	(0.039)
Observations	12,657	12,657	12,657	12,657
First stage F-Stat	34.30	34.30	34.30	34.30
Firm FE	Yes	Yes	Yes	Yes

Notes: This table reports the estimation of the second stage as defined in equation 1.7 in first differences for the period 2004-2013 at the layer level. *Δ ln* $\widehat{C_i}$ is the predicted change in credit to firm i instrumented using a linear function of FD, FD_b to construct the instrument. In panel A I look at the quantities, and the dependent variables are log changes of the averages number of workers in each managerial layer before and after the shock, while in panel B I look at the prices and the dependent variable is the average wage in each managerial layer. The production workers are workers dealing with simple well defined tasks, mainly manual or mechanical (no intellectual work) with low complexity, usually routine and sometimes repetitive. Workers in layer 1, namely higher-skill workers or team leaders, deal with complex or delicate tasks, usually not repetitive, and defined by the superiors. Middle managers deal with the organization and adaptation of the guidelines established by the superiors and directly linked with the executive work while workers in the top layer are in charge of the definition of the firm general policy or consulting on the organization of the firm; strategic planning; creation or adaptation of technical, scientific and administrative methods or processes. Robust standard errors in parenthesis.

TABLE 1.11: Credit shock IV - firm level

	(1)	(2)	(3)	(4)
Δ ln	*# workers*	*wage bill*	*wage bill det.*	*# layers*
$\Delta\ ln\ \widehat{C}_i$	0.182***	0.199***	0.189***	0.137**
	(0.049)	(0.052)	(0.053)	(0.059)
Observations	12,657	12,657	12,657	12,657
First stage F-Stat	42.63	42.63	42.63	42.63
Firm FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes

Notes: This table reports the estimation of the second stage as defined in equation 1.7 in first differences for the period 2004-2013. $\Delta\ ln\ \widehat{C}_i$ is the predicted change in credit to firm i instrumented using a linear function of FD, FD_b to construct the instrument. The dependent variables are log changes of the averages before and after the shock. The number of workers employed in the firm is the total amount of workers employed by the firm in the calendar year, the wage bill is the total amount of wages (base plus overtime) payed by the firm in each calendar year, the wage bill de-trended is the total amount of workers employed by the firm in the calendar year de-trended using a standard linear de-trending methodology to take out normal business cycle variation, while the number of layers is the number of management layers in the firm. A firm reporting c occupational categories will be said to have L = c − 1 layers of management: hence, in our data we will have firms spanning from 0 to 3 layers of management (as in (Caliendo et al., 2015a)). Robust standard errors in parenthesis.

TABLE 1.12: Trade shock OLS - firm level

	(1)	(2)	(3)	(4)
Δ ln	*# workers*	*wage bill*	*wage bill det.*	*# layers*
Δ ln $(Sales_i)$	0.254***	0.271***	0.271***	0.134***
	(0.014)	(0.014)	(0.014)	(0.006)
Observations	12,285	12,285	12,285	12,285
Sector FE	Yes	Yes	Yes	Yes

Notes: This table reports the results of the within firm estimation of equation 1.10. The independent variable, $\Delta ln(Sales_i)$ is the log change of de-trended sales between a pre-period, namely from 1998 to 2001 and a post period, from 2002 to 2004. The dependent variables are log changes of the averages before and after the shock. The number of workers employed in the firm is the total amount of workers employed by the firm in the calendar year, the wage bill is the total amount of wages (base plus overtime) payed by the firm in each calendar year, the wage bill de-trended is the total amount of workers employed by the firm in the calendar year detrended using a standard linear de-trending methodology to take out normal business cycle variation, while the number of layers is the number of management layers in the firm. A firm reporting c occupational categories will be said to have L = c − 1 layers of management: hence, in our data we will have firms spanning from 0 to 3 layers of management (as in (Caliendo et al., 2015a)). Robust standard errors in parenthesis.

TABLE 1.13: Trade shock OLS - layer level

Panel A: change in the number of workers in each layer				
	(1)	(2)	(3)	(4)
Δ ln (number)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
$\Delta ln\ (Sales_i)$	0.227***	0.194***	0.129***	0.089***
	(0.015)	(0.014)	(0.013)	(0.014)
Observations	12,285	11,629	8,280	3,961
Sector FE	Yes	Yes	Yes	Yes

Panel B: change in the average wage in each layer				
	(1)	(2)	(3)	(4)
Δ ln (wage)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
$\Delta\ ln\ (Sales_i)$	0.010***	0.015***	0.015***	0.027***
	(0.003)	(0.003)	(0.005)	(0.006)
Observations	12,285	11,629	8,280	3,961
Sector FE	Yes	Yes	Yes	Yes

Notes: This table reports the results of the within firm estimation of equation 1.10 at the layer level. The independent variable, $\Delta ln(Sales_i)$ is the log change of de-trended sales between a pre-period, namely from 1998 to 2001 and a post period, from 2002 to 2004. The dependent variables are log changes of the averages number of workers in each managerial layer before and after the shock. The production workers in column 1 are workers dealing with simple well defined tasks, mainly manual or mechanical (no intellectual work) with low complexity, usually routine and sometimes repetitive. Workers in layer 1, namely higher-skill workers or team leaders, deal with complex or delicate tasks, usually not repetitive, and defined by the superiors. Middle managers deal with the organization and adaptation of the guidelines established by the superiors and directly linked with the executive work while workers in the top layer are in charge of the definition of the firm general policy or consulting on the organization of the firm; strategic planning; creation or adaptation of technical, scientific and administrative methods or processes. Robust standard errors in parenthesis.

TABLE 1.14: Trade shock IV - span of control

Δ *ln*	(1) *Team leaders* / *Prod. workers*	(2) *Middle manager* / *Team leaders*	(3) *Top manager* / *Middle manager*
Δ ln $\widehat{Sales_i}$	-0.826***	-0.142	-0.469***
	(0.129)	(0.124)	(0.171)
Observations	10,785	7,164	4,268
Sector FE	Yes	Yes	Yes

Notes: This table reports the results of the within firm estimation of equation 1.12. The independent variable, $\Delta ln(\widehat{Sales_i})$ is the log change of de-trended sales between a pre-period, namely from 1998 to 2001 and a post period, from 2002 to 2004. The dependent variables are log changes of the averages before and after the shock. The ratios are computed using the total number of workers in each occupation category. In column 1 the dependent variable is the log change in the ratio of team leaders to production workers; in column 2 is the log change in the ratio of middle managers to team leaders; in column 3 is the log change in the ratio of top managers to middle managers. Robust standard errors in parenthesis.

TABLE 1.15: Trade shock IV - layer level

Panel A: change in the number of workers in each layer

	(1)	(2)	(3)	(4)
Δ ln (number)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
Δ ln $(\widehat{Sales_i})$	1.395***	0.604***	0.238***	-0.020
	(0.125)	(0.078)	(0.077)	(0.102)
Observations	12,285	11,629	8,280	3,961
Sector FE	Yes	Yes	Yes	Yes

Panel B: change in the average wage in each layer

	(1)	(2)	(3)	(4)
Δ ln (wage)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
Δ ln $(\widehat{Sales_i})$	0.125***	0.037	0.128***	-0.089
	(0.025)	(0.032)	(0.044)	(0.068)
Observations	12,285	11,629	8,280	3,961
Sector FE	Yes	Yes	Yes	Yes

Notes: This table reports the results of the within firm estimation of equation 1.10 at the layer level. The independent variable, $\Delta ln(\widehat{Sales_i})$ is the log change of de-trended sales between a pre-period, namely from 1998 to 2001 and a post period, from 2002 to 2004. The dependent variables are log changes of the averages number of workers in each managerial layer before and after the shock. The production workers in column 1 are workers dealing with simple well defined tasks, mainly manual or mechanical (no intellectual work) with low complexity, usually routine and sometimes repetitive. Workers in layer 1, namely higher-skill workers or team leaders, deal with complex or delicate tasks, usually not repetitive, and defined by the superiors. Middle managers deal with the organization and adaptation of the guidelines established by the superiors and directly linked with the executive work while workers in the top layer are in charge of the definition of the firm general policy or consulting on the organization of the firm; strategic planning; creation or adaptation of technical, scientific and administrative methods or processes. Robust standard errors in parenthesis.

TABLE 1.16: Trade shock IV - firm level

	(1)	(2)	(3)	(4)	(5)
	Δ ln (sales)	*Δ ln*			
		# workers	*wage bill*	*wage bill det.*	*# layers*
$\Delta IP^{Other}_{s,t}$	-0.177***				
	(0.016)				
$\Delta\, ln\ (\widehat{Sales_i})$		1.572***	1.631***	1.626***	0.040
		(0.129)	(0.134)	(0.134)	(0.082)
F-test	118.99	118.99	118.99	118.99	118.99
Observations	12,285	12,285	12,285	12,285	12,285

Notes: In column 1 the table reports the first stage regression as defined in equation 1.11; the independent variable is $\Delta IP^{Other}_{s,t}$ and the dependent variable is the change in log sales. From column 2 to column 5 I report the estimation of equation 1.12. The independent variable, $\Delta ln(Sales_i)$ is the log change of de-trended sales between a pre-period, namely from 1998 to 2001 and a post period, from 2002 to 2004 and is instrumented using the definition of import penetration in equation 1.9. The dependent variables are log changes of the averages before and after the shock. The number of workers employed in the firm is the total amount of workers employed by the firm in the calendar year, the wage bill is the total amount of wages (base plus overtime) payed by the firm in each calendar year, the wage bill de-trended is the total amount of workers employed by the firm in the calendar year de-trended using a standard linear de-trending methodology to take out normal business cycle variation, while the number of layers is the number of management layers in the firm. A firm reporting c occupational categories will be said to have L = c − 1 layers of management: hence, in our data we will have firms spanning from 0 to 3 layers of management (as in (Caliendo et al., 2015a)). Robust standard errors in parenthesis.

TABLE 1.17: Credit shock IV - temporary contracts

	(1)	(2)	(3)	(4)
Δ ln	*# workers*	*wage bill*	*wage bill det.*	*# layers*
$\Delta\, ln\, \widehat{C}_i$	0.241***	0.266***	0.257***	0.119*
	(0.054)	(0.057)	(0.059)	(0.070)
Temporary	-0.040*	-0.047**	-0.045*	-0.009
	(0.022)	(0.023)	(0.024)	(0.029)
$\Delta\, ln\, \widehat{C}_i$ * *Temporary*	0.200*	0.233**	0.228**	-0.037
	(0.104)	(0.111)	(0.115)	(0.139)
Observations	13,225	13,225	13,225	13,225
Sector FE	Yes	Yes	Yes	Yes

Notes: This table reports the estimation of the second stage as defined in equation 1.7 in first differences for the period 2004-2013 interacting the instrument with the measure of intensity in temporary contracts as defined in equation 1.13. FD_b is the measure of foreign dependence of bank b to the interbank borrowing market as a share of total assets of the bank in a pre-sample year, 2003. I estimate 1.7 with the interaction for the intensity in temporary contracts using a linear function of FD, FD_b to construct the instrument. The dependent variables are log changes of the averages before and after the shock. The number of workers employed in the firm is the total amount of workers employed by the firm in the calendar year, the wage bill is the total amount of wages (base plus overtime) payed by the firm in each calendar year, the wage bill de-trended is the total amount of workers employed by the firm in the calendar year de-trended using a standard linear de-trending methodology to take out normal business cycle variation. Robust standard errors in parenthesis.

TABLE 1.18: Credit shock IV - temporary contracts

	(1)	(2)	(3)	(4)
Δ ln (number)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
$\Delta\ ln\ \widehat{C}_i$	0.204**	0.327***	0.109	-0.015
	(0.087)	(0.093)	(0.077)	(0.104)
Temporary	-0.026	-0.094*	-0.018	0.034
	(0.036)	(0.038)	(0.031)	(0.043)
$\Delta\ ln\ \widehat{C}_i$ * *Temporary*	0.196	0.578***	0.318**	0.005
	(0.175)	(0.186)	(0.155)	(0.203)
Observations	13,225	12,247	10,080	5,167
Sector FE	Yes	Yes	Yes	Yes

Notes: This table reports the estimation of the second stage as defined in equation 1.7 in first differences for the period 2004-2013 interacting the instrument with the measure of intensity in temporary contracts as defined in equation 1.13 at the layer level. FD_b is the measure of foreign dependence of bank b to the interbank borrowing market as a share of total assets of the bank in a pre-sample year, 2003. I estimate 1.7 with the interaction for the intensity in temporary contracts using a linear function of FD, FD_b to construct the instrument. The dependent variables are log changes of the averages number of workers in each managerial layer before and after the shock. The production workers in column 1 are workers dealing with simple well defined tasks, mainly manual or mechanical (no intellectual work) with low complexity, usually routine and sometimes repetitive. Workers in layer 1, namely higher-skill workers or team leaders, deal with complex or delicate tasks, usually not repetitive, and defined by the superiors. Middle managers deal with the organization and adaptation of the guidelines established by the superiors and directly linked with the executive work while workers in the top layer are in charge of the definition of the firm general policy or consulting on the organization of the firm; strategic planning; creation or adaptation of technical, scientific and administrative methods or processes. Robust standard errors in parenthesis.

TABLE 1.19: Placebo using 2005

	Δ ln (C_i)
$\sum_b w_{ib} * FD_b$	-0.159
	(0.163)
Observations	13,534
F-test	0.94
Sector FE	Yes

Notes: This table reports the estimation of the first stage as defined in equation 1.14 in first differences for the period 2004-2007. I use the instrument constructed using information in 2003 to test if it has predictive power when used to a different period of time and a placebo shock defined in the year 2005. FD_b is the measure of foreign dependence of bank b to the interbank borrowing market as a share of total assets of the bank in a pre-sample year, 2003. The dependent variable, $\Delta ln(Credit)$ is the log change of short term credit with maturity up to one year between a pre-period, namely from 2004 to 2005 and a post period, from 2006 to 2007. Robust standard errors in parenthesis.

TABLE 1.20: Credit shock IV - span of control - manufacturing only

	(1)	(2)	(3)
Δ ln	*Team leaders / Prod. workers*	*Middle manager / Team leaders*	*Top manager / Middle manager*
Δ ln $\widehat{C}_i$	0.401*	-0.190	0.017
	(0.230)	(0.185)	(0.141)
Observations	4,825	3,627	2,303
Sector FE	Yes	Yes	Yes

Notes: This table reports the results of the within firm estimation of equation 1.7. The independent variable, *Δ ln* $\widehat{C}_i$ is the predicted change in credit to firm i instrumented using a linear function of FD, FD_b to construct the instrument. The dependent variables are log changes of the averages before and after the shock. The ratios are computed using the total number of workers in each occupation category. In column 1 the dependent variable is the log change in the ratio of team leaders to production workers; in column 2 is the log change in the ratio of middle managers to team leaders; in column 3 is the log change in the ratio of top managers to middle managers. Robust standard errors in parenthesis.

TABLE 1.21: Credit shock IV - layer level - manufacturing only

Panel A: change in the number of workers in each layer				
	(1)	(2)	(3)	(4)
Δ ln (number)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
Δ ln $\widehat{C_i}$	0.163*	0.298*	0.102	-0.037
	(0.095)	(0.166)	(0.084)	(0.080)
Panel A: change in the number of workers in each layer				
	(1)	(2)	(3)	(4)
Δ ln (wage)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
Δ ln $\widehat{C_i}$	0.061**	0.128**	0.089*	0.017
	(0.028)	(0.056)	(0.050)	(0.049)
Observations	5,340	5,166	4,116	2,195
First stage F-Stat	18.83	18.83	18.83	18.83
Firm FE	Yes	Yes	Yes	Yes

Notes: This table reports the estimation of the second stage as defined in equation 1.7 in first differences for the period 2004-2013 at the layer level. *Δ ln* $\widehat{C_i}$ is the predicted change in credit to firm i instrumented using a linear function of FD, FD_b to construct the instrument. In panel A I look at the quantities, and the dependent variables are log changes of the averages number of workers in each managerial layer before and after the shock, while in panel B I look at the prices and the dependent variable is the average wage in each managerial layer. The production workers are workers dealing with simple well defined tasks, mainly manual or mechanical (no intellectual work) with low complexity, usually routine and sometimes repetitive. Workers in layer 1, namely higher-skill workers or team leaders, deal with complex or delicate tasks, usually not repetitive, and defined by the superiors. Middle managers deal with the organization and adaptation of the guidelines established by the superiors and directly linked with the executive work while workers in the top layer are in charge of the definition of the firm general policy or consulting on the organization of the firm; strategic planning; creation or adaptation of technical, scientific and administrative methods or processes. Robust standard errors in parenthesis.

TABLE 1.22: Credit shock IV - firm level - manufacturing only

	(1)	(2)	(3)	(4)
Δ *ln*	*# workers*	*wage bill*	*wage bill det.*	*# layers*
$\Delta\ ln\ \widehat{C}_i$	0.190***	0.249***	0.232***	0.020
	(0.068)	(0.078)	(0.079)	(0.085)
Observations	5,340	5,340	5,340	5,340
First stage F-Stat	18.83	18.83	18.83	18.83
Firm FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes

Notes: This table reports the estimation of the second stage as defined in equation 1.7 in first differences for the period 2004-2013. $\Delta\ ln\ \widehat{C}_i$ is the predicted change in credit to firm i instrumented using a linear function of FD, FD_b to construct the instrument. The dependent variables are log changes of the averages before and after the shock. The number of workers employed in the firm is the total amount of workers employed by the firm in the calendar year, the wage bill is the total amount of wages (base plus overtime) payed by the firm in each calendar year, the wage bill de-trended is the total amount of workers employed by the firm in the calendar year de-trended using a standard linear de-trending methodology to take out normal business cycle variation, while the number of layers is the number of management layers in the firm. A firm reporting c occupational categories will be said to have L = c − 1 layers of management: hence, in our data we will have firms spanning from 0 to 3 layers of management (as in (Caliendo et al., 2015a)). Robust standard errors in parenthesis.

TABLE 1.23: Trade shock IV - span of control - manufacturing only

Δ *ln*	(1) $\frac{\textit{Team leaders}}{\textit{Prod. workers}}$	(2) $\frac{\textit{Middle manager}}{\textit{Team leaders}}$	(3) $\frac{\textit{Top manager}}{\textit{Middle manager}}$
Δ ln $\widehat{Sales_i}$	-1.168***	0.083	-0.830
	(0.413)	(0.356)	(0.506)
Observations	4,878	3,263	1,875
Sector FE	Yes	Yes	Yes

Notes: This table reports the results of the within firm estimation of equation 1.12. The independent variable, $\Delta ln(\widehat{Sales_i})$ is the log change of de-trended sales between a pre-period, namely from 1998 to 2001 and a post period, from 2002 to 2004. The dependent variables are log changes of the averages before and after the shock. The ratios are computed using the total number of workers in each occupation category. In column 1 the dependent variable is the log change in the ratio of team leaders to production workers; in column 2 is the log change in the ratio of middle managers to team leaders; in column 3 is the log change in the ratio of top managers to middle managers. Robust standard errors in parenthesis.

TABLE 1.24: Trade shock IV - layer level - manufacturing only

Panel A: change in the number of workers in each layer

	(1)	(2)	(3)	(4)
Δ ln (number)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
$\Delta\, ln\ (\widehat{Sales_i})$	1.141***	0.139	-0.158	-0.200
	(0.348)	(0.195)	(0.212)	(0.263)
Observations	5,572	5,217	3,744	1,807
Sector FE	Yes	Yes	Yes	Yes

Panel B: change in the average wage in each layer

	(1)	(2)	(3)	(4)
Δ ln (wage)	*Production workers*	*Team leaders*	*Middle managers*	*Top managers*
$\Delta\, ln\ (\widehat{Sales_i})$	0.315***	0.124	0.099	-0.294
	(0.116)	(0.096)	(0.122)	(0.204)
Observations	5,572	5,217	3,744	1,807
Sector FE	Yes	Yes	Yes	Yes

Notes: This table reports the results of the within firm estimation of equation 1.10 at the layer level. The independent variable, $\Delta ln(\widehat{Sales_i})$ is the log change of de-trended sales between a pre-period, namely from 1998 to 2001 and a post period, from 2002 to 2004. The dependent variables are log changes of the averages number of workers in each managerial layer before and after the shock. The production workers in column 1 are workers dealing with simple well defined tasks, mainly manual or mechanical (no intellectual work) with low complexity, usually routine and sometimes repetitive. Workers in layer 1, namely higher-skill workers or team leaders, deal with complex or delicate tasks, usually not repetitive, and defined by the superiors. Middle managers deal with the organization and adaptation of the guidelines established by the superiors and directly linked with the executive work while workers in the top layer are in charge of the definition of the firm general policy or consulting on the organization of the firm; strategic planning; creation or adaptation of technical, scientific and administrative methods or processes. Robust standard errors in parenthesis.

TABLE 1.25: Trade shock IV - firm level - manufacturing only

	(1)	(2)	(3)	(4)	(5)
	Δ ln (sales)	*Δ ln*			
		# workers	*wage bill*	*wage bill det.*	*# layers*
$\Delta IP^{Other}_{s,t}$	-0.203***				
	(0.060)				
$\Delta\ ln\ (\widehat{Sales_i})$		1.690***	1.864***	1.700***	0.490
		(0.479)	(0.526)	(0.479)	(0.382)
F-test	13.65	13.65	13.65	13.65	13.65
Observations	5,572	5,572	5,572	5,572	5,572

Notes: In column 1 the table reports the first stage regression as defined in equation 1.11; the independent variable is $\Delta IP^{Other}_{s,t}$ and the dependent variable is the change in log sales. From column 2 to column 5 I report the estimation of equation 1.12. The independent variable, $\Delta ln(Sales_i)$ is the log change of de-trended sales between a pre-period, namely from 1998 to 2001 and a post period, from 2002 to 2004 and is instrumented using the definition of import penetration in equation 1.9. The dependent variables are log changes of the averages before and after the shock. The number of workers employed in the firm is the total amount of workers employed by the firm in the calendar year, the wage bill is the total amount of wages (base plus overtime) payed by the firm in each calendar year, the wage bill de-trended is the total amount of workers employed by the firm in the calendar year de-trended using a standard linear de-trending methodology to take out normal business cycle variation, while the number of layers is the number of management layers in the firm. A firm reporting c occupational categories will be said to have L = c − 1 layers of management: hence, in our data we will have firms spanning from 0 to 3 layers of management (as in (Caliendo et al., 2015a)). Robust standard errors in parenthesis.

TABLE 1.26: Trade shock IV long term credit - firm level

	(1)	(2)	(3)	(4)
	Δ *ln*			
	# workers	*wage bill*	*wage bill det.*	*# layers*
$\Delta ln(LongTermCredit)$	-2.534	-3.027	-2.854	-1.824
	(8.275)	(9.858)	(9.319)	(6.031)
First stage F-test	0.10	0.10	0.10	0.10
Observations	9,766	9,766	9,766	9,766

Notes: This table reports the estimation of the second stage as defined in equation 1.7 in first differences for the period 2004-2013. The independent variable $\Delta ln(LongTermCredit)$ is the predicted change in long term credit to firm i instrumented using a linear function of FD, FD_b to construct the instrument. The dependent variables are log changes of the averages before and after the shock. The number of workers employed in the firm is the total amount of workers employed by the firm in the calendar year, the wage bill is the total amount of wages (base plus overtime) payed by the firm in each calendar year, the wage bill de-trended is the total amount of workers employed by the firm in the calendar year de-trended using a standard linear de-trending methodology to take out normal business cycle variation, while the number of layers is the number of management layers in the firm. A firm reporting c occupational categories will be said to have L = c − 1 layers of management: hence, in our data we will have firms spanning from 0 to 3 layers of management (as in (Caliendo et al., 2015a)). Robust standard errors in parenthesis.

Chapter 2

The Diffusion of Knowledge via Managers' mobility

Better managers and managerial practices lead to better firm performance. Yet, little is known about what happens when managers move across firms. Does a firm hiring a good manager improve its performance? If yes is there some valuable knowledge the manager has acquired and successfully diffused to the new firm? In order to answer these questions we use information related to specific activities the manager was involved in when working for previous firms: exporting. Crucially, we exploit the end of the civil war in Angola as an event study to account for the endogeneity of the matching between managers and firms. Our data is rich enough to allow controlling for both manager and firm unobservables and wash out any time-invariant ability of the manager as well as overall firm performance. We find that the export experience gained by managers in *previous* firms leads their *current* firm towards higher export performance, and commands a sizable wage premium for the manager. We further refine our analysis by looking at different types of managers (general, production, financial and sales) and show how specific export experience interacts with the degree of product differentiation and/or the financial vulnerability of a firm's products as well as with rising import competition from China.

"Managers are conductors of an input orchestra [...] Just as a poor conductor can lead to a cacophony rather than a symphony, one might expect poor management to lead to discordant production operations."

Chad Syverson, *What Determines Productivity (2011)*

The enormous variation in firm performance has become a focus of empirical and theoretical interest throughout the social sciences, including economics. Recent empirical studies have exploited the increasing availability of information on managerial practices and managers' characteristics to establish a strong connection with firm—as well as country—productivity and other dimensions of performance. More specifically, (Bloom and Van-Reenen, 2010), (Bloom et al., 2013), (Bloom et al., 2016) and (Guiso and Rustichini, 2011) among others, have established that better managers and managerial practices lead to better firm performance. We believe the next question is what happens when managers move from one firm to another. Does a firm hiring a good manager improve its performance? If yes is it due to the manager simply being a good manager or is there some valuable knowledge the manager has acquired and successfully diffused to the new firm? The objective of this paper is to provide answers to these questions.

These questions have long since attracted substantial interest in the business and management literature. For example, (Argote and Ingram, 2000) argues that the creation and transfer of knowledge are a basis for competitive advantage in firms while (Tsai, 2001), and subsequent related literature, emphasises knowledge transfer within an organization and highlights the importance of network position and absorptive capacity. However, empirical evidence about knowledge transfer within the business and management literature has so far been primarily focused on within-organization flows by means of rather limited data ((Chang et al., 2012), (Richards and Duxbury, 2015)). A noticeable exception is (Song et al., 2003) where, in order to investigate the conditions under which learning-by-hiring (or the acquisition of knowledge through the hiring of experts from other firms) is more likely, they study the patenting activities of engineers who moved from U.S. firms to non-U.S. firms. In the same spirit there are, within the urban economics literature on spill-overs, some contributions showing how job hopping help sustain the competitiveness of local industry clusters like Silicon Valley[1] while recent contributions to the international trade literature also highlight knowledge diffusion: (Artopoulos et al., 2013) explain how the diffusion of business practices from export pioneers to followers can lead to sustained export growth, while (Atkin et al., 2016) document a knowledge flow between intermediaries and foreign buyers leading to improvement in product quality.

These questions are certainly fascinating to many fields and scholars but one fundamental issue is that answering them is rather difficult: First, it is challenging to separate a manager's intrinsic capabilities from the knowledge and abilities she has learned in previous firms. Second, it is empirically difficult to show that such acquired knowledge and abilities impact current firm performance and it is even more complicated to solve the matching problem between firms and workers. In order to overcome the first challenge we draw on information related to specific activities the manager was involved in when working for previous firms. More specifically, we build on employer-employee data and firm-level trade data spanning several years to recover information on whether the manager has worked in the past for firms exporting to a specific destination country or a specific product. Our data is rich enough to allow controlling for both manager and firm unobservables and wash out any time-invariant ability of the manager as well as overall firm performance.

[1](Fallick et al., 2006) argue that job hopping is important in computer clusters because it facilitates the reallocation of talent and resources toward firms with superior innovations. Using detailed data on labor mobility, they find higher rates of job-hopping for college-educated men in Silicon Valley's computer industry than in other computer clusters.

To tackle the second challenge we then relate this destination-specific or product-specific measure of acquired knowledge to the current firm trade performance in these specific destinations or products. In doing so we deal with the endogeneity of hiring in two complementary ways. First, we explore the differential performance of firms with and without managers with specific export experience in the wake of an exogenous event: the sudden end of the Angolan civil war in 2002. This is the first paper to exploit a conflict related event to obtain a *quasi random* allocation of managers to firms conditional on firm observables and fixed-effects. Second, we draw on the panel nature of the data and use information on whether the firm had managers with destination-specific or product-specific export experience 3 years prior to evaluating firm-performance in those destinations or products. We further refine our analysis by looking at different types of managers (general, production, financial and sales) and show how specific export experience interacts with the degree of product differentiation and/or the financial vulnerability of a firm's products as well as with rising import competition from China.

We find that the export experience gained by managers in *previous* firms leads their *current* firm towards higher export performance, and commands a sizable wage premium for the manager. Moreover, export knowledge is decisive when it is *market-specific*: managers with experience related to markets (where by markets we mean destinations or products) served by their current firm receive an even higher wage premium; firms are more likely to enter markets where their managers have experience; exporters are more likely to stay in those markets, and their sales are on average higher. While it is reasonable to expect managers to learn valuable skills from their previous jobs and transfer them, the magnitudes we find are stark. Managers' export experience is a first-order feature in the data explaining more variation in firm export performance than size and productivity.

At the same time, we show that the experience premium accrued by different types of managers (general, production, financial and sales) aligns with a knowledge diffusion story. More specifically, we show that financial managers enjoy a basic export experience wage premium but no robust product- or destination-specific experience wage premium. General and production managers receive both a product- and a destination-specific experience premium but little or no basic experience premium. Sales managers benefit from a destination-specific experience premium while general managers get the largest premia in most cases. Furthermore, we find market-specific experience to be more valuable in terms of trade performance to firms selling products that are more differentiated and/or financially vulnerable while at the same time experience seems to help some firms coping with increasing import competition from China.

Our analysis stands on three solid pillars: reliable data on one country (Portugal) covering the universe of firms and their workers for several years, including rich information on the characteristics of both; the possibility of tracking workers—and in particular managers—as they move from firm to firm; a research design that accounts for unobserved heterogeneity, omitted variables, and, more broadly, endogeneity.

Our work relates to a number of strands in the literature. First, we contribute to the above cited empirical literature on management by showing how managers can diffuse knowledge and good practice across firms. Second, our work relates to the literature looking at the relationship between trade and tasks ((Blinder, 2006), (Grossman and Rossi-Hansberg, 2008)). Such literature suggests that the complexity of the tasks involved in the different stages of production process (design, manufacturing of parts, assembly, R&D, marketing, commercialization, etc.) is key to understand recent trends in international trade. Managers are different from other workers and likely to be particularly important for trade activity because they are responsible for the most complex tasks within a firm. Third, the role played by managers' mobility across firms in our analysis contributes to the recent debate about the channels via which knowledge diffusion takes place ((Balsvik, 2011), (Parrotta and Pozzoli, 2012), (Mion and Opromolla, 2014)). Last, but not least, our wage analysis contributes to the literature devoted to explaining the determinants of managers' pay ((Gabaix and Landier, 2008), (Guadalupe and Wulf, 2008)), and to the literature that studies the internal organization of the firm and how this relates to a firm's characteristics such as export status ((Caliendo and Rossi-Hansberg, 2012), (Caliendo et al., 2015b)).

With specific reference to (Mion and Opromolla, 2014) we expand upon own research in several ways. Crucially, we provide evidence on the causal impact of knowledge diffusion by exploring the differential performance of firms with and without managers with specific export experience in the wake of an exogenous event: the sudden end of the Angolan civil war in 2002. Moreover, while (Mion and Opromolla, 2014) focuses on the destination-specific export experience of managers this paper offers a comprehensive treatment of knowledge diffusion: we consider different types of experience (product and destination), different types of managers, the role of financial vulnerability and product differentiation, as well as rising import competition from China. Last but not least, we explore if knowledge remains in the firm once the experienced manager leaves.

The remainder of the paper is organized as follows. Section 2.1 describes the data. In Section 2.1.1, after defining some key variables, we show raw data evidence positively associating a manager's export experience with his/her wage and firm export performance. These descriptive results are confirmed by the econometric testing of Sections B.5 and 2.3. Section 2.4 concludes and provides a number of policy implications. Additional details about the data are provided in the Appendix. The Tables Appendix provides complementary Tables.

2.1 Data and descriptives

Our data combines information resulting from two panel datasets: international trade data at the firm-country-product level and matched employer-employee panel data. International trade data are collected by Statistics Portugal and—besides small adjustments—aggregate to the official total exports and imports of Portugal. For the purpose of this research, we use data on export transactions only, aggregated at the firm-destination-product-year level, for the period 1995-2005.

Employer-employee data come from *Quadros de Pessoal* (henceforth, QP), a dataset collected by the Ministry of Employment, drawing on a compulsory annual census of all firms in Portugal that employ at least one worker. Reported data cover the firm itself, as well as each of its workers. Each firm and each worker entering the database are assigned a unique, time-invariant identifying number which we use to follow firms and workers over time. Currently, the data set collects data on about 350,000 firms and 3 million employees. As for the trade data, we were able to gain access to information from 1995 to 2005. We describe the two datasets and their merging in more detail in the Appendix.

The dataset allows to follow workers—especially managers—as they move from firm to firm; moreover, knowing firms' trade status in each year, allows the identification of workers' export experience. This is possible thanks to an exhaustive coverage of firms, their workers, and their trade activity as well as a high degree of reliability. The richness of the data also makes it possible to control for a wealth of both worker and firm characteristics as well as for unobserved heterogeneity by means of various fixed effects. We provide in the Appendix more information about the way we have constructed some of the covariates.

TABLE 2.1: Selected Summary Statistics, Wage Sample, 2005

Variable	**Mean**	**Std. Dev.**	**N**
Worker-level			
Hourly Wage (log)	1.351	0.518	436,351
Age (Years)	38.206	10.695	436,351
Education (Years)	7.449	3.586	436,351
Tenure (Years)	10.043	9.277	436,351
Manager (0/1)	0.067	0.250	436,351
Manag. X Export Exp. (0/1)	0.015	0.122	436,351
Manag. X Matched Dest. Export Exp. (0/1)	0.012	0.109	436,351
Manag. X Matched Prod. Export Exp. (0/1)	0.011	0.104	436,351
Current firm-level			
Firm Size (log)	2.339	1.142	25,681
Firm Productivity (log)	10.480	0.908	25,681
Firm Age (log)	2.461	0.816	25,681
Foreign Ownership (0/1)	0.024	0.154	25,681
At Least One Manag. (0/1)	0.274	0.446	25,681
At Least One Manag. with Export Exp. (0/1)	0.083	0.276	25,681
At Least One Manag. with Matched Dest. Export Exp. (0/1)	0.050	0.218	25,681
At Least One Manag. with Matched Prod. Export Exp. (0/1)	0.046	0.209	25,681
Previous firm-level			
Firm Size (log)	2.125	1.164	4,583
Firm Productivity (log)	6.740	5.016	4,583

Notes: This Table shows summary statistics, relative to 2005, for a subset of worker-level and firm-level variables used in the regressions of Section B.5 and 2.3. Statistics refer to observations for which all covariates in the wage regression sample of Section B.5 are jointly available. Firm-level variables subdivide into those relative to the worker's current firm and to those relative to the previous firm. Variable names followed by "(0/1)" refer to dummy variables. In the last column, "N" refers to the number of workers for worker-level variables, and to the number of (current or previous) firms for firm-level variables.

Table 2.1 reports summary statistics, for 2005, of the main worker-level and firm-level variables—both for the worker's current and previous firm—referring to observations for which all covariates are jointly available. The top panel of Table 2.1 indicates that, in 2005, our sample includes 436,351 workers, with an average (log) hourly wage of 1.35 euros, an average age of 38.2 years, an average education of 7.45 years, and an average firm tenure of 10 years.[2] The middle

[2](Carneiro et al., 2012) find that average (log) hourly earnings (in real Euros) are 1.34 for men and 1.13 for women, in the 1986-2005 period. Workers' tenure and wage are described in the Appendix.

panel of Table 2.1 shows that these workers are employed by 25,681 firms, and reports the average firm (log) size, (log) productivity, (log) age, and the share of foreign-owned firms (2.4 percent). Finally, the bottom panel provides the average (log) size and productivity of the 4,583 firms *previously* employing the workers in our sample.

TABLE 2.2: Number of Exporters and Average Exports, by Country-group, Trade Sample, 2005

	Markets						
Variable	**Spain**	**IT-UK FR-DE**	**Other EU**	**Other OECD**	**CPLP**	**China**	**ROW**
# of Exporting firms	1,696	1,711	1,285	1,401	1,097	204	1,227
—with Export Exp.	838	833	644	711	558	127	651
—with Matched Dest. Export Exp.	717	736	524	624	455	57	547
Avg. Exports	2,322	4,046	1,454	1,244	301	596	950

Notes: This Table shows the number of firms exporting to each of the seven markets we consider and their average exports (in thousands euros) for the 2005 sample year. The number of exporters further subdivides into those having at least one manager with export experience and those having at least one manager with matched (destination) export experience. Statistics refers to observations for which all covariates in the trade performance analysis sample of Section 2.3 are jointly available. CPLP is the Portuguese acronym for the Community of Portuguese Language Countries.

TABLE 2.3: Number of Exporters and Average Exports, Seven largest product groups, Trade Sample, 2005

	Markets						
Variable	**Textiles**	**Wearing apparel**	**Paper products**	**Industrial chemicals**	**Machinery exc. electrical**	**Electrical machinery**	**Transport equipment**
# of Exporting firms	515	508	316	368	739	324	228
—with Export Exp.	272	205	195	225	393	187	143
—w. Mat. Prod. Exp.	194	149	122	152	327	135	92
Avg. Exports	1,940	2,125	2,813	2,593	2,389	5,779	10,940

Notes: This Table shows the number of firms exporting to each of the seven largest, in terms of total exports, product groups in our sample, and their average exports (in thousands euros) for the 2005 sample year. The number of exporters further subdivides into those having at least one manager with export experience and those having at least one manager with matched (product) export experience. Statistics refers to observations for which all covariates in the trade performance analysis sample of Section 2.3 are jointly available. The number and full titles of the product groups are 384 "Transport equipment", 383 "Electrical machinery apparatus, appliances and supplies" 382 "Machinery except electrical" 322 "Wearing apparel, except footwear" 321 "Textiles" 351 "Industrial chemicals", and 341 "Paper and paper products". See the Appendix for details on the product definition.

Tables 2.2 and 2.3 report selected summary statistics—for 2005—referring to the trade performance sample. In Section 2.3 we model a firm's entry and continuation into a specific destination, or into a specific product market, m, and analyze both the probability to start and continue exporting as well as the value of exports conditional on entry/continuation. When considering destinations, we partition countries into seven groups: Spain (the most frequent destination), other top 5 export destination countries (Italy, UK, France, and Germany), other EU countries, OECD countries not belonging to the EU, countries belonging to the Community of Portuguese Language Countries (CPLP in Portuguese), China, and the rest of the World. Table 2.2 shows, for each of the seven destinations, the number of exporting firms and average exports (in thousand euros). When considering products, we partition markets into 29 Isic rev.2 groups. The largest groups, in terms of total exports, are 384 "Transport equipment", 383 "Electrical machinery apparatus, appliances and supplies" 382 "Machinery except electrical" 322 "Wearing apparel, except footwear" 321 "Textiles" 351 "Industrial chemicals", and 341 "Paper and paper products" Table 2.3 shows, for each of the seven largest product groups, the number of exporting firms and average exports (in thousand euros).

2.1.1 Definitions and evidence from raw data

In this Section we draw the distinction between managers and non-managers, we define export experience as well as its two refinements: experience in a destination and experience in a product. We also show raw data evidence on the existence of an export experience wage premium for managers.

Managers

In our analysis, we partion workers into managers and non-managers. As it is effectively captured by the quote of (Syverson, 2010) at the beginning of the paper, managers are responsible for strategic decisions taken within the firm including the organization of the firm, planning, and the shaping of technical, scientific and administrative methods or processes.

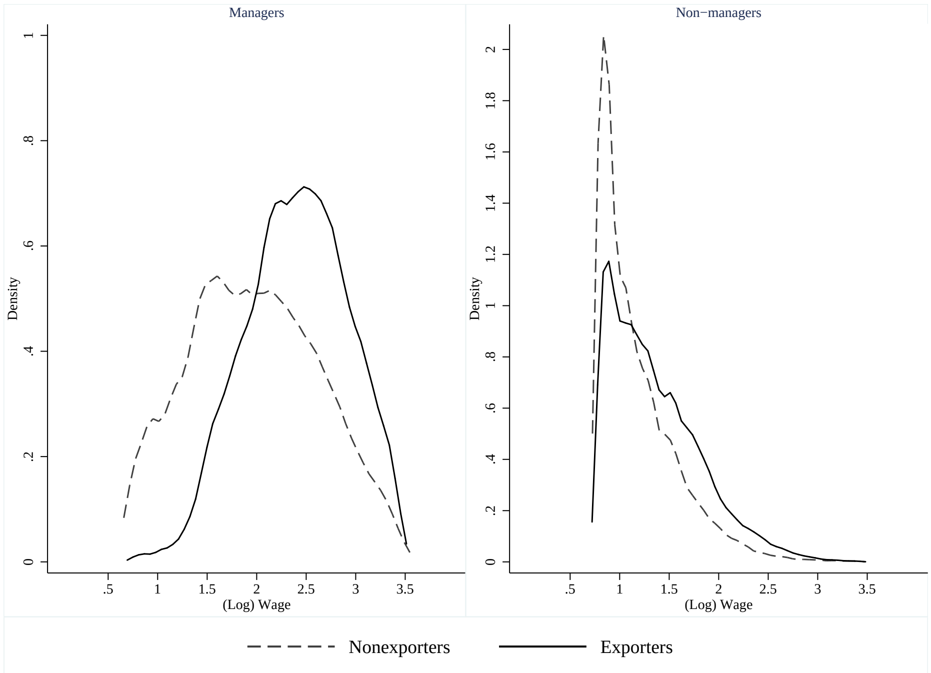
In practice, we identify managers using a (compulsory) classification of workers, according to eight hierarchical levels, defined by the Portuguese law (Decreto Lei 121/78 of July 2^{nd} 1978). Classification is based on the tasks performed and skill requirements, and each level can be considered as a layer in a hierarchy defined in terms of increasing responsibility and task complexity. Managers are defined as the workers belonging to one of the top two hierarchical levels: "Top management" and "Middle management"; non-manager are workers belonging to lower hierarchical levels. Table 2.1 shows that, in the wage sample in 2005, 6.7 percent of the workers are managers and 27.4 percent of the firms have at least one manager.

We then take a deeper look into the professional status of the manager by analysing the exact occupation within a firm. Using the four digit ISCO classification in *Quadros de Pessoal*, we look at the professional status of the managers specifically focusing on directors, the category to which the vast majority of managers belong to. We end up with 4 groups: general managers, production managers, financial managers and sales managers. We lump managers covering other occupations into a fifth group (other managers).

Figure 2.1 confirms that the distinction between managers and non-managers is relevant when considering a firm's trade activity; in fact, it shows that the exporter wage premium seems to come essentially from managers.[3] More specifically, Figure 2.1 shows the kernel density of the log hourly wage distribution

[3] A large literature tries to identify and explain a wage premium paid by exporting firms ((Frias et al., 2009), (Munch and Skaksen, 2008) (Schank et al., 2007)). (Martins and Opromolla, 2012), show that Portugal is not an exception to this robust empirical finding.

FIGURE 2.1: Wage density for managers and non-managers, by firm export status, 2005



Notes: This Figure shows the kernel density of the (log) hourly wage distribution in 2005 for managers (left panel) and non-managers (right panel), broken down by firm export status (exporters and non-exporters). Statistics refers to observations for which all covariates in the wage regression sample of Section B.5 are jointly available. The kernel is Epanechnikov and the kernel width is the Stata default one.

in our 2005 wage sample, both for managers and non-managers, broken down by firm export status (exporters and non-exporters). The wage density referring to managers employed by exporting firms clearly lies to the right of the one for managers employed by non-exporters. The evidence for non-managers is instead much weaker.

Export experience

Managers are not all alike: their set of skills and knowledge can be tightly connected to the experience they faced along their careers. In particular, only some managers have the chance to be involved in export activities. To the extent that experience acquired in exporting firms substantially improves the capacities and skills of a manager it should correspond to a wage premium. Furthermore, such experience is potentially valuable to all firms, but in particular to exporters, who might expect an improvement of their trade performance.

We exploit the matched employer-employee feature of our dataset to track workers over time: for each firm-year pair, we identify the subset of (currently employed) workers that have previously worked in a different firm. Moreover, we exploit the trade dataset to single-out those workers that were employed in the past *by an exporting firm*. We define such workers, and in particular managers, as having export experience.[4]

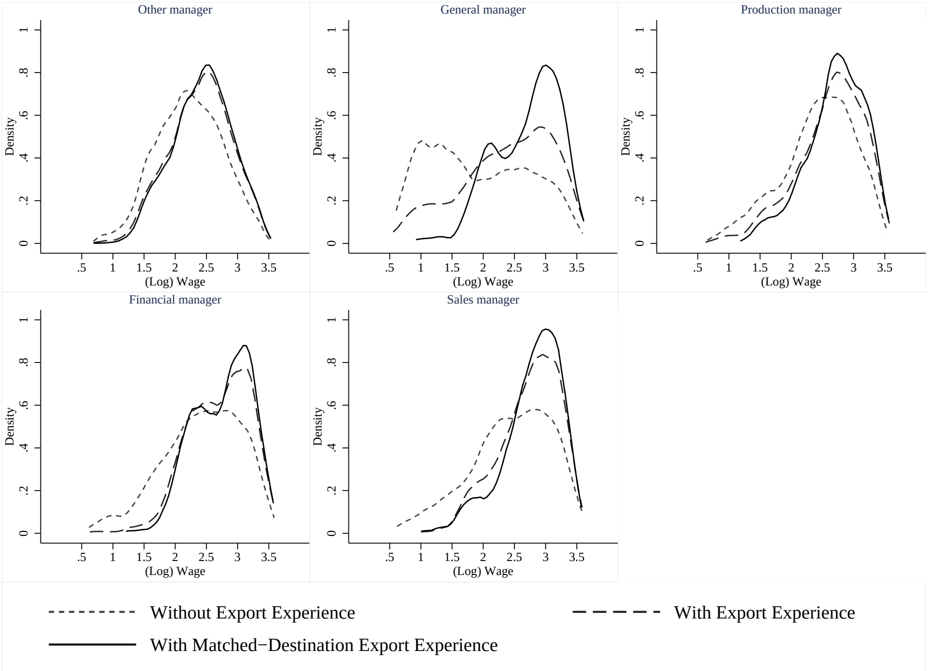
We further refine export experience in two ways. First, we define market specific export experience, where a market indicates either a destination d or a product p.[5] A worker is labeled with market specific export experience if she has previously worked in a firm exporting in market d or product p. Second, we define a worker as having matched export experience if she has export experience *and* has market (or product) specific export experience in at least one of the markets (or product) the current employing firm is actually exporting.

Figures 2.2 and 2.3 provide raw wage data evidence supporting the idea that the distinction between managers with and without export experience is relevant when considering a firm's international activity. Furthermore they also highlight the importance of destination and product experience and that the distinction holds for all of the five categories of managers we consider.

[4]We exploit the mobility of workers across firms to define experience, so we do not consider the export experience potentially acquired by the manager within the same firm. Table 2.1 indicates that about 23 percent of the managers (0.015/0.067) have export experience, while 8.3 percent of firms—i.e. 30% of the firms with at least one manager—have at least one manager with export experience.

[5]The former refers to one of the seven markets listed in Section 2.1 while the latter to one of the 29 product groups defined using the Isic rev2 classification (see the Appendix)

FIGURE 2.2: Wage density of managers distinguishing by: manager type and export experience (in a destination), 2005



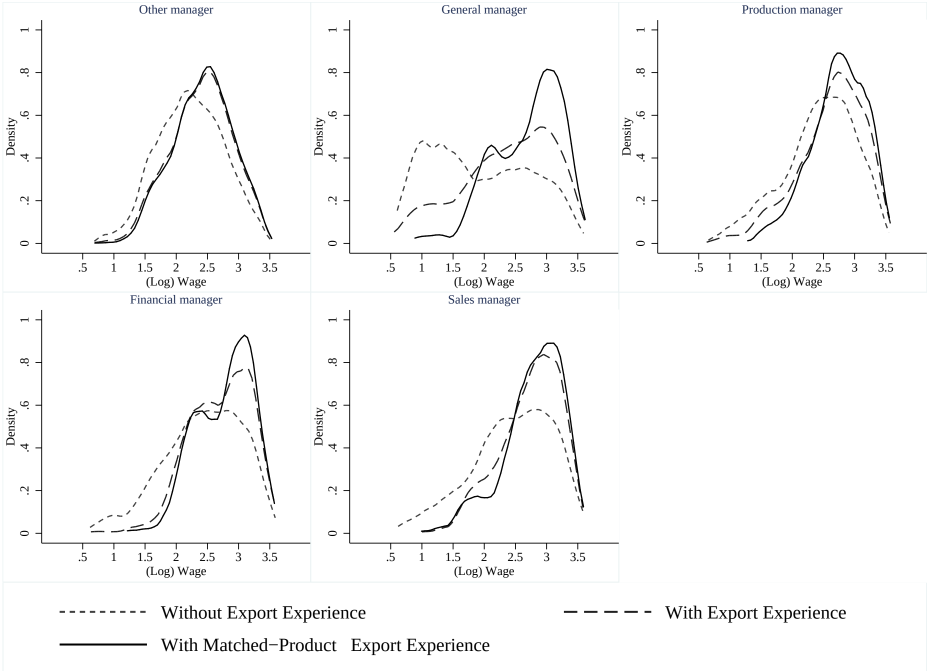
Notes: This Figure shows the kernel density of the (log) hourly wage distribution in 2005 for managers, broken down by manager type and degree of export experience (in a destination). Statistics refers to observations for which all covariates in the wage regression sample of Section B.5 are jointly available. The kernel is Epanechnikov and the kernel width is the Stata default one.

2.2 The civil war and the evolution of trade in Angola

Angola is the fastest growing developing economy in the world, despite has been plagued by three decades of civil war until very recent. In fact, following its independence from Portugal in 1974, Angola has been tormented by a long civil war between the Movimento Popular de Libertacao de Angola (MPLA) and the Uniao Nacional para a Indipendencia Total de Angola (UNITA). As a result of the national elections held in September 1992, the leader of MPLA Jose Eduardo dos Santos became prime minister with a very small margin; indeed, the UNITA's leader Jonas Savimbi never recognised his rival's victory and initiated a civil war almost entirely driven by his desire of political power.

The Angolan civil war had several phases that went hand in hand with structural transformations of the economy from a centrally-planned economy between

FIGURE 2.3: Wage density of managers distinguishing by: manager type and export experience (in a product), 2005



Notes: This Figure shows the kernel density of the (log) hourly wage distribution in 2005 for managers, broken down by manager type and degree of export experience (in a product). Statistics refers to observations for which all covariates in the wage regression sample of Section B.5 are jointly available. The kernel is Epanechnikov and the kernel width is the Stata default one.

1975 and 1992 to a market-oriented economy from 1992 to 2002. Indeed, the latter period was characterised by large privatisations of public enterprises from manufacturing industry to agriculture and commerce which essentially benefitted a small group of emergent entrepreneurs and economic groups closely related to the MPLA, the ruling political party. The immense privileges to these groups of people – including access to credit and hard currency – pushed out of the market any potential competitor. Moreover, The "Dutch disease" phenomenon continued, as did rent-seeking, by far the easiest way to profitably accumulate private capital. This sort of economic nepotism became a formidable barrier to entry for any new economic activity.

The Angolan civil war suddenly ended with the death of the rebels' leader, Jonas Savimbi, on February 22, 2002 followed by the cease fire signed a few weeks later, on April 4. This in turn implied an opening of the Angolan market to other firms which is one of the key drivers of Angola's rise as a developing economy. Figure 2.4 reports the evolution of aggregate exports to Angola from 1996 to 2005, while figure 2.5 shows the evolution of exports from Portugal towards Angola and the other ex-colonies. The political instability, together with the economic nepotism have represented a substantial barrier to exports to Angola before 2002, as it is clearly shown in the figure. The end of the civil war came together with a new peace agreement between the two old parties – MPLA and UNITA – but also with a new attention to the growth of the country and a gradual removal of barriers to new economic agents. Indeed, figure 2.4 shows a clear growth of exports from 2002 onwards and figure 2.6 confirms the reduction of the barriers to new firms in the market. [6]

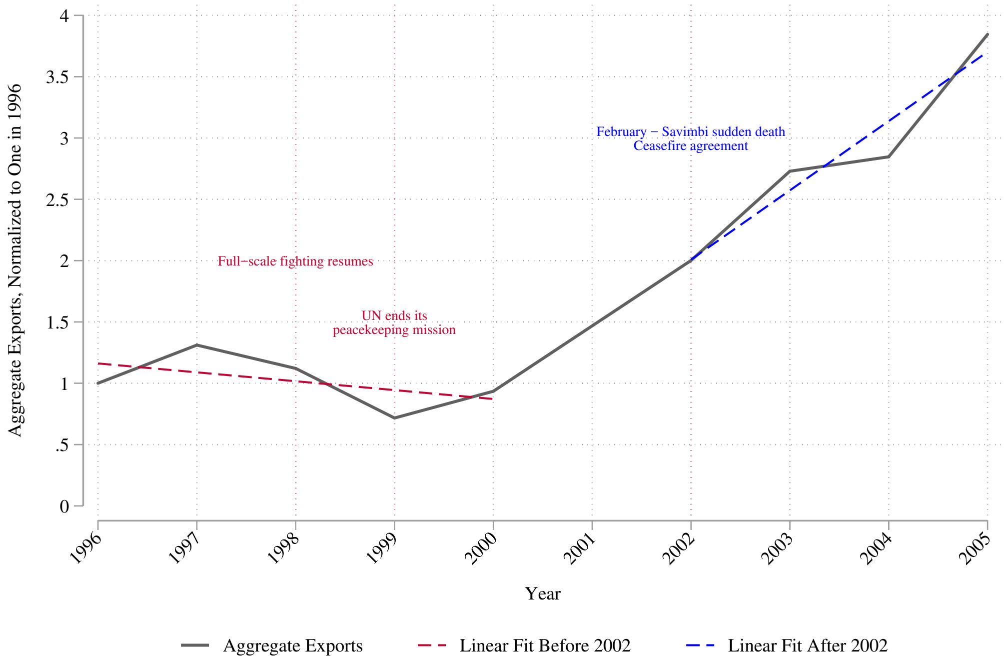
As discussed in (Guidolin and La Ferrara, 2007), the end of Angolan civil war was completely unexpected and represents an exogenous conflict-related event in which one party gained an unambiguous victory over the other and restored order. Furthermore, Angola is particularly relevant in our case because it is a former Portuguese colony still having strong ties with Portugal while being part of the Community of Portuguese Language Countries (CPLC). In this respect, it is a well known export destination for Portuguese firms and with a significant amount of trade occurring before, during and after the civil war.

2.2.1 The econometric model

Studying the effect of a manager's knowledge on firm performance is challenging. The identification problem arises naturally because hiring a manager with destination-specific experience can be a strategic decision in preparation for exporting. To address this concern, we follow the event study literature and the paper by (Guidolin and La Ferrara, 2007) and exploit an exogenous shock to solve

[6] Data for 2001 are not available and a linear interpolation has been performed to construct the figure. In the actual analysis, the year 2001 is not included in the sample

FIGURE 2.4: Aggregate exports to Angola, normalized to one in 1996



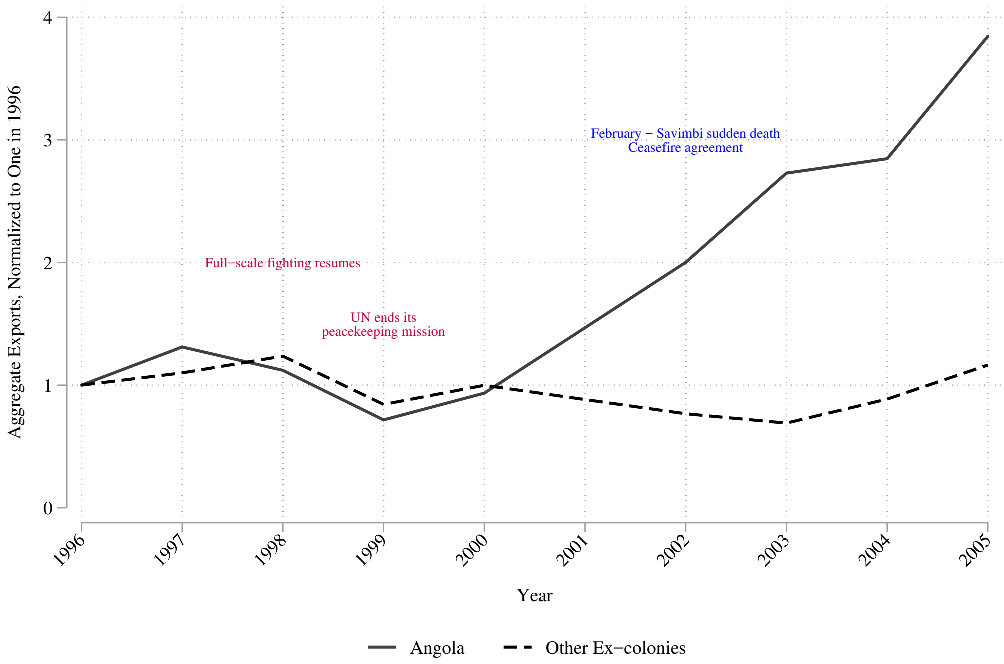
Notes: This Figure shows the evolution of exports from Portugal to Angola. Values have been normalised to one in 1996. Information for the year 2001 in the matched employer-employee dataset are missing, hence the trade flows for cannot be computed for the relevant set of firms. For this reason, the export value for 2001 is a linear interpolation between the year 2000 and the year 2002. The interpolated values for 2001 are not included in the regression.

the firm-manager matching problem. The randomness of the event generates a *quasi random* allocation of managers to firms conditional on firms observables and unobservables characteristics. Indeed, the end of the civil war in Angola was completely unexpected to the firms;

As a result, the estimation compares two identical firms in all respect except that one happens to have a manager with destination-specific export experience (also) in Angola, while the other has a manager with destination-specific export experience in other markets but Angola.

In our event study, we model a firm's likelihood to start exporting a specific product or to a specific destination and the value of exports conditional on entry. We consider the sample of firms with at least one manager and index firms by f and time by t. At each point in time we observe whether firm f exports: (i) to Angola or one of our seven destination groups; (ii) one of our 29 Isic rev2 product

FIGURE 2.5: Aggregate exports to Angola and to other ex-colonies, normalized to one in 1996



Notes: This Figure shows the evolution of exports from Portugal to Angola and to the other ex colonies. Values have been normalised to one in 1996. Information for the year 2001 in the matched employer-employee dataset are missing, hence the trade flows for cannot be computed for the relevant set of firms. For this reason, the export value for 2001 is a linear interpolation between the year 2000 and the year 2002. The interpolated values for 2001 are not included in the regression.

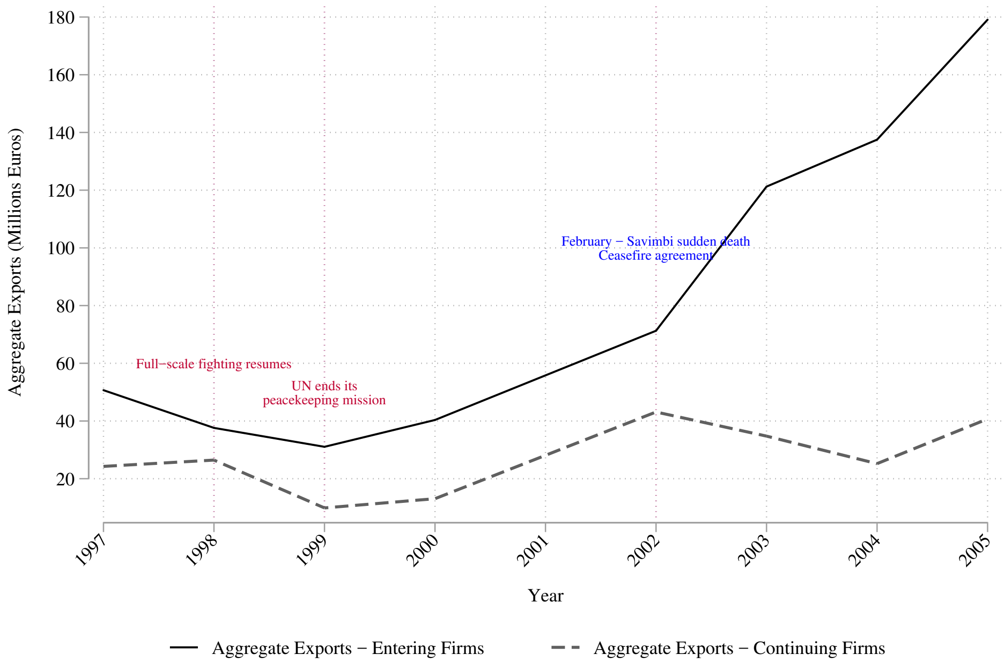
groups. We model a firm's entry and continuation into Angolan market and analyze the probability to start exporting as well as the value of exports conditional on entry.

The following selection model is estimated:

$$\begin{aligned} Entry_{ft} &= \mathbf{1}_{[Entry^*_{ft}>0]}, \\ Entry^*_{ft} &= \delta_1 + \beta_1(ManExp_{ft} * Year_t) + Z'_{1f}\Gamma_1 + \eta_{1t} + \zeta_{1ft}, \\ Exports_{ft} &= \delta_2 + \beta_2(ManExp_{ft} * Year_t) + Z'_{2f}\Gamma_2 + \eta_{2t} + \zeta_{2ft}, \end{aligned} \tag{2.1}$$

where $ManExp_{ft}$—our main variable of interest—is a dummy indicating the presence of (at least) one manager with export experience and/or specific export experience, Z_{1f} and Z_{2f} are two vectors of firm varying covariates affecting,

FIGURE 2.6: Aggregate exports to Angola, Entering vs. Continuing Firms, normalized to one in 1996



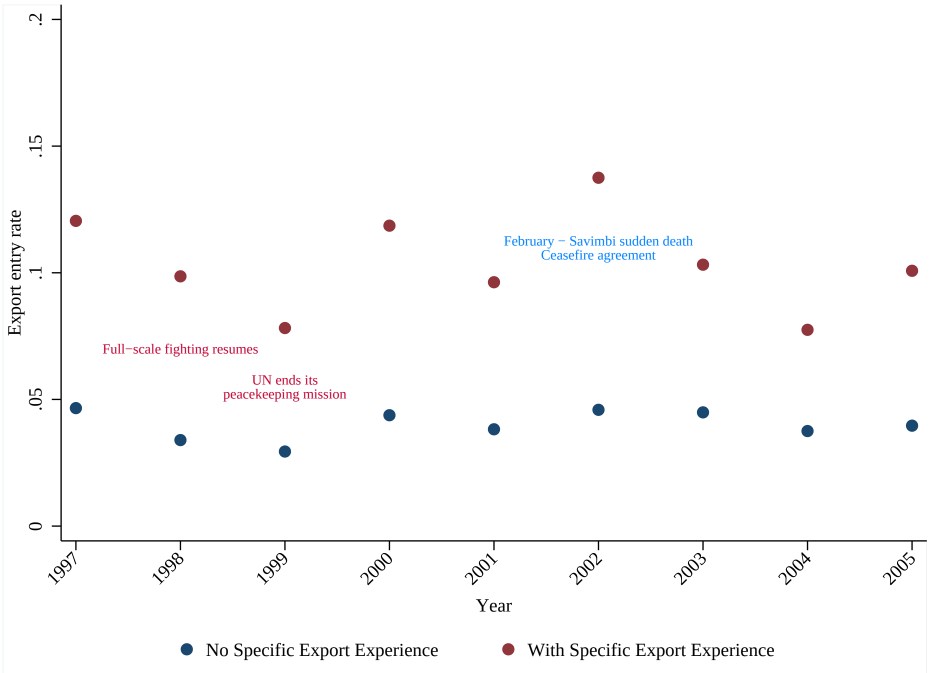
Notes: This Figure shows the evolution of exports from Portugal to Angola for firms that export for the first time in Angola vs firms that continue to export in the Angolan market. Values have been normalised to one in 1996. Information for the year 2001 in the matched employer-employee dataset are missing, hence the trade flows for cannot be computed for the relevant set of firms. For this reason, the export value for 2001 is a linear interpolation between the year 2000 and the year 2002. The interpolated values for 2001 are not included in the regression.

respectively, entry and exports conditional on entry that are captured with either observables or firm fixed effects, and η_{1t} and η_{2t} are year dummies.

2.2.2 Results

We explore the differential performance of firms with and without managers with destination-specific export experience in the wake of an exogenous event: the sudden end of the Angolan civil war in 2002. As discussed in Section 2.2, the Angolan civil war suddenly ended with the death of the rebels' leader, Jonas Savimbi, on February 22, 2002. The event was completely unexpected and represents an exogenous conflict-related event in which one party gained an unambiguous victory over the other and restored order. Furthermore, Angola is particularly relevant in our case because it is a former Portuguese colony still having strong ties with Portugal while being part of the Community of Portuguese Language Countries (CPLC). In this respect, it is a well known export destination for Portuguese firms and with a significant amount of trade occurring before, during and after the civil war.

FIGURE 2.7: Export entry rates in Angola



Notes: This Figure shows export entry rates in Angola, defined as the ratio between the number of firms starting to export in Angola at time t and the number of firms not exporting to Angola at time t-1, for two groups of firms: those that have no managers with export experience in Angola at time t and those that have at least one manager with export experience in Angola at time t.

The war started many years prior to our observational period (1997-2005) and ended suddenly in 2002. This means that, right after the shock, exporting firms did not have the time to prepare themselves to take advantage of the opportunities offered by the new politically stable setting by, for example, hiring managers with export experience. Yet, some firms in 2002 had managers with export experience in Angola while others had not. In this respect, Figure 2.7 shows export entry rates for firms with at least one manager with specific export experience in Angola and firms without such managers. Crucially, there is a sudden spike in export entry rates for firms with at least one manager with export experience in Angola in 2002. The situation is then a bit mixed after 2002 which can be understood with other shocks taking place as well as firms having had the time to adjust to the new situation.

TABLE 2.4: Probability to Start Exporting in Angola

VARIABLES	(1) 1 pse	(2) 2 pse	(3) 3 pse	(4) 4 pse
Manag. w/ Spec. Exp. (0/1)	0.014^a	0.005	-0.004	-0.004
	(0.002)	(0.003)	(0.005)	(0.006)
Year>=2000 * Manag. w/ Spec. Exp. (0/1)				-0.001
				(0.007)
Year>=2002 * Manag. w/ Spec. Exp. (0/1)			0.013^b	0.021^b
			(0.005)	(0.009)
Year>=2003 * Manag. w/ Spec. Exp. (0/1)				-0.010
				(0.007)
Year>=2004 * Manag. w/ Spec. Exp. (0/1)				-0.001
				(0.006)
Year>=2005 * Manag. w/ Spec. Exp. (0/1)				0.004
				(0.005)
Firm-Year Controls	X	X	X	X
Year Dummies	X	X	X	X
Firm FE		X	X	X
Observations	28,420	28,420	28,420	28,420
R^2	0.024	0.383	0.384	0.384

Notes: This Table reports OLS estimator coefficients and standard errors for the core covariates of our model of firm's entry into a foreign destination (2.2). Estimation results for all other covariates are provided in the Tables Appendix. The dependent variable takes value one when a firm f starts exporting to Angola at time t. The key independent variable is a dummy indicating if the firm has at least one manager with specific export experience in Angola. Specifications in columns (2), (3), and (4) include firm fixed effects. Firm-time controls are firm size, productivity, share of skilled workers, age, foreign ownership, mean and standard deviation of both age and education of firm f managers, mean and standard deviation of worker fixed effects corresponding to the managers of firm f coming from the wage analysis, and industry-level exports. See the Appendix for more details. All covariates have been divided by their respective standard deviation in order to deliver a comparable metric. Standard errors clustered at the firm-level in parentheses: $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

In order to establish the statistical significance of the 2002 spike and control for other factors we run our export entry model (2.2) focusing on Angola as a destination. Data is only varying across firms and time so we include year dummies; at the same time, we employ firm fixed effects as opposed to firm-time fixed effects used in section 2.3.1 while always using firm-time controls. We consider export experience alone as well as interacted with year dummies to detect time breaks in the data. Key columns are 3 and 4. Column 3 shows specific export experience significantly matters only post 2002. At the same time, column 4 makes use of additional time dummies to show this can be fully attributed to the year 2002, i.e., the year the conflict suddenly ended. No effect is found when looking at export volumes conditional on entry; indeed, results point towards a reduction in the fixed cost of exporting.

These results point towards an explanation consistent but with the one proposed by (Guidolin and La Ferrara, 2007): the end of the civil war represents the end of the economic nepotisms created by the conflict between MPLA and UNITA that favoured few politically connected firms and left most of the other firms out of the market. The opening of the market represent a reduction in the fixed cost of exporting, a finding that is clear from figure 2.6 as well as from the results of table 2.4. No gains are found for firms that previously exported in Angola, as well as for firms in specific sectors, such as the ones linked with resources or extraction. The next section presents additional results based on the panel data estimation that confirm the ones presented in section 2.2 and shed further light on the link between the specific knowledge of a manager and the export performance of the firm.

2.3 Panel data results

This section assesses whether export experience brought by managers has an impact on a firm's trade performance in the whole sample. Based on the model discussed in section 2.2.1, we model a firm's likelihood to start/continue exporting a specific product or to a specific destination and the value of exports conditional on entry/continuation. We control for endogeneity in a variety of ways, including firm-year fixed effects and market-year dummies to account for unobservables.

We consider the sample of firms with at least one manager and index firms by f, time by t and export markets by m, where m could either indicate a destination d (experience in a destinations regressions) or a product p (experience in a product regressions).[7] At each point in time we observe whether firm f exports: (i) to one of our seven destination groups; (ii) one of our 29 Isic rev2 product groups. We model a firm's entry and continuation into market m and analyze both the probability to start and continue exporting as well as the value of exports conditional on entry/continuation. We now describe the entry model with the one for continuation being its mirror image.

For each firm f and time $t \in [1996,\ 2005]$, we consider all the markets m to which the firm was *not* exporting in $t-1$. We construct the binary dependent variable $Entry_{fmt}$ taking value one when firm f starts exporting to market m at time t (and zero otherwise). In each period, each firm decides whether or not to enter into one or more of the markets (destination or product groups) in which it was not present in the previous year. We then define the continuous dependent variable $Exports_{fmt}$ equal to (log) exports of firm f to market m at time t. $Exports_{fmt}$ is observed when $Entry_{fmt}$=1.

The following selection model is estimated:

$$\begin{aligned} Entry_{fmt} &= \mathbf{1}_{[Entry^*_{fmt}>0]}, \\ Entry^*_{fmt} &= \delta_1 + ManExp_{fmt}\beta_1 + \mathbf{Z'_{1ft}\Gamma_1} + \eta_{1mt} + \zeta_{1fmt}, \\ Exports_{fmt} &= \delta_2 + ManExp_{fmt}\beta_2 + \mathbf{Z'_{2ft}\Gamma_2} + \eta_{2mt} + \zeta_{2fmt}, \end{aligned} \tag{2.2}$$

[7]Our trade performance analysis is representative of larger and more organizationally structured firms that account for the bulk of trade in Portugal. Firms with at least one manager represent (in 2005) 53.6 percent of exporting firms, account for 91.8 percent of exports, and 61.5 percent of manufacturing employment. See Section 2.1 for further details.

where $ManExp_{fmt}$—our main variable of interest—is a dummy indicating the presence of (at least) one manager with export experience and/or specific export experience, $\mathbf{Z_{1ft}}$ and $\mathbf{Z_{2ft}}$ are two vectors of firm- and time-varying covariates affecting, respectively, entry and exports conditional on entry that are captured with either observables or firm-year fixed effects,[8] and η_{1mt} and η_{2mt} are market-year dummies.

We consider separately export experience and specific export experience and estimate one specification of equation (2.2) for the former—in which we allow for firm fixed effects—and three specifications for the latter—in which we allow for either firm or firm-year fixed effects and also consider IV. We use market-year dummies in all specifications. We run separate regressions for destination- and product-specific experience. At the same time we provide results obtained from more sophisticated specifications where: (i) we interact experience in a product with a measure of the degree of differentiation of product p as well as the degree of financial vulnerability of product p; (ii) we break down the data at the firm-time-product-destination level and interact experience in a destination with a Chinese import penetration measure – based on (Autor et al., 2014b) – for product p in destination d at time t.

In our analysis we show that basic export experience does not significantly affect trade performance in any of the margins we consider. What does impact trade performance is specific export experience and the evidence is quite rich and consistent. The presence of (at least) one manager with specific (destination or product) export experience positively affects both the probability to start and continue exporting, with the magnitude being particularly sizeable for the former. Destination- and product-specific export experience substantially increase

[8] Observables are firm size, productivity, share of skilled workers, age, foreign ownership, mean and standard deviation of both age and education of its managers, mean and standard deviation of the worker fixed effects corresponding to its managers and coming from the wage analysis, and industry-level exports. See Section 2.1 and the Appendix for further details.

the value of exports conditional on continuation while product-specific experience also seems to have an impact on export values conditional on entry. Furthermore, we find experience to be more valuable to firms selling products that are more differentiated and/or financially vulnerable while at the same time export experience seems to help some firms coping with increasing import competition from China.

These results add to the evidence provided in Section 2.2 and, along with the existence of a wage premium for managers with matched export experience, are consistent with the hypothesis those managers carry valuable export-specific knowledge increasing their wage, and that such knowledge has a strong destination- and product-specific nature. Later on in Section 2.3.4, we discuss a number of caveats potentially applying to our analysis, including reverse causality.

2.3.1 Results

Tables 2.5 to 2.8 report key covariates estimates of our model of a firm's likelihood to start/continue exporting a specific product or to a specific destination and the value of exports conditional on entry/continuation. More specifically, Tables 2.5 for destinations and 2.6 for products refer to the probability to entry (left panel) and to continue (right panel) exporting to a specific market while in Tables 2.7 for destinations and 2.8 for products we consider the (log) value of exports conditional on entry (left panel) and continuation (right panel). All the other covariates are displayed in the Tables Appendix.

The overall picture stemming from Tables 2.5 to 2.8 can be summarized as follows:

The presence of basic export experience does not increase trade performance. Columns

TABLE 2.5: Probability to Start and Continue Exporting to a Specific Destination

	Prob. Start Exporting				Prob. Continue Exporting			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unconditional Prob.	0.051	0.051	0.050	0.061	0.870	0.870	0.877	0.871
Manag. w/ Export Exp.	0.001				-0.000			
	(0.001)				(0.002)			
Manag. w/ Specific Export Exp.		0.013^a	0.018^a	0.040^a		0.005^a	0.014^a	0.046^a
		(0.001)	(0.001)	(0.005)		(0.002)	(0.003)	(0.013)
Firm-Year Controls	X	X			X	X		
Destination-Year Dummies	X	X	X	X	X	X	X	X
Firm FE	X	X			X	X		
Firm-Year FE			X	X			X	X
IV				X				X
Observations	166,860	166,860	166,860	62,392	52,124	52,124	52,124	24,859
R^2	0.175	0.176	0.338	—	0.256	0.257	0.420	—

Notes: This Table reports OLS and IV estimator coefficients and standard errors for the core covariates of our model of firm's entry and continuation into a foreign destination (2.2). Estimation results for all other covariates are provided in the Tables Appendix. The dependent variable takes value one when a firm f starts exporting to a new (left panel) or continues exporting to a current (right panel) destination d at time t. The key independent variable in columns (1) and (5) is a dummy indicating if the firm has at least one manager with export experience. In columns (2) to (4) and (6) to (8), the key variable is instead a dummy indicating if the firm has at least one manager with destination-specific export experience. See Section 2.1.1 for the definition of a manager and the export experience (and its refinements). Specifications in columns (1), (2), (5), and (6) include firm fixed effects while specifications (3), (4), (7) and (8) include firm-year fixed effects. Specifications in columns (4) and (8) employ an IV estimator while other specifications refer to an OLS estimator. The instrument is the value of the dummy indicating whether the firm has at least one manager with destination-specific export experience at time $t-3$. This information is sometimes missing so leading to a smaller estimation sample. Standard errors clustered at the firm-level in parentheses: ${}^a p < 0.01$, ${}^b p < 0.05$, ${}^c p < 0.1$.

TABLE 2.6: Probability to Start and Continue Exporting a Specific Product

	Prob. Start Exporting				Prob. Continue Exporting			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unconditional Prob.	0.017	0.017	0.017	0.021	0.732	0.732	0.702	0.727
Manag. w/ Export Exp.	0.000				-0.002			
	(0.000)				(0.004)			
Manag. w/ Specific Export Exp.		0.008^a	0.009^a	0.018^a		0.031^a	0.048^a	0.120^a
		(0.000)	(0.000)	(0.001)		(0.002)	(0.003)	(0.011)
Firm-Year Controls	X	X			X	X		
Product-Year Dummies	X	X	X	X	X	X	X	X
Firm FE	X	X			X	X		
Firm-Year FE			X	X			X	X
IV				X				X
Observations	775,675	775,675	775,675	313,369	40,125	40,125	40,125	17,647
R^2	0.070	0.073	0.128	—	0.205	0.214	0.364	—

Notes: This Table reports OLS and IV estimator coefficients and standard errors for the core covariates of our model of firm's starting and continuing exporting a specific product (2.2). Estimation results for all other covariates are provided in the Tables Appendix. The dependent variable takes value one when a firm f starts exporting a new (left panel) or continues exporting a current (right panel) product p at time t. The key independent variable in columns (1) and (5) is a dummy indicating if the firm has at least one manager with export experience. In columns (2) to (4) and (6) to (8), the key variable is instead a dummy indicating if the firm has at least one manager with product-specific export experience. See Section 2.1.1 for the definition of a manager and the export experience (and its refinements). Specifications in columns (1), (2), (5), and (6) include firm fixed effects while specifications (3), (4), (7) and (8) include firm-year fixed effects. Specifications in columns (4) and (8) employ an IV estimator while other specifications refer to an OLS estimator. The instrument is the value of the dummy indicating whether the firm has at least one manager with product-specific export experience at time $t-3$. This information is sometimes missing so leading to a smaller estimation sample. Standard errors clustered at the firm-level in parentheses: ${}^a p < 0.01$, ${}^b p < 0.05$, ${}^c p < 0.1$.

TABLE 2.7: (Log) Value of Exports to a Specific Destination Conditional on Entry or Continuation

	Exports Condit. Entry				Exports Condit. Contin.			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Manag. w/ Export Exp.	0.025				0.017			
	(0.044)				(0.011)			
Manag. w/ Specific Export Exp.		0.043	-0.026	-0.043		0.059^a	0.157^a	0.452^a
		(0.034)	(0.080)	(0.251)		(0.011)	(0.031)	(0.112)
Firm-Year Controls	X	X			X	X		
Destination-Year Dummies	X	X	X	X	X	X	X	X
Firm FE	X	X			X	X		
Firm-Year FE			X	X			X	X
IV				X				X
Observations	6,732	6,732	6,732	1,463	45,023	45,023	45,023	21,414
R^2	0.478	0.478	0.597	—	0.506	0.507	0.544	—

Notes: This Table reports OLS and IV estimator coefficients and standard errors for the core covariates of our model of firm's entry and continuation into a foreign destination (2.2). Estimation results for all other covariates are provided in the Tables Appendix. The dependent variable is equal to the (log) exports value of firm f to destination d at time t. This variable is observed only if firm f starts (continues) exporting to destination d at time t. The key independent variable in columns (1) and (5) is a dummy indicating if the firm has at least one manager with export experience. In columns (2) to (4) and (6) to (8), the key variable is instead a dummy indicating if the firm has at least one manager with destination-specific export experience. See Section 2.1.1 for the definition of a manager and the export experience (and its refinements). Specifications in columns (1), (2), (5), and (6) include firm fixed effects while specifications (3), (4), (7) and (8) include firm-year fixed effects. Specifications in columns (4) and (8) employ an IV estimator while other specifications refer to an OLS estimator. The instrument is the value of the dummy indicating whether the firm has at least one manager with destination-specific export experience at time $t-3$. This information is sometimes missing so leading to a smaller estimation sample. Standard errors clustered at the firm-level in parentheses: $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE 2.8: (Log) Value of Exports of a Specific Product Conditional on Entry or Continuation

	Exports Condit. Entry				Exports Condit. Contin.			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Manag. w/ Export Exp.	0.077^c				0.032			
	(0.040)				(0.023)			
Manag. w/ Specific Export Exp.		0.104^a	0.107^a	0.118		0.190^a	0.379^a	1.084^a
		(0.018)	(0.024)	(0.082)		(0.016)	(0.031)	(0.119)
Firm-Year Controls	X	X			X	X		
Product-Year Dummies	X	X	X	X	X	X	X	X
Firm FE	X	X			X	X		
Firm-Year FE			X	X			X	X
IV				X				X
Observations	11,853	11,853	11,853	4,403	29,033	29,033	29,033	11,358
R^2	0.419	0.421	0.558	—	0.440	0.445	0.411	—

Notes: This Table reports OLS and IV estimator coefficients and standard errors for the core covariates of our model of firm's starting and continuing exporting a specific product (2.2). Estimation results for all other covariates are provided in the Tables Appendix. The dependent variable is equal to the (log) exports value of firm f of product p at time t. This variable is observed only if firm f starts (continues) exporting product p at time t. The key independent variable in columns (1) and (5) is a dummy indicating if the firm has at least one manager with export experience. In columns (2) to (4) and (6) to (8), the key variable is instead a dummy indicating if the firm has at least one manager with product-specific export experience. See Section 2.1.1 for the definition of a manager and the export experience (and its refinements). Specifications in columns (1), (2), (5), and (6) include firm fixed effects while specifications (3), (4), (7) and (8) include firm-year fixed effects. Specifications in columns (4) and (8) employ an IV estimator while other specifications refer to an OLS estimator. The instrument is the value of the dummy indicating whether the firm has at least one manager with product-specific export experience at time $t-3$. This information is sometimes missing so leading to a smaller estimation sample. Standard errors clustered at the firm-level in parentheses: $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

(1) and (5) in the four Tables strongly indicate that just having one or more managers with basic export experience neither increases the probability to start or continue exporting a specific product or in a specific market not implies higher export values.

The presence of specific export experience does increase trade performance. Columns (2) to (4) and (6) to (8) in the four Tables strongly indicate that having one or more managers with specific export experience increases the probability to start and continue exporting a specific product or in a specific market and goes along with higher export values. In terms of the latter the estimated IV impact in column (8) is 57% ($\exp(0.452) - 1$) for export to a specific destination conditional on continuation and a stunning 195% for export of a specific product conditional on continuation. As far as the value of exports conditional on entry is concerned we do not find robust evidence of a boost effect. There is some evidence of a positive impact for product-specific experience but it does not survive in the IV specification. Moving to probabilities of entry and continuation we find strong evidence of a positive effect across the board. When compared to the raw probabilities reported in the top part of Tables 2.5 and 2.6, IV estimates in columns (4) imply that both destination-specific and product-specific experience almost double the probability to start exporting. When looking at the probability to continue exporting (column 8), the magnitudes relative to raw probabilities are instead in the range of 5-15%. There are many ways of rationalizing a smaller impact on continuation with respect to entry: A possible explanation is that firms that already export to a given market are likely to have managers without specific export experience who helped the firm to enter to that market in the past. Therefore, the impact of having a manager with specific export experience might well be positive for such firms (as suggested by our analysis) but not as important as for firms who wish to start exporting.

Furthermore, when confronting the coefficients corresponding to the presence of specific export experience with those (see Tables Appendix) of more established covariates used in the trade literature, like firm size and productivity, we find that specific (destination or product) experience always matters more than productivity while firm size explains more variation than specific experience only for the probability to continue exporting to a specific destination. In the remaining 3 cases destination-specific experience matters more than firm size while product-specific experience always explains more variation than firm size.

2.3.2 Managers arriving and leaving

The analysis presented so far focuses on the *presence* of managers with experience in a firm at a given point in time. In what follows we present some additional results about the *arrival* and *departure* of managers with experience. More specifically, we consider sub-samples of the observations used in the estimations provided in Tables 2.5 and 2.6 to better isolate the arrival of specific export knowledge into a firm and the departure of specific export knowledge from a firm. We use firm-time fixed effects and market-time dummies in all estimations.

In terms of arrival we consider, as in column (3) of Tables 2.5 and 2.6, firms who are not exporting in $t-1$ and look at whether they export in t or not depending on whether there is in the firm at least one manager with specific export experience in t. However, unlike in Tables 2.5 and 2.6, we now only consider firms that in $t-1$ have no managers with export experience (neither general nor specific) while further imposing that all firms in t have managers with export experience—though not necessarily specific to the considered market. This means we compare the probability to start exporting to a given destination or to start exporting a specific product—for firms without experienced managers in $t-1$—depending on whether the managers arriving in t have export experience that is specific to the destination/product or not. In both cases, managers with export experience have arrived in t but in one case the knowledge is specific while in the other it is not.

In the case of the knowledge leaving a firm we consider, as in column (7) of Tables 2.5 and 2.6, firms who are exporting in $t-1$ and look at whether they export in t or not conditional on whether there is in the firm at least one manager with specific export experience in t. However, unlike in Tables 2.5 and 2.6, we now only consider firms that in $t-1$ do have managers with specific export experience while further imposing that all firms in t have managers with export experience though not necessarily specific to the considered market. This means we compare the probability to continue exporting to a given destination or to continue exporting a specific product—for firms with managers with specific experience—depending on whether the managers that work in the firm in t have export experience that is specific to the destination/product or not. In one case, specific export experience remains in the firm while in the other it leaves the firm.

The slice of the data we use to perform these analyses is quite peculiar and subject to clear selection biases. Therefore, we do not claim any causality for the effects we find but still believe they are interesting to look at and compared with previous findings. Results, reported in Table 2.9 below, portrait an captivating picture. As far as the arrival of specific export knowledge is concerned, columns (1) and (2) point to a positive and significant effect with a magnitude larger than the comparable column (3) of Tables 2.5 and 2.6 and broadly in line with IV results in column (4) of Tables 2.5 and 2.6. Turning to specific knowledge leaving a firm column (4) suggests that when product-specific knowledge departs the probability to continue exporting a specific product substantially decreases. The magnitude we find is in line with the IV impact we obtain in column (8) of Table

2.6. However, when looking at destination-specific knowledge there is no significant impact. This is in line with a scenario in which the destination-specific knowledge of the manager leaving the firm has been fully transferred to the firm who does not experience any reduction in trade performance.

TABLE 2.9: Probability to Start and Continue Exporting to a Specific Destination or a Specific Product Depending on Whether Specific Export Experience Arrives or Leaves a Firm

	Prob. Start Exporting		**Prob. Continue Exporting**	
	(1)	(2)	(3)	(4)
Experience	Dest.	Prod.	Dest.	Prod.
Arrival or Departure of Manag. w/ Specific Export Exp.	0.048^a	0.034^a	0.032	-0.109^a
	(0.007)	(0.003)	(0.025)	(0.029)
Market-Year Dummies	X	X	X	X
Firm-Year FE	X	X	X	X
Observations	12,231	54,179	14,190	6,772
R^2	0.331	0.145	0.454	0.365

Notes: This Table reports OLS coefficients and standard errors for the core covariates of our model of firm's starting and continuing exporting a specific product or to a specific destination (2.2). The dependent variable takes value one when a firm f starts exporting to a new (left panel) or continues exporting to a current (right panel) market m at time t. The key independent variable is a dummy indicating if managers with specific export experience have arrived into (left panel) or left from (right panel) a firm. See Section 2.1.1 for the definition of a manager and the export experience (and its refinements). All specifications include firm-year fixed effects and market-time dummies. Standard errors clustered at the firm-level in parentheses: $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

2.3.3 Additional findings

We now come back to analyzing the impact of the *presence* of managers with export experience and report in Tables 2.10 and 2.11 a number of additional findings. In Table 2.10 we look at whether specific export experience interacts with the degree of product differentiation and/or the financial vulnerability of a firm's products. In this respect we believe export experience should be relatively more valuable to firms selling more differentiated products, i.e., products whose attributes are more difficult to observe, and products needing more financing, for example because of longer production processes and larger mismatch between investments and profits requiring more managerial effort and expertise. We also believe this should be particularly the case for firms starting to export. In Table 2.10 we thus look at entry probabilities and focus on experience in a product to examine the interaction between the presence of specific export experience with a measure of product differentiation and a measure of external financial dependence. We consider only our two most demanding specifications (firm-time fixed effects and IV). The positive and significant interaction coefficients do suggest that export experience is more valuable to firms selling more differentiated products and products needing more external financing.

TABLE 2.10: Probability to Start Exporting a Specific Product; Interactions with External Financial Dependence and Product Differentiation

	Prob. Start Exporting			
	(1)	(2)	(3)	(4)
Manag. w/ Spec. Export Exp.	0.007^{a}	0.008^{a}	0.014^{a}	0.013^{a}
	(0.000)	(0.001)	(0.001)	(0.002)
Manag. w/ Spec. Export Exp. * Ext. Fin. Dep.	0.029^{a}		0.041^{a}	
	(0.004)		(0.011)	
Manag. w/ Spec. Export Exp. * Prod. Diff.		0.008^{b}		0.029^{a}
		(0.003)		(0.008)
Product-Year Dummies	X	X	X	X
Firm-Year FE	X	X	X	X
IV			X	X
Observations	775,675	775,675	313,369	313,369
R^2	0.128	0.127	—	—

Notes: This Table reports OLS and IV estimator coefficients and standard errors for the core covariates of our model of firm's starting exporting a specific product (2.2) further enriched with product-specific measures of external financial dependence and product differentiation. Estimation results for all other covariates are provided in the Tables Appendix. The dependent variable takes value one when a firm f starts exporting a new product p at time t. The key independent variable in columns (1) and (3) is the interaction between a dummy indicating if the firm has at least one manager with product-specific export experience and our measure of external financial dependence. In columns (2) an (4) the key variable is the interaction between a dummy indicating if the firm has at least one manager with product-specific export experience and our measure of product differentiation. See Section 2.1.1 for the definition of a manager and the export experience (and its refinements) as well as for the description of the external financial dependence and product differentiation measures. All specifications include firm-year fixed effects and product-year dummies. Specifications in columns (3) and (4) employ an IV estimator while other specifications refer to an OLS estimator. The instruments for the two reported covariates are built on a dummy indicating whether the firm has at least one manager with product-specific export experience at time $t-3$. This information is sometimes missing so leading to a smaller estimation sample. All covariates, except product-year dummies, have been divided by their respective standard deviation in order to deliver a comparable metric. Standard errors clustered at the firm-level in parentheses: $^{a}p < 0.01$, $^{b}p < 0.05$, $^{c}p < 0.1$.

We perform in Table 2.11 a related exercise. The recent literature on China and trade has documented[9] many instances in which increasing imports from China put western firms and labour markets under competitive pressure generating a number of negative (employment cuts, firm death) and positive (skill and technological upgrading) reactions. Within this increasingly difficult environment we believe managerial export experience should be particularly valuable. To this end we break down our data at the firm-time-product-destination level and interact experience in a destination with a Chinese import penetration measure – based on (Autor et al., 2014b) – for product p in destination d at time t. Our Chinese import penetration measure proxies for the increasing degree of competition faced by a firm in exporting its products to a particular destination. We focus on firms that are already established and thus estimate a model of export continuation while including both destination-time and product-time dummies along with firm or firm-time fixed effects. Results shown in Table 2.11 suggest that import competition from China reduces continuation probabilities. At the same time the interaction with experience in a destination is positive and significant in the two non-IV specifications while being very close to significance in the IV specification; with the latter drawing on a much smaller sample. Though not extremely robust, these finding may suggest a connection between increasing import competition from China and the importance of specific export experience.

2.3.4 Endogeneity and other issues

Reverse causality. Does a firm hire managers with export experience to improve its trade performance or does the firm decide (based for example on some positive shocks) to export and then hires managers with export experience? In other words, how important is the issue of reversed causality in our analysis?

[9]See, for example, (Autor et al., 2014b), (Bernard et al., 2006), (Bloom et al., 2011b) and (Mion and Zhu, 2013).

TABLE 2.11: Probability to Continue Exporting a Specific Product to a Specific Destination; Interaction with Chinese Import Penetration

	Prob. Continue Exporting		
	(1)	(2)	(3)
Manag. w/ Spec. Export Exp.	0.003	0.012^a	0.046^a
	(0.002)	(0.004)	(0.014)
Manag. w/ Spec. Export Exp. * Imp. Penetr. China	0.004^a	0.005^a	0.005
	(0.001)	(0.001)	(0.003)
Imp. Penetr. China	0.105	-0.017^a	-0.023^a
	(0.998)	(0.006)	(0.006)
Product-Year Dummies	X	X	X
Destination-Year Dummies	X	X	X
Firm FE and Firm controls	X		
Firm-Year FE		X	X
IV			X
Observations	1,514,409	1,514,409	757,654
R^2	0.302	0.518	—

Notes: This Table reports OLS and IV estimator coefficients and standard errors for the core covariates of an enriched version of our model of firm's continuation into a foreign destination (2.2). Estimation results for all other covariates are provided in the Tables Appendix. The dependent variable takes value one when a firm f continues exporting product p to a current destination d at time t. The key independent variables are a dummy indicating if the firm has at least one manager with destination-specific export experience, a measure of Chinese import penetration in destination d of product p and time t and the interaction between the two. See Section 2.1.1 for the definition of a manager and the export experience (and its refinements) as well as for our measure of Chinese import penetration. The specification in columns (1) includes firm fixed effects and the firm-time covariates discussed in the previous Tables while specifications (2) and (3) include firm-year fixed effects. The Specification in columns (3) employs an IV estimator while other specifications refer to an OLS estimator. The instruments for the first two covariates are built on a dummy indicating whether the firm has at least one manager with destination-specific export experience at time $t-3$. This information is sometimes missing so leading to a smaller estimation sample. All specifications include destination-year and product-year dummies. All covariates, except destination-year and product-year dummies, have been divided by their respective standard deviation in order to deliver a comparable metric. Standard errors clustered at the firm-level in parentheses: $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

First, it is important to consider that managers with export experience cost more and the more so if they have an export experience matching the market portfolio of a firm.[10] Therefore, such managers should in all likelihood improve firm performance along some margins and it would be difficult to argue that export performance (especially when related to specific experience) would not be part of those margins. Whether the magnitudes we get here are lower or higher than the causal effect is another question.

Second, shocks pushing a firm to start/continue exporting that have been so

[10]See Section B.5 of the Appendix

far considered by the international trade literature (Bernard et al., 2012) are firm-time specific (e.g. productivity, skill intensity, R&D intensity, quality). We fully allow for such shocks and in particular our framework allows such shocks to be arbitrarily correlated with the presence of managers with specific export experience by means of firm-year fixed effects.

Third, in order to be an issue in our IV analysis, the more general case of firm-time-market shocks/omitted variables should be such that those unobservables are correlated with specific export experience at time t as well as at time $t-3$. In this respect there is substantial evidence – including (Das et al., 2007), (Iacovone and Javorcik, 2012) and (Moxnes, 2010) – that there are large sunk investment costs firms have to incur in order to export in a given market and that the time frame corresponding to firm's decisions today affecting export performance tomorrow (like setting up or increasing investments in quality and/or productivity) is about two yeas. Therefore, $ManExp_{fmt-3}$ should be uncorrelated with a firm's shocks and investments in between $t-2$ and t; those eventually leading the firm to improve its trade performance in t.

Fourth, in order to further address the issue of reverse causality we exploit the exogeneity of the sudden end of the Angolan civil war in 2002. The shock was unanticipated and right after the shock exporting firms did not have the time to prepare themselves to take advantage of the opportunities offered by the new politically stable setting by, for example, hiring managers with export experience. However, some firms in 2002 had managers with export experience in Angola while others had not and we show later on this makes a difference.

Finally, IV estimates in our analysis are typically larger than non-instrumented one. We believe this is consistent with substitutability being at work between hiring a manager with export experience and other export performance-enhancing forms of investments. More specifically, suppose that a firm is interested in entering (or staying, or improving its performance) in market m. The firm can either hire a manager with market-m export experience or undertake another costly activity, A_{fmt}, unobservable to us. Suppose that both choices affect the firm trade performance with respect to market m. Both choices are costly: in particular, our wage analysis shows that hiring a manager with specific export experience entails paying an extra wage premium. If the distribution of the unobservable A_{fmt} across firms, markets and time is positively (negatively) correlated to $ManExp_{fmt}$, the estimated coefficient of the latter will be upward (downward) biased. A positive correlation means that the A activity and hiring a manager with specific export experience are complementary. A negative correlation instead reveals that the two forms of investment are substitutes. The empirical international trade literature (Bernard et al., 2012) has no clear stance towards investments improving trade performance being substitutes or complements. Therefore, the sign of the bias is a priori ambiguous and our IV findings point towards substitutability.

Selection. The value of exports is observed only if a firm starts or continues to export to a market. We cope with the issue of firm selection into a market by using firm-year fixed effects and market-year dummies; most of the determinants of export entry emphasized by the trade literature are either at the firm-time or market-time level. A more recent strand of the literature, including (Morales et al., 2012), is exploring other determinants of firm export behavior which are truly firm-time-market specific and are related to a firm's past activity in "related" markets. We could certainly incorporate such determinants in our analysis to better address selection but, so far, it is not clear whether they provide valid exclusion restriction, i.e. whether they affect entry and/or continuation but not the value of exports.

Alternative definitions of entry and continuation. Though characterized by an overall strong degree of persistency over time, export activity can be erratic, especially when considering "young exporters". (Eaton et al., 2008) show, using Colombian data, that nearly one half of all new exporters stops exporting after just one year, and total exports are dominated by a small number of large and stable exporters.[11] (Békés and Muraközy, 2012) shows, using Hungarian data, that temporary trade is a pervasive feature of the data which is characterized by a number of specificities in terms of the firms, markets, and products involved. Therefore, a concern could be whether our results are sensitive to the the presence of short-lived export participation. In unreported results, available upon request, we have experimented with more stringent definitions of continuing and new exporters in a given market, based on the firm activity both in $t-1$ and in $t-2$ as in (Eaton et al., 2008), finding very similar results.

Alternative way of dealing with reverse causality. As an alternative way of dealing with reverse causality we construct an additional manager with specific experience dummy. We consider such dummy being equal to one if the firm has at least one manager with specific experience in t with the additional constraint that the managers should have been hired by the firm either in $t-1$ or $t-2$ or $t-3$. In unreported results, available upon request, we have used such a dummy as an alternative instrument. Estimations confirm our previous findings.

2.4 Conclusions and policy implications

This paper exploits a unique dataset for Portugal that allows to finely measure firm trade performance and managers' wages as well as to draw a sharp portrait of managers' mobility across firms. Crucially, we exploit the end of the civil war

[11] See (Amador and Opromolla, 2012) for similar findings using Portuguese data.

in Angola as an event study to account for the endogeneity of the matching between managers and firms. The paper shows that the export experience gained by managers in *previous* firms leads their *current* firm towards higher export performance, and commands a sizeable wage premium for the manager. Moreover, export knowledge proves to be very valuable when it is *market-specific*: managers with experience related to markets served by their current firm receive an even higher wage premium; firms are more likely to enter markets where their managers have experience; exporters are more likely to stay in those markets, and their sales are on average higher. At the same time, we show that the experience premium accrued by different types of managers (general, production, financial and sales) aligns with a knowledge diffusion story. We also find market-specific experience to be more valuable in terms of trade performance to firms selling products that are more differentiated and/or financially vulnerable while at the same time experience seems to help some firms coping with increasing import competition from China.

There are several policy implications stemming from our analysis. Our findings point to the importance of the presence of market-specific knowledge within the firm as a way to achieve competitiveness over and beyond firm productivity and scale. Improving firms' productivity and scale of operations is notoriously difficult and can be very expensive. Therefore, policies fostering knowledge exchange and diffusion of best practices among firms might be a more cost-effective tool that the Portuguese government might wish to employ in order to increase Portuguese firms' competitiveness and performance. Our findings also point to the existence of sizeable knowledge diffusion across firms via the mobility of managers. The presence of such knowledge flows means that policies directly affecting managerial skills and knowledge in some firms will sooner or later spill-over to other firms. With specific reference to the export activity, this has profound implications for the design and evaluation of export promotion programmes. Indeed, existing firm-level quantifications of the benefits of export promotion activities ((Mion and Muûls, 2015), (Broocks and Van Biesebroeck, 2017)) focus on benefits directly enjoyed by supported firms so neglecting spill-overs effects on other firms.

Chapter 3

Trade and Migration: A Quantitative Assessment

The economic effects from labor market integration are crucially affected by the extent to which countries are open to trade. In this paper we build a multi-country dynamic general equilibrium model to study and quantify the economic effects of trade and labor market integration in the context of the 2004 European Union enlargement. In our model, trade is costly and features households of different skills and nationalities facing costly forward-looking relocation decisions. We use the EU Labour Force Survey to construct migration flows by skill and nationality across 17 countries and a constructed rest of the world for the period 2002-2007. We exploit the timing of the change in policies due to the 2004 EU enlargement to identify the corresponding changes in labor mobility costs. We apply our model and use these estimates, as well as the observed changes in tariffs, to quantify the effects from the EU enlargement. We find that new member state countries are the largest winners from the EU enlargement, and in particular low-skilled labor. We find smaller welfare gains for EU-15 countries. However, in the absence of changes to trade policy, the EU-15 would have been worse off after the enlargement. We study even further the interaction effects between trade and migration policies, the importance of the timing of migration policy, and the role of different mechanisms in shaping our results. Our results highlight the importance of trade for the quantification of the welfare and migration effects from labor market integration.

3.1 Introduction

The aggregate and distributional consequences of economic integration are a central theme of debate in many countries, especially regarding the effects of trade and labor market integration. In this paper we study the general equilibrium effects of both goods and labor market integration and provide a quantitative assessment of the 2004 European Union enlargement. We do so by first constructing a new micro-data on gross migration flows by nationality and skills to study the migration effects associated to an actual change in policy. Second, we exploit a unique policy variation associated to the 2004 EU enlargement: the sequential changes to migration costs that each European country followed in the enlargement process. We use this timing variation in the changes to migration policy to identify policy-related changes in migration costs. Finally, given the sequential nature of the change in migration policy following the EU enlargement, migration decisions associated to the policy were inherently forward looking and dynamic. Accordingly, we develop a multi-country quantitative general equilibrium model of trade and migration policy with dynamic migration decisions.

The model features households of different skills and nationality with forward-looking relocation decisions. In each period, households consume and supply labor in a given country and decide whether to relocate in the future to a different country or not. The decision to migrate depends on the households location, nationality, skill, migration costs that are affected by policy, and an idiosyncratic shock ‡ la ArtuÁ, Chaudhuri, and McLaren (2010).[1] As mentioned above, taking into account the dynamic decision of households on where and when to migrate is particularly important in the context of the EU enlargement since countries reduced migration restrictions sequentially over time. Moreover, it turns out that the possibility to move in the future to another country whose real wages have increased adds to the welfare of a worker by raising her option value of being in a given location. In fact, even if migrants and natives obtain the same real wage they value each location differently since they face different continuation values as a result of different migration costs.

The production side of the economy captures the large degree of heterogeneity between old and new EU member states in terms of technology, and factor endowments. It features producers of differentiated varieties in each country with heterogeneous technology as in (Eaton and Kortum, 2002). In addition, we allow technology levels to be proportional to the size of the economy in order to capture the idea that there are benefits from firms and people locating next to each other.[2] Production requires high-skilled and low-skilled labor. Firms also demand local fixed factors (structures, land) and, as a result, increases in population size put upward pressure on factor prices that can mitigate the benefits from having a larger market. Goods are traded across countries subject to trade costs which depend on geographic barriers and trade policy (tariffs) as in (Caliendo and Parro, 2015). As a consequence, a change to trade policy impacts the terms of trade which in turn influences the effect of a change to migration restrictions.

All these features shape the economic effects of trade and labor market integration. Countries that experience a net inflow of migrants can be better off

[1] Keeping track of each household's nationality is relevant in the context of changes to migration policies. For instance, if the U.K. eliminates migration restrictions to Polish nationals, Polish households can freely move to the U.K. regardless of the location they are currently residing in. However, unless other EU countries drop migration restrictions to Polish nationals, Polish nationals can't migrate from the U.K. to another EU country as British nationals can.

[2] In this sense, we follow (Krugman, 1980), (Jones, 1995), (Kortum, 1997), (Eaton and Kortum, 2001), and (Ramondo et al., 2016).

because of higher productivity (scale effects) and from an increase in the supply of high- and low-skilled workers. However, they can also suffer from congestion effects associated to the straining of the local fixed factors, and from a worsening of the terms of trade associated to a downward pressure on wages. Changes in trade policy have the standard gains from trade effects, but in addition they also affect migration decisions. Understanding the overall contribution of these channels, as well as the role played by each channel in shaping the aggregate results, is a quantitative question that we answer in the context of an actual change in policy.

We apply our framework to quantify the welfare and migration effects of the 2004 EU enlargement. The 2004 EU enlargement is an agreement between member states of the European Union (EU) and New Member States (NMS) that includes both goods market integration, and factors market integration. On the integration in the goods market, tariffs were reduced to zero starting in 2004, and the NMS countries resigned to previous free trade agreements (FTAs) and joined EU's FTAs.[3] On factors market integration, migration restrictions were eliminated although, as described in detail later on, the timing of these changes to migration policies varied across countries.

Evaluating the effects of the EU enlargement requires information on how trade and migration costs changed due to the policy. For the case of trade policy one can directly observe the change in tariffs; however, policy-related changes in migration restrictions are not directly observed. To identify the changes in migration costs due to the change in policy, we exploit the cross-country variation in the timing of the adoption of the new migration policy.[4] Our identification strategy has a difference-in-difference-in-differences (DDD) flavor, and relies on the

[3]While tariffs applied to many goods were already zero by 2004 between the EU and NMS states, the average tariff rates applied across countries were far from zero. Section 2 documents the effective applied rates across countries before and after the enlargement.

[4]We estimate the whole set of changes in migration costs due to the EU enlargement over the period 2002-2007. That is, for NMS nationals that migrate from NMS countries to EU countries,

assumption that the trend in migration costs between countries that change migration policy and those that do not would have been the same in the absence of the EU enlargement. We confirm our identifying assumption by running several placebo tests and checking pre-treatment trends.

To estimate the changes in migration costs due to the EU enlargement and to compute our model we require data on bilateral gross migration flows by nationality and skill. We use raw data from the European Labour Force Survey (EU-LFS) to construct these yearly migration flows for a group of 17 EU countries and the rest of the world for the period 2002-2007.[5] To evaluate the changes to trade policy, we collect tariff data over the period 2002-2007.

To compute the effects of the EU enlargement we also need estimates of the migration cost elasticity, the elasticity of substitution between low and high-skilled workers, and the trade elasticity. We estimate the migration elasticity across countries using the two-step PPML estimation approach developed by (Artuç and McLaren, 2015) to study occupational mobility within the United States. We use our data on gross migration flows and wages across countries to estimate the international migration elasticity across European countries. In order to estimate the elasticity of substitution between low and high-skilled workers we use detailed matched employer-employee data for Portugal. We instrument the relative supply of high- to low-skilled labor by using information on displaced workers, located in the same region but in different industries, that are forced to change firm because of firm closure. Finally, we obtain the trade elasticity from (Caliendo and Parro, 2015).

Using our model, estimated changes in migration costs, observed changes in tariffs, and estimated migration, trade, and substitution elasticities we proceed to

for NMS nationals that migrate across NMS countries, and for EU nationals that migrate from EU countries to NMS countries.

[5]We collect data up to the year 2007 in an attempt to exclude the effects of the 2008 global financial crisis.

our empirical analysis. We compute our model using the structural differences-in-differences approach *(dynamic hat algebra)* developed in (Caliendo et al., 2017a). The method, which consists on expressing the time-differenced equilibrium conditions of a counterfactual economy relative to a baseline economy, has two main attractive properties. First, one can solve the model and perform counterfactual analyses without needing to estimate the set of exogenous state variables, (hereafter referred to as fundamentals). In our application, we solve for a counterfactual economy where we hold trade and migration policy unchanged relative to a baseline economy which contains the actual evolution of policies (i.e. the EU enlargement). Second, since the baseline economy is calibrated using time series, when feeding into the model the actual changes in policy we match exactly the observed gross migration flows, trade flows, as well as the observed labor market allocations and wages. This also means that in our application, fundamentals like technology and the non-policy component of trade and migration costs are time varying.

We first evaluate the migration effects of the EU enlargement. We find that the full impact of the EU enlargement on the stock of NMS nationals in EU-15 countries is realized very gradually over time. For instance, three years after the EU enlargement (that is, in 2007) the stock of NMS nationals in EU countries increases by 0.03 percentage points, while ten years after the implementation, the stock raises by 0.23 percentage points. We find that in steady state, the stock of NMS nationals in EU-15 countries increases by 0.63 percentage points or by about 3.3 million. Across skill groups, we find that the EU enlargement primarily increases migration of low-skilled NMS workers to EU-15 countries, and to a much lesser extent the migration of high-skilled workers. We also find that migration would have been larger in the absence of changes to trade policy. For instance, the stock of NMS workers in EU-15 countries would have been about 300 thousands people larger in the steady state.

Turning to the welfare effects, we find that on aggregate all groups of countries gain, and in particular NMS countries: NMS countries welfare increases by 1.41%, EU-15 countries welfare increases by 0.14%, while for Europe as a whole welfare increases by 0.36%. We further study the aggregate welfare effects along three dimensions. First, we show that the welfare effects of the EU enlargement are quite heterogeneous across countries and skills. Second, we show that the timing of changes to migration policy has important distributional effects. Third, we show that the level of trade integration has a quantitative impact on the welfare effects of changes to migration policy. We discuss each of these three findings in turn.

Across skilled groups, the largest winners from the EU enlargement are the low-skilled workers in NMS countries. The welfare of low-skilled workers in NMS countries increase by 1.46%, as opposed to an increase of 0.97% for high-skilled workers. On the other hand, EU-15 countries experience smaller welfare gains, that are mostly concentrated on high-skilled workers: welfare increases by 0.23% for high-skilled and 0.12% for low-skilled workers. The simultaneous reduction in migration and trade costs that characterized the enlargement is crucial for EU-15 countries: we show that, in the absence of changes to trade policy, the EU-15 countries would have been worse off.

When looking at the welfare impact on specific countries, we find that Poland and Hungary are the largest winners from the EU enlargement. The only group of workers that experiences a welfare loss are the low-skilled workers from the United Kingdom, with a welfare loss of 0.17%. This is mainly due to the increase in labor market competition due to the relatively larger inflow of low-skilled migrants. These losses more than offset the welfare gains associated to the reduction in tariffs.

The timing of changes to migration policy matters. We find that opening to trade and delaying opening to migration would have benefited EU-15 low-skilled workers more compared to EU-15 high-skilled workers. We also find that NMS countries would have been worse off compared with the actual gains; yet welfare gains are still positive.

We find that the level of trade integration has a quantitative impact on the welfare effects of changes to migration policy. Countries that receive migrants gain more under costly trade than under free trade while the reverse happens to the countries that experience an outflow of workers. For instance, welfare gains from reductions in migration restrictions for NMS countries would have been 13% higher under free trade compared to autarky. The intuition is that the labor market competing effects of migrants on wages pass-through less to local prices the more open the economy is.

We also extend our model to account for potential congestion effects from public goods. We find that in the presence of public goods migration effects from the EU enlargement are somewhat lower as immigration strains public goods and reduces incentives to migrate. Welfare gains are larger in NMS countries that experience a net outflow of workers that help decongest public goods, and smaller in EU-15 countries that experience a net inflow of workers. We also evaluate the quantitative importance of the mechanisms that operate in the model and find that abstracting from trade, congestion effects, and scale effects results in a significantly different welfare evaluation of trade and migration policies.

Our paper brings together two different but complementary elements in the analysis: on the one hand, we use a reduced-form analysis that exploits migration policy changes to identify changes in migration costs associated to the EU enlargement; on the other hand we use a rich dynamic general equilibrium model that includes all the mechanisms described above to quantify the migration and welfare effects of actual changes to trade and migration policies.

We now briefly discuss the connection of this study to the literature. Our research is complementary to studies that have employed static models of trade and migration to investigate different mechanisms in which trade and migration are interrelated. For instance, the effects of immigration in a Ricardian model with technology differences across countries studied in (Davis and Weinstein, 2002), the welfare effects of migration through remittances in (di Giovanni et al., 2015), and crowding out effects and labor market adjustments to immigration across tradable and non-tradable occupations in (Burstein et al., 2017). In addition, our result extend the key insight of (Davis and Weinstein, 2002) that in a Ricardian model with technology differences countries experiencing immigration always loose with respect to a free trade baseline.

Our paper also complements studies that focus on the impact of immigration on wages and employment of native workers, a question that has been extensively studied in the literature (e.g. (Hanson and Slaughter, 2002), (Hanson and Slaughter, 2016); (Ottaviano and Peri, 2012b); (Ottaviano et al., 2013); (Hong and Mclaren, 2016); and many more).

We also build on quantitative trade literature for trade policy analysis, such as (Costinot and Rodriguez-Clare, 2014), (Ossa, 2014), and in particular on (Caliendo and Parro, 2015). We depart from these studies by adding labor market dynamics and policy-dependent mobility frictions. In this sense, our paper relates to studies that evaluate the impact of trade shocks on labor markets, like (Artuç et al., 2010); (Dix-Carneiro, 2014); (Dix Carneiro and Kovak, 2017); (Cosar, 2013); (Coşar et al., 2016); (Kondo, 2013); (Menezes-Filho and Muendler, 2011), (McLaren and Hakobyan, 2015), and (Galle et al., 2017). For a recent review with the advances in this literature, see (McLaren, 2017).

This study relates to quantitative research where labor reallocation plays an important role in order to analyze the spatial distribution of economic activity, such as in (Ahlfeldt et al., 2015), (Redding and Sturm, 2008), (Redding, 2016), (Allen and Arkolakis, 2014), (Caliendo et al., 2017b), (Fajgelbaum et al., 2015), (Monte et al., 2015), (Tombe and Zhu, 2015).[6]

There is a fast-growing literature using spatial dynamic general equilibrium models that we also contribute to. Our framework with labor market dynamics builds on (Artuç et al., 2010), and it is particularly close to the general equilibrium model of trade and labor market dynamics developed in (Caliendo et al., 2017a) (hereafter CDP). CDP focus on studying the dynamic adjustments of labor markets to a trade shock, while in this paper we focus on quantifying how counterfactual dynamic responses to migration and trade policy change the distribution of economic activity. Also, different from CDP, we bring into the analysis households of different skills and nationalities, and policy-dependent migration costs. Other papers, notably (Desmet and Rossi-Hansberg, 2014), employ spatial dynamic models to understand how the distribution of economic activity shapes the dynamics of local innovation and growth by determining the market size of firms. Following this research, (Desmet et al., 2016) study how migration shocks shape the dynamics of local innovation and growth.[7]

Our paper also connects with studies that have used the EU enlargement (as an ex-ante and ex-post evaluation) to study the economics implications of the integration (e.g. (Baldwin, 1995), (Baldwin et al., 1997), (Dustmann and Frattini, 2011), and (Kennan, 2017)). Our approach departs in several ways, and in particular by employing new quantitative techniques to study the general equilibrium effects of the enlargement in a model of costly trade and migration.

Finally, we mention other mechanisms in the literature that will not be part

[6] For a review of new developments in quantitative spatial models see (Redding and Rossi-Hansberg, 2016).

[7] See also (Klein and Ventura, 2009), who study the effects on output, welfare, and capital accumulation of removing labor mobility barriers in a neoclassical growth model.

of our analysis. Some studies have focused on the substitution between migrants and natives in production, although the results on the value of the elasticity of substitution are contrasting, as documented by (Borjas et al., 2012). As explained above, in our paper natives and migrants are perfect substitutes in production but they still value locations differently as a result of facing different migration restrictions. That is, when deciding to migrate and where to live, the option value for a migrant and a native vary and as a consequence migrants could in fact trade-off lower wages for a higher option value.

We will also abstract from explicitly modeling selection effects in the migration decisions coming from unobserved heterogeneity in labor market skills. Selection effects could lead to an increase in productivity by better sorting migrants across location (e.g. (Borjas, 1987), (Young, 2013), (Lagakos and Waugh, 2013), (Bryan and Morten, 2017)). In our model, immigration fosters productivity through agglomeration forces as explained later on. (Diamond, 2016) has also found that the internal migration of college graduates leads to increases in amenities in U.S. higher skill cities over the period 1980-2000. We abstract from endogenous amenities in our model, but we believe that this mechanism is somehow less relevant in the context of the EU enlargement as we quantify the effects of international migration, and as we will document later on, most of the migration due to the enlargement was low-skilled. Still, studying the impact of immigration on amenities at the country level is a promising avenue for future research.

The rest of the paper is structured as follows. Section 2 describes the main migration and trade policy changes as a consequence of the EU enlargement. We also describe the data to construct gross migration flows across European countries by skill and nationality, and present some reduced-form evidence on the change in migration flows after the 2004 EU enlargement. In Section 3 we develop a dynamic model for trade and migration policy analysis that accounts for the main features of the EU enlargement and the migration data. Section 4 describes other data construction and sources needed to compute the model, the estimation of changes to migration costs due to the EU enlargement, and the estimation of the relevant elasticities of the model. In Section 5 we compute the migration and welfare effects from the EU enlargement and discuss the results. Finally, section 6 concludes. The Appendix includes a detailed description of the EU enlargement process, of the data, and of the different methodologies employed throughout the paper.

3.2 The 2004 Enlargement of the European Union

On May 1^{st} 2004 ten new countries with a combined population of almost 75 million officially joined the European Union (EU) bringing the total number of member states from 15 to 25 countries.[8] The New Member States (NMS), are: Czech Republic, Cyprus, Estonia, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, and Slovakia. Country size and the relative endowment of skilled workers were very heterogeneous within NMS countries and between NMS and EU-15 countries. For instance, the NMS countries were very heterogeneous in terms of population size, ranging from 0.4 millions in Malta to 38 millions in Poland in 2004. In addition, the relative endowment of low-skilled worker was much higher in NMS countries than in EU-15 countries. In particular, on average, the ratio of low-to-high-skilled labor was 3.8 in EU-15 countries, and 5.2 in NMS countries in 2004.

In this section we highlight the features of the 2004 enlargement that directly affect the international migration of workers within Europe and international

[8] The existing EU-15 member states are Austria, Belgium, Denmark, Finland, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, Netherlands, Portugal, Sweden, and the United Kingdom.

trade both between the enlarged set of EU members and between the EU and the rest of the world.[9]

3.2.1 Migration Policies

The freedom of movement of workers is considered as one of the four fundamental freedoms guaranteed by EU law (*acquis communautaire*), along with the free movement of goods.[10] EU law effectively establishes the right of EU nationals to freely move to another member state, to take up employment, and reside, as well as protects against any possible discrimination, on the basis of nationality, in employment-related matters.[11]

The Accession Treaty of 2003 allowed the "old" member states to temporarily restrict, for a maximum of 7 years, the access to their labor markets to citizens from the accessing countries, with the exception of Malta and Cyprus. These temporary restrictions were organized in three phases according to a 2+3+2 formula. During an initial period of 2 years, member states, through national laws, could regulate the access of workers from all new member states; member states could then extend their national measures for an additional 3 years, and an additional extension for other 2 years was possible. The transitional arrangements were scheduled to end irrevocably seven years after accession, i.e. on April 30th, 2011. The decision about the timing to eliminate migration restrictions was mainly political, and therefore, the potential migration effects unlikely influenced this timing. For instance, initially and until only three months before the enlargement,

[9] Appendix C.1 describes the steps of the EU membership process, and reports additional information on the accessing countries.

[10] As effectively and concisely defined by Article 45 (ex Article 39 of the Treaty Establishing the European Community) of the Treaty on the Functioning of the European Union, the freedom of movement of workers entails "*the abolition of any discrimination based on nationality between workers of the member states as regards employment, remuneration and other conditions of work and employment*".

[11] Once a worker has been admitted to the labor market of a particular member state, community law on equal treatment as regards remuneration, social security, other employment-related measures, and access to social and tax advantages is valid.

EU-15 countries had decided to eliminate migration restrictions all in 2004. In addition, this was an unprecedented enlargement given that it was the first one to include countries at very different stages of development. As a result, there was little evidence on the potential migration effects of the enlargement, with a large range of estimates.[12]

We now briefly summarize the phase-in period of the accession. Appendix C.1 presents further details.

Before 2004. Workers could flow freely within the EU-15 member states but not between EU-15 and NMS as well as between NMS countries.

Phase 1. In 2004, the U.K., Ireland, and Sweden open their borders to NMS countries, which reciprocate by opening their borders to British, Irish and Swedish citizens. All the other EU-15 countries keep applying restrictions to NMS countries, except to Cyprus and Malta. All NMS countries decide to open their borders to EU-15 member states, except for Hungary, Poland, and Slovenia which apply reciprocal measures. NMS countries lift all restrictions among each others.

Phase 2. In 2006, Italy, Greece, Portugal, and Spain lift restrictions on workers from NMS countries. As a consequence, Hungary, Poland, and Slovenia drop their reciprocal measures towards these four member states. Slovenia and Poland dropped the reciprocal measures altogether in 2006 and 2007, respectively, while Hungary simplified them in 2008. During phase 2, The Netherlands and Luxembourg (in 2007), and France (in 2008) also lift restrictions on workers from NMS countries.

Phase 3. Belgium and Denmark opened their labor market to NMS countries in 2009, while Austria and Germany opened their labor markets at the end of the transitional period, in 2011.

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[12] See for instance Fihel, Janicka, Kaczmarcyk, and Nestorowicz 2015, "Free Movement of Workers and Transitional Arrangements: Lessons from the 2004 and 2007 Enlargements".

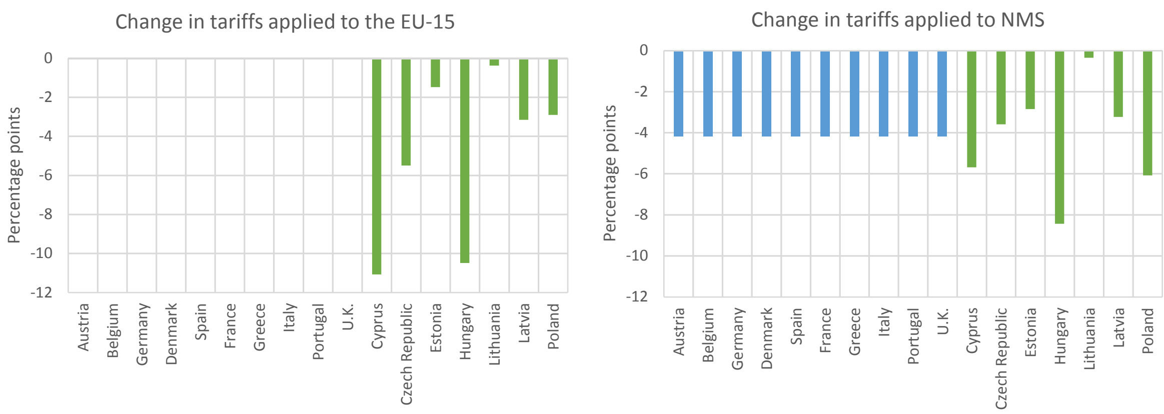
As we can see, there is considerable variation in terms of which countries open to which over time across the phases. This variation is going to result useful for us in order to identify the changes in migration costs due to migration policy. Yet, phase 3 of the agreement was in the middle of the 2008 great financial crisis and this can interfere with our identification of the effects of the change in policy. As a result, in our quantitative analysis, we focus on the effects of the enlargement accounting for the first two phase-in periods. We now briefly describe the change in trade policy.

3.2.2 Trade Policies

As part of the enlargement process, NMS became part of the European Union Customs Union, and of the European common commercial policy. As a result, tariffs between NMS and EU-15 countries were reduced to zero starting in 2004. Figure 3.1 presents the change in tariffs applied to EU-15 countries and to NMS countries as a consequence of the EU-enlargement. The average tariff rate before the enlargement was about 4.3 percent between NMS countries, the average tariff applied by NMS to EU-15 countries was about 5 percent, and the average tariff applied by EU-15 to NMS countries was about 4.2 percent. After the accession, from 2004 on, tariffs between all EU-25 countries are zero. Also, as a consequence of the EU enlargement process, NMS automatically entered into the trade agreements to which the EU is a party, and resigned their own existing agreements.[13] This resulted in additional changes in trade policy for NMS. We use all these tariff changes in our quantitative assessment later on.

[13] In Appendix C.1.2 we provide more detail on the trade policy implemented after the EU enlargement.

FIGURE 3.1: Average tariff changes due to the EU enlargement



Note: Average (trade weighted) tariff changes from 2003 to 2004. The figures show the set of EU-15 and NMS countries used in our empirical analysis. Source WITS.

3.2.3 Gross Migration Flows by Nationality and Skill

In order to quantify the migration and welfare effects of changes in migration policy, data on migration flows across European countries before and after the EU enlargement are needed. In particular, we need migration flows by nationality and skill since, as discussed above, the mobility restrictions that EU15 and NMS nationals face are quite different, and the level of educational attainment is very heterogeneous across all the countries involved in the enlargement. Given that the existing migration data are mostly based on census sources and contain information only on stocks of migrants, we proceed to construct gross migration flows by nationality and skill across European countries.

We construct bilateral gross migration flows for European countries from 2002 to 2007 using information contained in the European Labour Force Survey (EU-LFS), a large household survey providing confidential quarterly or annual results on labor participation of people aged 15 and over, as well as on persons outside the labor force from 1983 onward. The EU-LFS is currently conducted in the 28 member states of the European Union, two candidate countries and three countries of the European Free Trade Association (EFTA).[14] The main strength of the EU-LFS is to use the same concepts and definitions in every country, follow International Labour Organization guidelines using common classifications (NACE, ISCO, ISCED, NUTS), and record the same set of characteristics in each country. Because of these features, the EU-LFS is the basis for unemployment and education statistics in Europe.

The survey contains information on a representative sample of the labor force in each country. Individuals are assigned a weight to represent the share of people with the same characteristics in the country. For each individual in a specific year, we have information on age, nationality, skills and, crucially for our purpose, country of residence 12 months before. We use the information on country of residence in the previous year to construct bilateral gross migration flows by year, country of origin, nationality and skill for a group of 17 EU countries.[15]

We group migrants in three broad nationality categories that follow immediately from the 2004 European enlargement: EU-15 nationals, NMS nationals, and Other nationals (rest of the world). Moreover, we follow the international standard classification of education (ISCED 1997) and define high skill labor as college educated and low skill labor as individuals with high school degree or less. We constraint our sample to include only individuals of working age—between 15 and 65 years old—and only countries with consistent information on nationality, skills and country of origin over the period 2002-2007. We end up with a total of 17 countries, ten former EU members, Austria, Belgium, Germany, Denmark,

[14] The national statistical institute of each country in Europe conducts surveys that are centrally processed by Eurostat; each national institute is responsible for selecting the sample, preparing the questionnaires, conducting the direct interviews among households, and forwarding the results to Eurostat in accordance with the requirements of the regulation.

[15] As an example, looking at the U.K. survey in 2004, we know if a Polish high-skilled worker moved to the U.K. from Poland in the previous 12 months. Migration shares, $\mu^{ij}_{n,s,t}$ are computed as the share of migrants that moved to a specific destination country over a population defined by country of origin, nationality and skills.

Spain, France, Greece, Italy, Portugal, and the United Kingdom, and seven NMS, Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Latvia, and Poland. Our group of countries covers 91 percent of the 2004 EU-25 population.[16]

As an illustration, Figure 3.2 plots the gross flows and stocks of NMS migrants in EU15 countries that arise from our constructed gross migration flows data. As we can see from the panels, the largest fraction of migrants was low-skilled.[17]

3.2.4 Reduced-Form Evidence

With the constructed gross migration flows, we can now proceed to provide a first evidence on the migration effects of the EU enlargement by presenting reduced-form evidence on the change in migration flows of NMS nationals to EU-15 countries after the 2004 enlargement. In particular, we explore whether there was a significant change in migration flows after 2004, controlling by country characteristics and time effects. As an example, we use our constructed data on bilateral gross migration flows to estimate a simple difference-in-difference (DD) model to evaluate the change in the flow of NMS nationals migrating to the U.K. after 2004. We choose the U.K. since it is the only EU-15 country in our sample that eliminated migration restrictions immediately in 2004. We consider the NMS nationals as the treated group and the EU-15 and Other nationals as the control group, and run the following regression,

$$\log F_{n,t}^{i,UK} = \lambda_{i,t} + \alpha_{NMS} + \beta_{03} I\left(UK, 2003\right) + \beta_{04} I\left(UK, 2004\right) + \beta_{05} I\left(UK, 2005\right) +$$

$$+ \beta_{06} I\left(UK, 2006\right) + \beta_{07} I\left(UK, 2007\right) + \varepsilon_{n,t}^{i},$$

[16]Country surveys for Ireland, Malta, Netherlands, Sweden, Slovenia, Bulgaria, Slovakia, Luxembourg, Romania and Finland do not contain sufficient information to compute migration flows consistently between 2002 and 2007, so we assign these countries to the rest of the world (RoW). More information on each case is contained in Appendix C.2.1.

[17]Appendix C.2.2 describes in greater detail how we construct the gross migration flows, and provides a set of external validation statistics.

where the dependent variable log $F^{i,UK}_{n,t}$ is the (log) flow of nationality n migrants from NMS country i to the U.K. in year t, $\lambda_{i,t}$ is a set of origin-year fixed effects that captures origin-time-specific factors, and α_{NMS} is a fixed effect that captures possible difference between NMS nationals and the control group prior to the EU enlargement. The coefficients $\{\beta_{0t}\}_{t=3-7}$, interacted with an indicator function equal to one for the year t capture the change in the flow of NMS migrants to the U.K. after the enlargement relative to the control group. We expect $\beta_{04} - \beta_{07}$ to be positive and significant, pointing to an increase in the flow of NMS nationals migrating to the U.K. after the EU enlargement, controlling by country characteristics and time effects.[18]

Figure 3.3, reporting the estimated βs, as well as the 99th, 95th, and 90th percentiles confidence intervals, provides evidence of a significant change in migration flows of NMS nationals after the EU enlargement. In particular, the difference-in-difference estimates show that the flow of NMS nationals to the U.K. jumps up in 2004, and the NMS migrants steadily increases in the years following the enlargement.

Besides an increase in the flow of NMS nationals migrating to the EU-15 countries, the EU enlargement also had heterogeneous migration impacts on individual destinations for NMS migrants. Figure 3.4 reports a stark example of this diversion effect: Germany had been, for several reasons throughout history, the main European destination for Polish migrants. After the enlargement, the share of Polish migrants moving from Poland to Germany has been constantly decreasing, with the U.K. progressively becoming the top destination for Polish migrants.

[18] The coefficient β_{03} instead allows us to carry on a test for causality in the spirit of Granger (1969): a non-significant β_{03} is consistent with the opening of the U.K. labor market to NMS nationals causing the change in $F^{i,UK}_{n,t}$, but not vice-versa.

Section C.2.2 in the Appendix uses our gross migration data to depict other examples of migration patterns.

We next turn to a structural analysis, where we will capture the aspects of the EU enlargement discussed in this section: the sequential change in migration policy, the significant and gradual change in migration flows after the enlargement, and the heterogeneity of destination countries. To do so, in the next section we develop a structural model of trade and migration with multiple countries, and households of different nationalities and skills making forward-looking migration decisions. Later on, we will also use the changes in migration flows across countries after the enlargement to identify the policy-related changes in migration costs, not only for the case of the U.K., but also for all countries that changed migration policy. After doing so, we will feed these policy-related changes in migration costs into our structural model to quantify the general equilibrium effects of the EU enlargement.

3.3 A Dynamic Model of Trade and Labor Markets Integration

In this section, we develop a dynamic general equilibrium model for trade and migration policy analysis that accounts for the main features of the EU enlargement and the migration data outlined above. The world is composed of N countries, indexed by i and j. Each country represents a competitive labor market where a continuum of firms produce goods with heterogeneous productivities. A fraction of goods are traded across countries, and the movement of goods is subject to trade costs. As we will see later on, a component of trade costs is tariffs, which are affected by trade policy in each country. As in (Eaton and Kortum, 2002) productivities have a FrÈchet distribution with a dispersion parameter θ

which, as we will see below, is also the trade cost elasticity. Production of goods in a given country requires high-skilled and low-skilled labor, which are imperfect substitutes, and fixed factors that we call structures.

In the model, time is discrete and households have perfect foresight. Households make forward-looking labor relocation decisions subject to migration costs and idiosyncratic preferences. Each period they decide whether to stay in the same country or to move to a different country, a decision that depends on real wages and expected continuation values. Migration policy in each country has an impact on migration costs, and therefore on households' decisions.

We start by describing the problem of the households, we then set up the production structure in each country, and finally, we derive the market clearing conditions. After doing so, we define the equilibrium of the model.

3.3.1 Households

Households are forward-looking, observe the economic conditions in all countries and optimally decide where to work. Households face costs of moving across countries and are subject to idiosyncratic shocks that affect their moving decision. If they begin the period in a country, they work and earn the market wage. As described above, households in a given country are of different nationalities that we index by n, and with different skills that we index by s.

The value of a n national of skill s in country i at time t, $v^i_{n,s,t}$, is given by

$$v^i_{n,s,t} = log(C^i_{s,t}) + \underset{\{j\}_{j=1}^N}{max} \{\beta E[v^j_{n,s,t+1}] - m^{ij}_{n,s,t} + \nu\epsilon^j_{n,s,t}\},$$

where $C^i_{s,t}$ is the consumption aggregator that we describe below. The term $m^{ij}_{n,s,t}$ is the migration cost from country i to country j at time t for a household native from country n and skill level s.

The migration cost, $m^{ij}_{n,s,t}$ in our model is time varying, as it can be impacted by changes to migration policy. Specifically, we allow mobility costs to have a non-policy and a policy component, that is, $m^{ij}_{n,s,t} = \tilde{m}^{ij}_{n,s,t} + mpol^{ij}_{n,s,t}$, where $\tilde{m}^{ij}_{n,s,t}$ is the non-policy component of the cost of migrating from country i to country j for a household of nationality n and skill s, and $mpol^{ij}_{n,s,t}$ is the policy component that is impacted by migration restrictions. Moreover, we allow non-policy migration to also be time-varying and include origin-specific components, destination-specific components, and bilateral components, that is $\tilde{m}^{ij}_{n,s,t} = \bar{m}^{i}_{n,s,t} + \bar{m}^{j}_{n,s,t} + \bar{m}^{ij}_{n,s,t}$.

We assume that idiosyncratic preference shocks $\epsilon^{j}_{n,s,t}$ are stochastic i.i.d. of a Type-I extreme value distribution with zero mean, and with dispersion parameter ν that later on we will relate it to the migration cost elasticity. Finally, β is the discount factor. The presence of migration costs and idiosyncratic preferences generates a gradual adjustment of flows in response to changes in the economy since only the fraction of households with idiosyncratic preference for a location that more than offset the migration cost will relocate each period.

Using the properties of the Type-I extreme value distribution, we can solve for the expected (expectation over ϵ) lifetime utility of a worker of nationality n and skill s in country i, namely $V^{i}_{n,s,t} \equiv E[v^{i}_{n,s,t}]$,

$$V^{i}_{n,s,t} = log\left(C^{i}_{s,t}\right) + \nu log\left(\sum\nolimits_{j=1}^{N} exp(\beta V^{j}_{n,s,t+1} - m^{ij}_{n,s,t})^{1/\nu}\right). \quad (3.1)$$

The first term in equation (3.1) represents the current utility of that households in country i and the second term captures the expected value of staying in that country the next period and the option value of migrating to a different country. Note that the option value of migration varies by skill and nationality, and captures the fact that households of different nationalities living in the same country face different migration restrictions.

Households supply a unit of labor inelastically, and receive a competitive nominal wage $w^i_{s,t}$ that depends on the country of residency, and the skill level. Given this, the indirect utility of a household with skill s in country i is given by

$$C^i_{s,t} = \frac{w^i_{s,t}}{P^i_t}, \tag{3.2}$$

where P^i_t is the local price index.

Using the properties of the extreme value distribution, we also solve for the fraction of households of nationality n and skill s that migrates from country i to country j at time t, which we denote by $\mu^{ij}_{n,s,t}$

$$\mu^{ij}_{n,s,t} = \frac{exp(\beta V^j_{n,s,t+1} - m^{ij}_{n,s,t})^{1/\nu}}{\sum_{k=1}^{N} exp(\beta V^k_{n,s,t+1} - m^{ik}_{n,s,t})^{1/\nu}}. \tag{3.3}$$

This equation describes gross flows of migrants by nationality and skill across countries. Notice that $1/\nu$ captures the response of migration flows to migration costs, or in other words, the migration cost elasticity, which is a parameter that we need to estimate.

With the initial distribution of labor by nationality and skill across countries, and the migration flows at each period, we can solve for the evolution of labor by nationality and skill at each moment in time. Specifically,

$$L^i_{n,s,t+1} = \sum_{j=1}^{N} \mu^{ji}_{n,s,t} L^j_{n,s,t}, \text{ for all } n, s. \tag{3.4}$$

Finally, the total labor supply in each country is then given by the sum of high-skill (h) and low-skill (l) workers of all nationalities,

$$L^i_t = \sum_{n=1}^{N} \left(L^i_{n,h,t} + L^i_{n,l,t} \right).$$

We now turn to describe the production structure of each economy.

3.3.2 Production

A continuum of goods is produced in each country with technology as in (Eaton and Kortum, 2002). The technology to produce these goods requires both high-skilled and low-skilled labor, and structures. High-skilled and low-skilled labor are imperfect substitutes, and structures is a fixed factor. Total factor productivity (TFP) is composed of two terms: an aggregate component (A_t^i), which is common to all varieties in a country, and a variety-specific component (z^i) that is a stochastic realization from a FrÈchet distribution. We allow technology levels to be endogenous and proportional to the size of the economy, that is $A_t^i = \phi_t^i L_t^i$, as in (Ramondo et al., 2016).[19] Note that, although the elasticity of TFP with respect to population size is equal to one under this formulation, the elasticity of real income with respect to population is less than one because of the congestion effects in the presence of local fixed factors.[20]

Since each variety is identified by z^i, we use it to index a variety. Therefore, the production function of a given good in country i is given by

$$q_t^i(z^i) = z^i A_t^i \left(\left(\delta_h^i\right)^{\frac{1}{\rho}} \left(L_{h,t}^i\right)^{\frac{\rho-1}{\rho}} + \left(\delta_l^i\right)^{\frac{1}{\rho}} \left(L_{l,t}^i\right)^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho(1-\gamma^i)}{\rho-1}} \left(H^i\right)^{\gamma^i},$$

where $L_{h,t}^i$ and $L_{l,t}^i$ are the amount of high and low-skilled labor used to produce a given good in country i, ρ is the elasticity of substitution between high and low-skilled labor, $(1-\gamma^i)$ is the share of labor payments in value added, δ_h^i is the weight of high-skilled labor in production, and δ_l^i is the weight of low-skilled labor, with $\delta_h^i + \delta_l^i = 1$. The stock of land and infrastructures is H^i, which, as mentioned before, is a fixed factor.

[19]Note that an isomorphic relation arises from models with free entry of firms as in (Melitz, 2003).

[20]Given this, the production structure of our model can be mapped into existing static models with scale effects that show existence and uniqueness of the equilibrium (e.g. (Kucheryavyy et al., 2016)).

We refer to rentiers as the owners of the fixed factors H^i. As in (Caliendo et al., 2017b) we assume that there is a mass one of rentiers in each economy and that rentiers consume local goods using (3.2), the same consumption aggregator as households. Rentiers obtain rents $r_t^i H^i$ from the fixed factors they own and rent to firms. We assume that these rents are sent to a global portfolio and that rentiers obtain a share ι^i of the global portfolio revenues $\chi_t = \sum_{i=1}^N r_t^i H^i$, where r_t^i is the rental price of structures in country i. Differences between remittances to the global portfolio and the income transfers from the global portfolio will generate imbalances in each country, and therefore, this assumption on the behavior of the rentiers will allow us, in our quantitative model, to match the observed trade imbalances across nations. This ownership structure has only an indirect impact on workers' welfare through market clearing conditions since workers are not the owners of the fixed factor. An alternative is to model workers as owners of assets and the possibility of carrying these assets to different countries. This formulation implies a much harder problem to solve since it would require to keep track of each household and her assets, and therefore, we leave it for future research.

Goods can be traded across countries subject to trade costs. Specifically the cost of shipping goods from country j to country i is given by $\kappa_t^{ij} = (1 + \tau_t^{ij}) d_t^{ij}$, where d_t^{ij} is an iceberg-type trade cost, which includes non-tariff trade barriers, and τ_t^{ij} is an ad-valorem tariff.

As in (Eaton and Kortum, 2002), using the properties of the FrÈchet distribution we can solve for the bilateral trade shares π_t^{ij} and the price index P_t^i as a function of factor prices, productivities and trade costs. Specifically,

$$\pi_t^{ij} = \frac{A_t^j (\kappa_t^{ij} x_t^j)^{-\theta}}{\sum_{k=1}^N A_t^k (\kappa_t^{ik} x_t^k)^{-\theta}}, \tag{3.5}$$

$$P_t^i = \left(\sum_{j=1}^N A_t^j (\kappa_t^{ij} x_t^j)^{-\theta} \right)^{-\frac{1}{\theta}}, \tag{3.6}$$

where x_t^i is the unit price of an input bundle, namely

$$x_t^i \equiv \zeta^i \left(\delta_h^i (w_{h,t}^i)^{1-\rho} + \delta_l^i (w_{l,t}^i)^{1-\rho}\right)^{\frac{(1-\gamma^i)}{1-\rho}} (r_t^i)^{\gamma^i}, \tag{3.7}$$

where ζ^i is a constant. We now describe the market clearing conditions and the equilibrium of the model.

3.3.3 Market Clearing

The total expenditure on goods by country i is given by labor income of workers of all skill levels and nationalities residing in country i, by income of local rentiers, and by tariff revenues. Namely, the goods market clearing is given by

$$X_t^i = \sum_{n=1}^N \sum_{s=h,l} w_{s,t}^i L_{n,s,t}^i + \iota^i \chi_t + T_t^i, \text{ for all } i, \tag{3.8}$$

where $\chi_t = \sum_{i=1}^N r_t^i H^i$ is the rent of the global portfolio, and where
$T_t^i = \sum_{j=1}^N \tau_t^{ij} \frac{\pi_t^{ij}}{(1+\tau_t^{ij})} X_t^i$ are tariff revenues.

Finally, the labor markets clear, i.e

$$w_{s,t}^i L_{s,t}^i = \xi_{s,t}^i (1-\gamma^i) \Sigma_{j=1}^N \frac{\pi_t^{ji}}{(1+\tau_t^{ji})} X_t^j, \text{ for all } i, s, \tag{3.9}$$

where $\xi_{s,t}^i$ is the share of skill s in the labor payments, which is time varying given the CES production structure.

3.3.4 Equilibrium

We denote by $\Theta_t \equiv (\{d_t^{ij}\}, \{\tilde{m}_{n,h,t}^{ij}\}, \{\tilde{m}_{n,l,t}^{ij}\}, \{\phi_t^i\}, \{H^i\})_{i=1,j=1}^{N,N}$ the set of constant and time-varying fundamentals, that is, bilateral non-tariff (iceberg) trade costs, non-policy mobility costs by nationality and skills, the exogenous component of productivity across countries, and the stock of fixed factors across countries. In addition, we denote by $\Upsilon_t \equiv (\{\tau_t^{ij}\}, \{mpol_{n,h,t}^{ij}\}, \{mpol_{n,l,t}^{ij}\})_{n=1,i=1,j=1}^{N,N,N}$ the different economic policies of a country: tariffs and migration policies that impact migration costs $m_{n,s,t}^{ij}$. The state of the economy is given by the distribution of labor across each market at a given moment in time $L_t = \left\{L_{n,h,t}^i, L_{n,l,t}^i\right\}_{n=1,i=1}^{N,N}$. We now seek to define the equilibrium of the model given fundamentals, trade policies, and migration policies. First, we formally define the *static equilibrium*, which is given by the set of factor prices that solve the static trade equilibrium.

Definition 1. *Given $(L_t, \Theta_t, \Upsilon_t)$, the* **static equilibrium** *is a set $\{w_{h,t}^i, w_{l,t}^i, r_t^i\}_{i=1}^N$ of factor prices that solves the static sub-problem given by the equilibrium conditions* (3.5), (3.6), (3.7), (3.8), and (3.9).

We denote by $\omega_{s,t}^i \equiv w_{s,t}^i / P_t^i$ real income and by $\omega_{s,t}^i(L_t, \Theta_t, \Upsilon_t)$ the solution of the static equilibrium given $(L_t, \Theta_t, \Upsilon_t)$. We now define the sequential competitive equilibrium of the model given a sequence of fundamentals and policies:

Definition 2. *Given an initial allocation of labor L_0, a sequence of fundamentals $\{\Theta_t\}_{t=0}^{\infty}$, and a sequence of policies $\{\Upsilon_t\}_{t=0}^{\infty}$, a* **sequential competitive equilibrium** *of the model is a sequence $\{L_{n,s,t}, \mu_{n,s,t}, V_{n,s,t}, \omega_{s,t}^i(L_t, \Theta_t, \Upsilon_t)\}_{n=1,t=0}^{N,\infty}$ for $s = \{h, l\}$, that solves the households' dynamic problem, equilibrium conditions* (3.1), (3.3), (3.4), *and the temporary equilibrium at each t.*

Definition 2 illustrates the equilibrium of the model given an initial condition on the state of the economy and for a given sequence of fundamentals and policies. Our goal now is to use the model to study the trade, migration and welfare effects of changes to trade and migration policies. We do so in the multi-country version of the model calibrated to the EU economies and a constructed rest of the world. Taking a large scale model to the data requires estimating a large set of unknown parameters—technologies, iceberg trade costs, the non-policy component of migration costs, and the endowments of fixed factors—that we refer to as fundamentals. We use the method proposed by CDP, dynamic hat algebra (henceforth DHA), to take the model to the data to study the effects of changes to trade and migration policies. The key advantage of DHA is that we can conduct our quantitative analysis without estimating the fundamentals of the economy. We now express the equilibrium conditions of the model in relative time differences and show how we can use the model and data to study the effects of the EU enlargement.

3.3.5 Solving for Policy Changes

Suppose we want to study the effects of changes in policy from $\{\Upsilon_t\}_{t=0}^{\infty} \to \{\Upsilon'_t\}_{t=0}^{\infty}$. Let $\dot{y}_{t+1} \equiv y_{t+1}/y_t$ denote the relative time change of a variable, and let $\hat{y}_{t+1} \equiv \dot{y}'_{t+1}/\dot{y}_{t+1}$ denote the relative time difference of the variable under a sequence of policies $\{\Upsilon'_t\}_{t=0}^{\infty}$ relative to the sequence of policies $\{\Upsilon_t\}_{t=0}^{\infty}$.

For instance, if y_{t+1} are prices, $\hat{y}_{t+1}$ is the relative change in prices as a consequence of the change in policy. Given this notation we can write the equilibrium conditions of the model for a given change in the sequence of policies. Importantly, what the next proposition shows is that, given data on the allocations of the economy, we can study the effects of a change in policy without information on the sequence of fundamentals. To simplify notation let $\hat{mpol}^{ij}_{n,s,t} \equiv \exp(mpol'^{ij}_{n,s,t+1} - mpol'^{ij}_{n,s,t}) / \exp(mpol^{ij}_{n,s,t+1} - mpol^{ij}_{n,s,t})$, and
$\hat{u}^i_{n,s,t} \equiv \exp(V'^i_{n,s,t+1} - V'^i_{n,s,t}) / \exp(V^i_{n,s,t+1} - V^i_{n,s,t})$.

Proposition 1. *Given data $\{L_t, \mu_t, \pi_t, X_t\}_{t=0}^{\infty}$, elasticities $(\nu, \theta, \beta, \rho)$, and a sequence of counterfactual changes in policy $\{\hat{\Upsilon}_t\}_{t=0}^{\infty}$, solving the model does not require $\{\Theta_t\}_{t=0}^{\infty}$,* *and solves*

$$\hat{u}^{i}_{n,s,t} = \hat{C}^{i}_{s,t}\left(\sum_{j=1}^{N} \mu'^{ij}_{n,s,t-1}\dot{\mu}^{ij}_{n,s,t}\left(\hat{mpol}^{ij}_{n,s,t}\right)^{-1/\nu}\left(\hat{u}^{j}_{n,s,t+1}\right)^{\beta/\nu}\right)^{\nu},$$

$$\mu'^{ij}_{n,s,t} = \frac{\mu'^{ij}_{n,s,t-1}\dot{\mu}^{ij}_{n,s,t}\left(\hat{mpol}^{ij}_{n,s,t}\right)^{-1/\nu}\left(\hat{u}^{j}_{n,s,t+1}\right)^{\beta/\nu}}{\sum_{k=1}^{N} \mu'^{ik}_{n,s,t-1}\dot{\mu}^{ik}_{n,s,t}\left(\hat{mpol}^{ik}_{n,s,t}\right)^{-1/\nu}\left(\hat{u}^{k}_{n,s,t+1}\right)^{\beta/\nu}},$$

$$L'^{i}_{n,s,t+1} = \sum_{j=1}^{N} \mu'^{ji}_{n,s,t}L'^{j}_{n,s,t},$$

for all n, and s, where $\dot{\mu}^{ij}_{n,s,t}$ is the observed (data) change in migration flows over time, and $\hat{C}^{i}_{s,t} = \hat{\omega}^{i}_{s,t}(\widehat{L}_t, \widehat{\Upsilon}_t)$ *is obtained from solving the static trade equilibrium conditions.*[21]

The result in Proposition 1 follows directly from CDP, and shows how we can use data and estimated elasticities to study the effects of a change in policy without needing to estimate fundamentals.

We apply the result of Proposition 1 as follows. Consider a sequence of observed allocations (data) before and after the change in policy. This sequence of data contains information of the actual fundamentals and the policies in place at each time, including the policy changes due to the EU enlargement. To isolate the effect of the EU enlargement, we have to construct a counterfactual sequence of allocations that reflects the evolution of the economies in the absence of the EU enlargement. Proposition 1 shows how to compute this counterfactual economy under a new sequence of policies, $\hat{\Upsilon}_t$, relative to the data. For the case of the EU enlargement, the counterfactual sequence of policies is to leave tariffs and migration policy unchanged, that is, at the pre-enlargement level. Therefore,

[21] Appendix C.6 describes the equilibrium conditions of the temporary equilibrium in relative time differences.

the solution to the equilibrium conditions in relative time differences showed in Proposition 1 answers the following question: "How would the economy look like if everything would have happened as in the data (changes in fundamentals, other policies, etc.) except for the EU enlargement?"

The methodology developed in CDP has two main attractive properties to quantify the effects of the EU enlargement. First, we only need to identify the change in policy and therefore, we do not need to identify the evolution of the whole set of unobservable parameters (fundamentals) during the period of analysis. Second, we solve for the counterfactual economy relative to an economy that is calibrated using time series, and therefore, when feeding into the model the actual changes in policy, it will match exactly the observed gross migration flows, trade flows, and all the rest of observed labor market allocations. We can apply the result in Proposition 1 to study any other counterfactual change in policy and/or to study changes in fundamentals. Of course, this requires the use of time series data on labor allocations, migration and trade flows, and expenditures, as well as estimates of the elasticities.[22] Implementing this methodology requires a measure of the changes in policies that we want to study. While the magnitude of changes in tariffs comes immediately from the data, measuring the change in migration costs associated with the EU enlargement is challenging.

In the next section, we describe how we construct the data to compute the model, we present the estimation strategy used to measure the changes in policy-related migration costs, and we estimate all the relevant elasticities.

[22]In practice, there is no infinite sequence of data. To overcome this, we follow CDP and use the maximum possible data available and then use the model to solve forward for the economy under a constant set of fundamentals and policies. In our application this would mean to use data from the years 2002 to 2007 and then solve forward with the level of fundamentals and policies implied by the data of the year 2007.

3.4 Estimation

To implement the DHA described in the previous section, we need data on bilateral migration shares by nationality and skill $\mu^{ij}_{n,s,t}$, bilateral trade shares π^{ij}_t, total expenditure by country X^i_t, and the distribution of labor by nationality and skill across countries $L^i_{n,s,t}$. In addition, we need to compute the share of labor payments in value added $(1-\gamma^i)$ and the share of labor by skill $\xi^i_{s,t}$. We also need estimates of the migration cost elasticity $1/\nu$, and an estimate of the elasticity of substitution between low and high skill workers ρ. We also need to input a value for the trade cost elasticity θ, and for the discount factor β. In our quantitative analysis we use the value $\theta = 4.5$ from (Caliendo and Parro, 2015), whose methodology is consistent with the gravity-trade equation of our model.[23] Finally, we impose a yearly discount factor $\beta = 0.97$. To evaluate the change in trade and migration policy we also need bilateral ad-valorem tariffs τ^{ij}_t, and the changes in migration costs associated to the policy for each country pair. In this section we describe the data construction, and estimation strategies to obtain the elasticities and changes in migration costs associated to the EU enlargement. Appendix C.2, C.3, and C.4 present a more extensive description of the data and the estimation methodologies.

Section 3.2.3 described the construction of gross migration flows across European countries by nationality and skill $\mu^{ij}_{n,s,t}$. We now briefly describe the production and trade data needed to compute the model. We construct the bilateral trade shares π^{ij}_t for the 17 countries in our sample, and a constructed rest of the world, using trade flows from the World Input-Output Database (WIOD), and we also compute total expenditure by country X^i_t from WIOD. Employment $L_{n,s,t}$ is computed using the stocks of workers by country, nationality, skills and year from the EU-LFS. The share of labor payments in value added $(1-\gamma^i)$ is computed with

[23]The methodology in Caliendo and Parro (2015) is consistent with models that deliver a multiplicative gravity equation, like the model in this paper.

information on labor compensation retrieved from the socio economic accounts of the WIOD. The share of labor by skill $\xi^i_{s,t}$ in total labor payment is obtained using labor compensation data by skill from the socio economic account of the WIOD data set.

3.4.1 Identifying Policy-Related Changes in Migration and Trade Costs

In this section we present our strategy to measure the changes in migration costs due to the EU enlargement for each pair of countries in our sample. As we described in Section 3.2.1, the elimination of migration restrictions was implemented at different points in time for different pairs of countries. The main changes in migration policy over the period 2002-2007 were the United Kingdom opening to NMS countries in 2004, followed by Greece, Italy, Spain, and Portugal in 2006, and NMS countries opening their respective labor markets to each other in 2004. Therefore this is the set of changes in migration costs that we are going to estimate in what follows.

Our strategy employs a difference-in-difference-in-differences approach based on the migration shares equilibrium equation (3.3). Define $y^{ij}_{n,s,t} \equiv \log \mu^{ij}_{n,s,t}$, then the log odds of the probability of migrating from country i to country j with respect to the probability of staying in country i for workers of nationality n and skill s is given by

$$y^{ij}_{n,s,t} - y^{ii}_{n,s,t} = -\frac{1}{\nu}\left(m^{ij}_{n,s,t} - m^{ii}_{n,s,t}\right) + \frac{\beta}{\nu}V^{j}_{n,s,t+1} - \frac{\beta}{\nu}V^{i}_{n,s,t+1}. \tag{3.10}$$

Intuitively, the log odds are decreasing in the cost of migrating from i to j relative to the cost of staying in i, and increasing in the value of living in j compared to the value of living in country i. Equation (3.10) provides therefore a natural starting point to measure the change in relative migration costs from country i to j between two time periods; a decrease in migration costs, controlling for the change in the relative value of living in j, would result in an increase in the ratio of migrants to stayers.

Our goal is to estimate the change in migration costs due to the EU enlargement ($mpol^{ij}_{n,post-enlarg.}$ -$mpol^{ij}_{n,pre-enlarg}$). In order to separate changes in policy from changes in the non-policy components of migration costs, we estimate (3.10) in a difference in difference fashion and impose our identification restriction that the change (before and after the enlargement) in the trend in migration costs between countries that changed migration policy and those that do not is only due to the EU enlargement. We control for destination-nationality-skill-time and origin-nationality-skill-time factors such as the value terms and changes in the non-policy origin and destination specific migration costs with origin-nationality-skill-time and destination-nationality-skill-time fixed effects.[24]

Therefore, our identification of changes in migration costs due to the change in policy is internally consistent with both the model developed in Section 3.3 and our migration cost structure discussed in the subsection 3.3.1. We next describe in more detail how we proceed to identify the changes in migration costs due to the enlargement for each of the policy changes in our period of analysis.

Example: U.K. Policy-Related Changes in Migration Costs Applied to NMS

To explain in more detail our identification strategy, we start by describing the estimation of the policy-related change in the cost of migrating from NMS to the U.K. We then follow with the rest of changes to migration policy. In the case of

[24]The decision to open could, in fact, be affected by the current stock or the recent inflows of immigrants in the country, or by the political orientation of the government. As explained in Footnote 12, this is unlikely in the case of 2004 EU enlargement. Still, we control for these, and other, possibilities through the destination-skill-time fixed effects. Similarly, the economic situation in the NMS countries, as well as other *push* migration factors, are accounted for by the origin-skill-time fixed effects.

the U.K. we consider three sets of gross migration flows: from NMS countries to the U.K., our treated group in the difference-in-difference jargon; from NMS countries to Austria, Belgium, Denmark, France, and Germany (EU-5), our first control group, that corresponds to a set of EU countries that did not open their labor market to NMS countries before 2008; and from EU-5 to the U.K., the second control group. Starting from equation (3.10) and using our migration cost structure discussed in the subsection 3.3.1, we can express equation (3.10) as a function of origin-specific factors, destination-specific factors, non-policy bilateral mobility costs and the cost associated to migration policy:

$$\begin{aligned} y^{ij}_{n,s,t} - y^{ii}_{n,s,t} = & -\frac{1}{\nu} mpol^{ij}_{n,s,t} \;\; - \frac{1}{\nu}\left(\bar{m}^{i}_{n,s,t} - \frac{1}{\nu} m^{ii}_{n,s,t}\right) - \frac{\beta}{\nu} V^{i}_{n,s,t+1} \\ & - \frac{1}{\nu}\bar{m}^{j}_{n,s,t} + \frac{\beta}{\nu} V^{j}_{n,s,t+1} \;\; - \frac{1}{\nu}\bar{m}^{ij}_{n,s,t}. \end{aligned} \tag{3.11}$$

The left-hand side terms in equation (3.11) are the log migration flows to U.K. and control groups minus stayers. The first term in the right-hand side of equation (3.11) captures the policy component of migration costs, the second and third terms represent the origin-specific factors, the fourth and fifth terms represent the destination-specific factors, and the last term represents the bilateral non-policy component of migration costs. In our empirical model, we capture the origin specific factors with origin-skill-time fixed effects, and the destination specific factors with destination-skill-time fixed effects. Notice that our first control group identifies the origin fixed effects, and the second control group identifies the destination fixed effects. The bilateral non-policy component will be captured with a bilateral dummy, whose coefficient will measure the migration cost pre-enlargement from NMS countries to the U.K. relative to the migration costs from NMS countries to the EU-5 group and from the EU-5 group to the U.K. Finally, the change in costs due to the policy will be captured with a bilateral and time-varying dummy, whose coefficient will measure the change in these relative migration costs before and after the enlargement, our object of interest. We pool the flows of low and high-skilled workers for the bilateral dummies to capture the fact that changes in migration policy were non-discriminatory across skills and nationalities. Therefore, our empirical model resulting from our structural model is given by:

$$\begin{aligned} y_{n,s,t}^{ij} - y_{n,s,t}^{ii} = \delta_{n,s,t}^{U.K.} I_{n,s,t}\left(j = U.K.\right) + \textstyle\sum_{o \in NMS} \alpha_{n,s,t}^{o} I_{n,s,t}\left(i = o\right) + \\ + \beta_{n}^{U.K.} \textstyle\sum_{o \in NMS} I_{n,s,t}\left(j = U.K., i = o\right) + \\ + \beta_{n,post}^{U.K.} \textstyle\sum_{o \in NMS} I_{n,s,t}\left(j = U.K., i = o, t \in post\right) + \varepsilon_{n,s,t}^{ij}, \end{aligned} \tag{3.12}$$

where $I\left(.\right)$ is an indicator function, $\delta_{n,s,t}^{U.K.}$ represents the coefficients of a set of year-skill dummies for when the destination is the U.K., $\alpha_{n,s,t}^{o}$ represents the coefficients of a set of year-skill dummies for each source NMS country, $\beta_{n}^{U.K.}$ is the coefficient of a dummy for when the origin is an NMS country and the destination is the U.K., and $\beta_{n,post}^{U.K.}$ is the coefficient of a dummy for when the origin is an NMS country, the destination is the U.K., and t belongs to the post 2003 period.[25] Finally, $\varepsilon_{n,s,t}^{ij}$ is a random disturbance of relative migration costs and it is assumed to be orthogonal to changes in migration policy.

The coefficient $\beta_{n,post}^{U.K.}$ is then our main coefficient of interest, representing the change in migration costs between the pre- and post-enlargement periods, normalized by $-1/\nu$, i.e.

$$\beta_{n,post}^{U.K.} \equiv -\frac{1}{\nu}\left(mpol_{NMS,post-enlarg.}^{NMS,UK} - mpol_{NMS,pre-enlarg.}^{NMS,UK}\right). \tag{3.13}$$

In other words, given an estimate of the migration elasticity, $\beta_{n,post}^{U.K.}$ provides an

[25]Note that the origin-nationality-skill-time fixed effects $\alpha_{n,s,t}^{o}$ also control for changes in the cost of staying in country o for a s-skilled n national.

estimate of the average change in the cost of migrating from NMS countries to the U.K. due to the enlargement process, after controlling for any destination-skill-nationality-time and origin-skill-nationality-time confounding factors.[26]

Note the importance of using three sets of gross flows, from NMS to the U.K., from NMS to EU-5 countries, and from EU-5 countries to the U.K., in order to identify destination-nationality-skill-time and origin-nationality-skill-time fixed effects.[27] The coefficient $\beta^{U.K.}_{n,post}$ is then the sum of three components: the average change in the cost of migrating from NMS countries to the U.K., our target, minus both the change in the cost of migrating from NMS countries to EU-5 countries and the change in the cost of migrating from EU-5 countries to the U.K. for NMS nationals. We exploit the fact that (i) EU-5 countries did not open their labor markets to NMS countries in the sample period (which justifies choosing EU-5 as the control group), and (ii) those NMS nationals residing in EU-5 before the EU enlargement did not experience changes in migration costs associated to the EU enlargement.[28] Appendix C.3.1 and C.3.2 provide support for the common trend assumption underlying the difference-in-difference strategy.

EU Countries Policy-Related Change in Migration Costs Applied to NMS

The top panel of table 3.1 presents our estimates of the policy-related changes in migration costs for the case of NMS nationals moving from NMS countries to the U.K, Greece, Italy, Spain, and Portugal. As we can see, all estimates are

[26]Note that one could have estimated a coefficient across NMS origin countries and skills. Instead, we constrained the point estimate to be equal across skill groups. This does not mean that the migration costs are the same for different skill groups, it only means that the change in policy was proportionally equal across different skill groups.

[27]Given that we are aggregating data at the origin-destination-year level for a given nationality we account for possible random effects common to all individuals migrating from the same origin country to the same destination country in the same year.

[28]One reason why this is the case is that NMS nationals already legally working in one of the old member states at the date of accession for an uninterrupted period of at least 12 months continue to have access to the labor market of that member state. NMS nationals who had in 2004 legally worked in e.g. Germany for at least 12 months could keep working there even if the German labor market was not generally open to NMS nationals.

TABLE 3.1: Estimates of Changes in Migration Costs, NMS nationals

	NMS nationals				
Destination $j \rightarrow$	***U.K. (2004)***	***GR (2006)***	***IT (2006)***	***ES (2006)***	***PT (2006)***
$\beta^j_{n,post}$	3.52***	2.29**	1.01*	0.18	1.01***
	(1.11)	(0.83)	(0.55)	(0.54)	(0.49)
R^2	0.96	0.97	0.98	0.97	0.98
Obs.	564	564	564	564	564

Notes: The table reports difference-in-difference estimates, from separate regressions, of the change in migration cost from NMS countries to either the United Kingdom (U.K.), Greece (GR), Italy (IT), Spain (ES), or Portugal (PT) for NMS nationals. Recall, from equation (3.13), that a positive estimate implies a reduction in migration costs. The treatment period (post) is 2004-2007 for the U.K., and 2006-2007 for the other destinations. Parentheses includes robust standard errors, *** p<0.01, ** p<0.05, * p<0.10. Similar significance is obtained if instead we use two-way clustering at the origin-destination-country level.

positive and significant (except for Spain), pointing to a reduction in the cost of migrating from NMS to Europe for NMS nationals both in 2004 and 2006.[29] These coefficients are hard to interpret since they reflect the change in the migration cost scaled by the migration elasticity and measured in units of utility. To understand the magnitude, in terms of consumption, real wages, etc., of these changes we need to use these estimates as inputs in our quantitative model.

Placebo Experiments

To support our identification strategy we also run placebo experiments. The intuition is that we expect the costs of migrating from NMS countries to the U.K., Greece, Italy, Spain, and Portugal not to have changed for EU-15 nationals as a consequence of the EU enlargement. The bottom panel of table 3.2 reports these estimates, and reassuringly shows no change in the migration costs due to the enlargement from NMS to Europe for those that already were European citizens.

[29]Recall, from equation (3.13), that a positive estimate implies a reduction in migration costs.

TABLE 3.2: Placebo Estimates of Changes in Migration Costs, EU nationals

	EU nationals				
Destination $j \rightarrow$	*U.K. (2004)*	*GR (2006)*	*IT (2006)*	*ES (2006)*	*PT (2006)*
$\beta^j_{n,post}$	0.74	−0.08	−0.02	0.46	−1.22
	(1.40)	(1.52)	(1.35)	(1.34)	(1.45)
R^2	0.88	0.90	0.89	0.90	0.90
Obs.	564	564	564	564	564

Notes: The table reports difference-in-difference estimates, from separate regressions, of the change in migration cost from NMS countries to either the United Kingdom (U.K.), Greece (GR), Italy (IT), Spain (ES), or Portugal (PT) for EU-15 nationals. The results correspond to a placebo exercise since no migration policy changes occurred for EU-15 nationals. The treatment period (post) is 2004-2007 for the U.K., and 2006-2007 for the other destinations. Parentheses includes robust standard errors, *** p<0.01, ** p<0.05, * p<0.10. Similar significance is obtained if instead we use two-way clustering at the origin-destination-country level.

Change in the Migration Costs from NMS to NMS

We now consider the other main changes in migration policy: NMS countries opening their respective labor markets to each other. In these cases we cannot apply anymore the difference-in-difference methodology since, because of data limitations, there is no control group we can exploit.[30] Therefore, to estimate this set of migration costs we proceed in an alternative way. Taking the product between the ratio of migrants to stayers in one direction and in the opposite direction, we can differentiate the value functions, and the resulting ratio will only contain information on migration frictions.[31] Taking logs, we get

$$\left(y^{ij}_{n,s,t} - y^{ii}_{n,s,t}\right) + \left(y^{ji}_{n,s,t} - y^{jj}_{n,s,t}\right) = -\frac{1}{\nu}\left(\left(m^{ij}_{n,s,t} - m^{ii}_{n,s,t}\right) + \left(m^{ji}_{n,s,t} - m^{jj}_{n,s,t}\right)\right).$$

[30] Bulgaria and Romania, which could have potentially been an alternative control group, have limited information on nationality.

[31] In the international trade literature this ratio is known as the Head and Ries index, and it is used to identify trade frictions.

TABLE 3.3: Changes in Migration Costs, NMS to NMS

	NMS nationals
β_{post}	1.71^{***}
	(0.49)
R^2	0.99
Obs.	252

Notes: $^{***}p < 0.01$, robust standard errors

With this measure we can only estimate a combination of migration costs in one direction and in the opposite direction, and therefore we need to impose more structure to separate them. In particular, we assume the change in migration costs to be symmetric, and to be the same for each pair of NMS countries. Following the same logic as in equation (3.11), but noticing that all origin-specific and destination-specific factors cancel out, we regress the measure of migration frictions on a constant and a dummy variable for the post-enlargement period,

$$\left(y^{ij}_{n,s,t} - y^{ii}_{n,s,t}\right) + \left(y^{ji}_{n,s,t} - y^{jj}_{n,s,t}\right) = \alpha + \beta_{post} I^{ij}_{n,s,t} \left(t \in post\right) + \varepsilon^{ij}_{n,s,t},$$

where $I\left(.\right)$ is an indicator function and *post* represents the post 2003 period, and the constant captures the non-policy bilateral migration costs. Then, β_{post} captures the average change between the pre- and post-enlargement period of the migration frictions, which measures the policy-related change in migration costs.[32]

Table 3.3 reports the results, and shows a reduction in the cost of migrating from NMS to NMS countries, for NMS nationals, in 2004.

[32]We also used the same strategy in order to identify the changes in costs of migrating to NMS for EU nationals. For this case we used the flows of EU nationals from the EU to NMS before and after the change in policy. Given that there where not many flows over our sample period and no significant variation in the flows we ended up obtaining not economically significant estimates for this case.

Change in Trade Policy

Finally, we employ bilateral tariffs τ_t^{ij} between each pair of countries and the rest of the world, using information from the World Integrated Trade Solution (WITS) data set, to capture changes in trade costs due to the EU enlargement. We use effectively applied rates and we combine information from two different data sets, the TRAINS data set and the WTO data set, to have complete and consistent information on tariffs over time.[33]

Armed with this set of estimates of the changes in trade and migration costs associated with the EU enlargement , we now proceed to estimate the necessary elasticities for our quantitative analysis.

3.4.2 International Migration Elasticity

The migration elasticity is needed to evaluate the welfare effects associated to changes in the barriers to migrate; welfare effects depend on the magnitude of the change in barriers, and on how sensitive the decision to migrate is to the barriers themselves. (Artuç et al., 2010) and CDP, provide estimates of the elasticities for internal migration flows, while here we deal with international migration. We therefore adapt the methodology of (Artuç and McLaren, 2015) to the structure of our model, and apply it to the flows of EU nationals within the EU, to provide a value for the international migration elasticity.[34]

The first stage of the methodology is a fixed-effect estimation that uses the migration share equation (3.3) and bilateral gross migration flows data to estimate value differences and the migration cost function normalized by ν. The second stage of the methodology relies on the Bellman equation. We insert the estimated

[33] In Appendix C.2.3 we explain in detail how we construct the bilateral tariff data for each country pair.

[34] We describe in detail the implementation of the methodology and report the results, both for the baseline case and for the extension with public good described later, in Appendix C.4.

value differences from the first stage into the Bellman equation, and construct a linear regression to retrieve the international migration elasticity by exploiting the variation in real wages. We estimate the second stage model as an IV regression, using two-period lagged values of real wages as instruments, and clustering standard errors at the country level.[35]

In our preferred specification with $\beta = 0.97$ we obtain an elasticity of 0.44—significant at 1 percent—which implies a value of ν of 2.3. This is the value that we use when performing our quantitative analysis.

3.4.3 Elasticity of Substitution Between Low- and High-Skilled Workers

In this section, we provide the estimate of the elasticity of substitution between low and high-skilled workers that will be used to quantify the effects of the EU enlargement.[36] Following the literature, low-skilled workers include workers with a high-school degree or less, and high-skilled workers are workers with some college education and college graduates. We estimate the elasticity of substitution using detailed information on workers' wages and hours, as well as firms' location and industry, from the Portuguese matched employer-employee data (*Quadros de Pessoal*) for the period 1991-2008.[37] Our estimation strategy

[35]We emphasize three merits of the (Artuç and McLaren, 2015) methodology: First, the estimation strategy does not require taking logarithm of probabilities. Given that most of the migration shares are very small this is an important feature that avoids causing large errors and imprecise estimates, and allows us to work with 17 countries. Second, we can be agnostic about exactly what information workers have when they form their expectations of future wages, and only assume that forecast errors are mean zero conditional on contemporaneous information. Third, we impose only a mild assumption on bilateral migration costs: we assume that migration costs for EU nationals flowing across EU-15 member states did not vary over time and skills. Note, however, that we can still let the cost of migrating out of country i, and into country j, be skill-dependent.

[36]We will also check the robustness of our results using estimates of the elasticity obtained via alternative econometric approaches, as well as estimates from the literature.

[37]We resort to *Quadros de Pessoal* for a number of reasons. First, *Quadros de Pessoal's* provides an exhaustive coverage of firms and their workers over a long time-span. Currently, the data set collects information on about 350,000 firms and 3 million employees per year. Second, we can estimate an elasticity of substitution between low and high-skill workers that is consistent with

builds on standard approaches (e.g. (Katz and Murphy, 1992)), but we instrument the endogeneity of the relative supply of high to low-skilled workers. We estimate the following econometric model based on the equilibrium conditions of the theory laid out in Section 3.3,

$$\ln \frac{w_{h,t}^{vr}}{w_{l,t}^{vr}} = -\frac{1}{\rho} \ln \frac{L_{h,t}^{vr}}{L_{l,t}^{vr}} + \alpha^{vr} + \varepsilon_t^{vr}, \tag{3.14}$$

where $\left(w_{h,t}^{vr}/w_{l,t}^{vr}\right)$ is the ratio of high- and low-skilled workers' wages in industry v and region r (in Portugal), $\left(L_{h,t}^{vr}/L_{l,t}^{vr}\right)$ is the corresponding relative supply, and ρ is the elasticity of substitution between low and high-skilled workers. Finally, we have written the relative weight of high- and low-skilled workers $(1/\rho)\ln\left(\delta_h^{vr}/\delta_l^{vr}\right)$ as the sum of an industry-region fixed effect and a residual industry-region-time effect $\alpha^{vr} + \varepsilon_t^{vr}$.

The main difficulty faced by researchers in this area is that the relative number of more educated workers and their relative wages are determined simultaneously by demand and supply. Because of that, the relative supply term $\left(L_{h,t}^{vr}/L_{l,t}^{vr}\right)$ in equation (3.14) could be correlated with industry-region demand shocks (ε_t^{vr}), making it difficult to identify the elasticity of substitution via OLS. We tackle this issue by using instrumental variable estimation.[38] Our instrument for $\left(L_{h,t}^{vr}/L_{l,t}^{vr}\right)$ is constructed using information on the local availability of low-

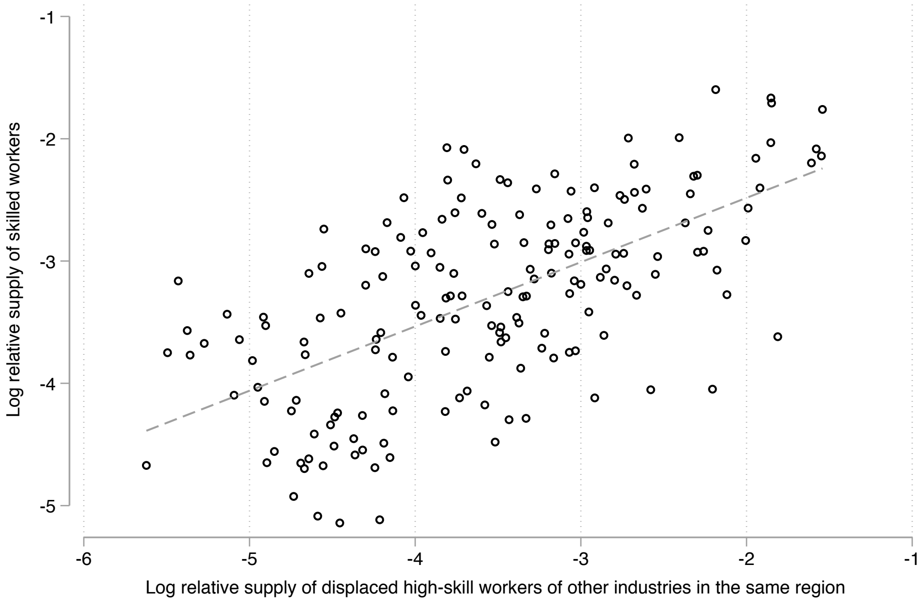
the skills definitions from the EU-LFS. Third, we can estimate an elasticity of substitution using data from an European country, and we can compare our findings to other estimates available in the literature for other countries. Last but not least, we can exploit the richness of the data to implement an instrumental variable strategy, described below, that facilitates the identification of the elasticity of substitution.

[38]Many papers estimating the elasticity of substitution between low- and high-skilled workers do not consider endogeneity issues. Two important exceptions are (Angrist, 1995) and (Ciccone and Peri, 2005). (Angrist, 1995) estimate the relationship between the return to schooling and the supply of more educated workers among Palestinians in the West Bank and the Gaza Strip during the 1980s, exploiting the fact that the increase in the supply of more educated workers was mainly driven by the creation of new local institutions of higher education. (Ciccone and Peri, 2005) estimate the long-run elasticity of substitution between low- and high-skilled workers at the U.S. state level using data from five 1950-1990 decennial censuses. They exploit time- and state-specific child labor and compulsory school attendance laws as instruments.

and high-skilled workers that change firm because of displacement, and in particular because of firm closure.[39] A firm closure can be considered as an exogenous shock to a worker's career, since it results in a separation of all plant's workers and it is not related to the worker's own job performance ((Dustmann and Meghir, 2005)). Moreover, when instrumenting the relative labor supply of a given industry, we consider only closures of firms that belong to other industries, so that their closure is hardly related to the market of the industry under consideration. Finally, as workers tend to search and accept more easily new jobs in the same local labor market of the past job, we consider closures of firms that belong to the same region of the industry under consideration. Overall, the local availability of displaced workers can then be considered as an exogenous labor supply shock for local firms. Figure 3.5 shows the correlation between the instrumented variable and the instrument.

[39] Displacement is usually defined as the permanent and involuntary separation of workers from their jobs without cause (i.e. for economic reasons). Displacement occurs when a firm shuts down or substantially downsizes.

FIGURE 3.5: Relative supply of high-skilled workers and displaced high-skilled workers, by industry and region, 1992-2005



Note: Own elaboration using the matched employer-employee data set *Quadros de Pessoal* described in Section C.2.5 and Appendix C.5. Low-skill includes all workers with a high-school degree or less, and high-skilled are workers with some college education and college graduates. Each circle in the plot corresponds to an industry-region-year, where regions are approximately NUTS II (5 regions), and industries are NACE 1-digit. The dashed line corresponds to the predicted values of a linear OLS model, with slope of 0.53 (with standard error 0.050) and R^2 equal to 0.39.

Employing the methodology and data outlined above (and described more in detail in Appendix C.5), we obtain an elasticity of 4, which is the number we use in our quantitative analysis. The estimate of the elasticity of substitution is pretty robust to alternative different specifications, methodologies, and levels of data aggregation (Appendix C.5). Our estimate is slightly above those commonly found for the U.S. ((Katz and Murphy, 1992),(Johnson, 1997), (Krusell et al., 2000b), (Ottaviano and Peri, 2012a), (Ciccone and Peri, 2005)) which ranges between 1.5 and 2.5, but below the elasticity of substitution of 5 between low- and medium-skilled workers found for Germany ((Dustmann et al., 2009)). Since the set of European countries we consider in the quantitative analysis is pretty diverse in terms of labor market institutions and workforce characteristics we consider our benchmark estimate of 4 as a good compromise.

3.5 Economic Effects of the 2004 EU Enlargement

In this section, we use the estimated policy-related changes in migration costs, and the observed changes in tariffs, to quantify the migration and welfare effects of the EU enlargement. We first compute the migration effects from the actual changes to migration and trade policies over the period 2002-2007, and we then quantify the welfare effects. We also use our model to study the interaction between trade openness and migration policy, and to decompose the role of the different mechanisms of the model in shaping the welfare effects.

3.5.1 Migration Effects

We start by quantifying the migration effects from the EU enlargement. In particular, with our structural model we want to answer questions such as: How did the stock of new member states (NMS) migrants in EU-15 countries respond to the EU enlargement? Was NMS migration gradual or a once for all process? What was the change in the stock of NMS migrants in EU-15 countries across skill groups, and in the short and long run? What would have been the migration effects in the absence of changes to trade policy?

To compute the migration effects, we feed into our structural model the estimated changes in migration costs and the observed changes in tariffs over 2002-2007, and compute the change migration effects compared with an economy where migration and trade policies stayed unchanged. Figure 3.6 displays the evolution of the stock of NMS nationals in EU-15 countries (for all workers and by skill).

TABLE 3.4: Migration effects by skill group: Change in the stock of NMS nationals in EU-15

	High skill (%)		*High skill (thous.)*	
	Δ EU enlargement	w/o trade policy	Δ EU enlargement	w/o trade policy
2002	0	0	0	0
2007	0.014	0.019	51.9	69.3
2015	0.058	0.066	215.8	246.2
Steady state	0.130	0.168	485.2	625.9

	Low skill (%)		*Low skill (thous.)*	
	Δ EU enlargement	w/o trade policy	Δ EU enlargement	w/o trade policy
2002	0	0	0	0
2007	0.066	0.070	246.1	262.6
2015	0.301	0.312	1,124	1,162
Steady state	0.753	0.793	2,809	2,959

Notes: This table shows the percentage and absolute change in the stock of low skill and high skill NMS nationals in EU-15 countries due to the 2004 EU enlargement. Columns 2 and 4 report the counterfactual change in the absence of trade policy changes.

The darker line shows the evolution of the stock in the baseline economy with the actual changes to migration and trade policy between 2002-2007. The dashed line shows the evolution of the stock of NMS nationals in the counterfactual economy, where we hold migration costs and tariffs constant at the levels before the EU enlargement. Therefore, the difference between the two lines is the migration effects from the EU enlargement. From the figure, panel a, we can see that the increase in the stock of NMS migrants in EU-15 countries is realized very gradually over time. For instance, three years after the EU enlargement (that is, in 2007) the stock of NMS nationals in EU-15 countries increases by 0.03 percentage points, while ten years after the implementation, the stock raises by 0.23 percentage points. We find that in steady state, the stock of NMS nationals in EU-15 countries increases by 0.63 percentage points, or by about 3.3 million, which corresponds to about 5 percent of the population of the NMS countries in 2004. Across individual countries, we find that the United Kingdom is the country that experienced the largest increase in the stock of NMS nationals.

We now turn to compute the change in the stock of migrants across different skills, and after doing so, we discuss the interaction between migration and trade policies. Figure 3.6, panel b, presents the evolution of the stock of low and high skill NMS migrants in EU15 countries. In Table 3.4, columns (1) and (3), we also decompose the stock of NMS nationals in EU-15 countries by skill. We find that the EU enlargement primarily increases the migration of low-skilled NMS workers to EU-15 countries, and to a much lesser extent the migration of high-skilled workers. For instance, as we can see from the table, the stock of NMS high-skilled workers in EU-15 countries increases by 0.014 percentage points, or 51.9 thousands by 2007, by 0.06 percentage points or 215.8 thousands by 2015, and by 0.13 percentage points or by about 485.2 thousands in the long run. We find that the change in the stock of NMS low-skilled workers is much larger. Specifically, for the case of low-skilled workers, the stock of NMS nationals in EU-15 countries increases by 0.066 percentage points or 246.1 thousands by 2007, by 0.3 percentage points or 1.1 million by 2015, and by 0.75 percentage points or by about 2.8 million in the steady state.

We can also use the model to compute what the migration effects would have been in the absence of changes to trade policy. In columns (2) and (4) of Table 3.4, we compute the change in the stock of NMS nationals in EU-15 countries holding trade policy constant. We find that migration would have been larger in the absence of changes to trade policy. For instance, the stock of low-skilled workers would have been about 150 thousands larger in the long run, and the stock of high-skilled workers would have been about 140 thousands larger. The gains from trade associated with the entry of NMS countries into the European Custom Union and the common commercial policy seemed to have moderated the incentive to emigrate towards the EU-15 member states.

3.5.2 Welfare Effects

We now turn to the welfare analysis. We start by describing the welfare effects of the EU enlargement, and we then study the interaction between trade and changes to migration policy. We also study the importance of the timing to changes in migration policy, and we quantify the welfare effects of the different mechanisms that operate in our structural model.

Table 3.5, column (1) presents the welfare effect of the EU enlargement. Similar to the previous section, to compute these welfare effects, we feed into our structural model the estimated policy-related changes in migration costs and the observed changes in tariffs over 2002-2007, and compute the change in welfare, measured in terms of consumption equivalent, compared with an economy where migration and trade policies stayed unchanged. We do so across skills, and nationalities (NMS nationals and EU nationals), and to facilitate the analysis we aggregate individual countries into NMS and EU-15 countries using employment as weights. Before turning to the results, it is important to clarify the interpretation of the welfare numbers from the table. In particular, the welfare effect for a given country and skill group, say NMS low-skilled workers, corresponds to the change in welfare, measured in consumption equivalent, of a representative low-skilled worker living in NMS countries previous to the EU enlargement. In other words, this welfare number takes into account both migrants and stayers.

Turning to the results in the table, we can see that the largest winners are the NMS countries, and in particular the low-skilled workers. Welfare of NMS low-skilled workers increases 1.46%, while welfare for high-skilled workers increases 0.97%. The larger welfare effect for low-skilled workers is explained by a higher option value of migration for low-skilled workers than for high-skilled workers due to the fact that, for instance, low-skilled workers are relatively more scarce in EU-15 countries. As a result, as we explained above, more low-skilled workers than high-skilled workers migrate to EU-15 countries after the EU enlargement. On the other hand, we find relatively smaller welfare effects for workers in EU-15 countries. Welfare increases 0.23% for high-skilled workers and 0.12% for low-skilled workers. High-skilled workers in EU-15 countries benefit from the increase in the relative supply of low-skilled labor after the reduction in migration restrictions, and the resulting expansion in total output. We find that aggregate NMS welfare increases 1.41%, using employment to aggregate across skills. Welfare in EU-15 countries increases 0.14%, and aggregate welfare for Europe increases 0.36%.

In column (2) of Table 3.5, we present the welfare effects of only changes to trade policy. Specifically, we feed into our structural model the changes to tariffs over 2002-2007, but we hold migration policy constant at the initial level. We find positive welfare effects across all countries and skill groups. Welfare gains are larger for NMS countries than for EU countries as they experience a larger decline in tariffs. For the case of EU-15 countries, welfare gains for high-skilled and low-skilled workers, are about 0.18%, and for the EU-15 as a whole as well. In NMS countries, welfare gains for high and low-skilled workers are 0.83% and 81%, respectively, and 0.81% for the aggregate NMS.

The third column in Table 3.5 presents the welfare effects of only changes to migration policy. To do so, we feed into the model the estimated changes in migration costs, but hold tariffs constant at the initial level. We find that welfare for both EU-15 and NMS countries, and across both skill groups, are lower in the absence of changes to trade policy. In particular, we find that in the absence of changes to trade policy the EU-15 countries would have lost from the EU enlargement. For the case of NMS countries, welfare would have increased 0.13% for high-skilled workers, and 0.63% for low-skilled workers. Welfare for NMS

TABLE 3.5: Welfare effects of trade and migration policies, percent

		EU enlargement	Only changes to trade policy	Only changes to migration policy
EU-15	*High skill*	0.231	0.178	0.049
	Low skill	0.123	0.183	-0.059
	Aggregate	0.144	0.182	-0.037
NMS	*High skill*	0.965	0.833	0.132
	Low skill	1.464	0.812	0.629
	Aggregate	1.405	0.815	0.570
	Europe	0.359	0.290	0.066

Notes: This table shows the percentage change in welfare, measured as consumption equivalent, from changes to migration and trade policy. Column 2 presents the welfare effects due to changes in migration and trade policies, Column 3 presents the welfare effects from only changes to trade policy, and Column 4 shows the welfare effects due to only changes to migration policy.

increases by 0.57% with only changes to migration policy, and welfare for Europe would have been 0.07%.

In Table 3.6 we study further the interaction between trade and migration policies. In particular, we study the welfare effects of the changes to migration policy under three different levels of goods market integration. Column (1) replicates the third column in the previous table, and therefore it shows the welfare effects of the actual changes to migration policy under the actual level of trade integration at the time of the EU-enlargement. In Column (2) we compute the welfare effects of the actual changes to migration policy if Europe would have been under trade autarky at the time of the enlargement. To do so, we first compute the equilibrium allocations when trade costs are set to infinite, and we then feed into the model the changes to migration policies. In Column (3), we study the welfare effects of the actual changes to migration policy if Europe would have been a free trade area at the time of the enlargement. To do so, we first compute the equilibrium allocations when tariffs are eliminated, and we then feed into the model the changes to migration policies.

TABLE 3.6: Trade openness and welfare effects of migration policy (percent)

		Only changes to migration policy	Changes to migration policy under trade autarky	Changes to migration policy under free trade
EU-15	*High skill*	0.049	0.061	0.048
	Low skill	-0.059	-0.052	-0.060
	Aggregate	-0.037	-0.030	-0.039
NMS	*High skill*	0.132	0.078	0.141
	Low skill	0.629	0.572	0.638
	Aggregate	0.570	0.514	0.580
	Europe	0.066	0.063	0.067

Notes: This table shows the percentage change in welfare, measured as consumption equivalent, due to the actual changes to migration policy. Column 2 presents the welfare effects under the actual level of trade openness, Column 3 shows the welfare effects under trade autarky, and Column 4 shows the welfare effects under free trade.

We can see from the table how the level of trade openness impacts the welfare effects of migration policy. In particular, for the case of NMS countries, welfare effects would have been about 13% lower under trade autarky compared to free trade.

The intuition is that the upward pressure on labor cost in NMS countries that experience a net outflow of workers pass through less to local prices the more open the economy is. The opposite happens in EU-15 countries that experience a net inflow of workers. We can see from the table that EU-15 countries would have had smaller welfare losses from the changes to migration policy under trade autarky, although this effect is very small. The important take away of these exercises is that trade has a quantitative impact on the welfare evaluation of migration policy.

Finally, Figure 3.7 presents the welfare effects of the EU enlargement across different countries. We can see from the figure that although NMS countries are the largest winners, there is heterogeneity in the welfare effects across countries. Overall, we find that Poland, and Hungary are the largest winners from the EU enlargement. We find that the only country that experience welfare losses is the

United Kingdom, and specifically low-skilled workers whose welfare declines 0.17% as a consequences of the enlargement. As mentioned above, we find that low-skilled workers in EU-15 countries lose from only changes in migration policy because of the large increase in the supply of low-skilled workers. In the case of the United Kingdom, these losses are larger than the gains from the reduction in tariffs because of the larger inflow of NMS nationals. Furthermore, the large inflow of NMS nationals after the enlargement is a consequence of a large change in the option value of migration.

Distributional Effects of the Timing of Migration Policy

What would have been the welfare effects if countries had changed migration restrictions with a different timing? In this subsection we study the importance of the timing of changes to migration policy. To do so, Figure 3.8 panel a, shows the welfare effects for EU-15 and NMS countries, relative to the actual effects, assuming that instead of changing policy as they did over 2002-2007, countries would have changed policy in different years. That is, we study the effects from a bilateral reduction in migration restrictions between the United Kingdom, Greece, Italy, Spain, Portugal, and NMS all happening in the year 2004, or 2005, and so on. The figure shows that delaying the opening in migration, NMS countries would have lower welfare gains compared to the actual gains, and the same is true for the case of EU-15 high-skilled workers. For instance, if all countries had changed migration policy in 2012, welfare gains for NMS low-skilled workers would have been about 8% lower than the actual gains. On the other hand, we find that low-skilled workers in EU-15 countries would have been better of by delaying changes to migration policy. The result is explained by the fact that EU-15 low-skilled workers gained from changes to trade policy but lost from changes to migration policy, and therefore, delaying the changes to migration policy increases the relative impact of trade policy in their welfare.

In part, the previous result is driven by the United Kingdom that is the only country that experiences welfare losses for low-skilled workers. Given that, on panel b we investigate the welfare effects on the United Kingdom of delaying the change in migration policy. The figure plots the welfare effects under different opening years, and we find that both welfare losses of low-skilled workers and welfare gains of high-skilled workers would have been smaller by delaying opening to migration.

Accounting for the Provision of Public Goods

In this section we extend our model to account for additional congestion effects coming from the provision of public goods. In particular, this extension is motivated by evidence on the fact that migrants are net beneficiaries of the welfare system across countries, and therefore are more likely to use social benefits and consume public goods than natives.[40] To capture the congestion of public goods due to immigration, we assume that households derive some utility from the per capita provision of public goods in the economy. Specifically, the indirect utility of a household with skill s in country i is given by

$$C^i_{s,t} = \left(\frac{G^i}{L^i_t}\right)^{\alpha_i} \left((1-\tau^i_L)\frac{w^i_{s,t}}{P^i_t}\right)^{1-\alpha_i}, \tag{3.15}$$

where P^i_t is the local price index, and α_i is the fraction of public goods in total consumption.[41] The supply of public goods, G^i, is fixed over time. In order to supply G^i the government purchases final goods and finances its spending from three sources: tariff revenues, labor taxes (τ^i_L), and lump sum transfers from

[40] See (Kerr and Kerr, 2011) for a survey.

[41] Similar specifications for preferences of public goods have been used recently in other quantitative studies, see (Fajgelbaum et al., 2015).

the owners of fixed factors in each country. As a result, the government budget constraint is given by

$$P_t^i G^i = T_t^i + \sum_{n=1}^{N} \sum_{s=h,l} \tau_L^i w_{s,t}^i L_{n,s,t}^i + R_t^i \text{ for all } i, \tag{3.16}$$

where the double summation term on the right-hand side represents labor tax revenues, and R_t^i are lump-sum taxes.

The total expenditure on goods by country i is now given by government purchases, by net labor income of workers of all skill levels and nationalities residing in country i, and by local rentiers. Namely, the goods market clearing is given by

$$X_t^i = P_t^i G^i + \sum_{n=1}^{N} \sum_{s=h,l} (1 - \tau_L^i) w_{s,t}^i L_{n,s,t}^i + \iota^i \chi_t - R_t^i, \text{ for all } i, \tag{3.17}$$

with $\chi_t = \sum_{i=1}^{N} r_t^i H^i$. As we can see, the net income of rentiers is given by the share of the global portfolio minus lump-sum taxes, $(\iota^i \chi_t - R_t^i)$.

The equilibrium of this economy is the same as that described in Section 3.3.4, but with the indirect utility given by (3.15), and the market clearing conditions given by (3.16) and (3.17). Given this, the CDP solution method described in Section (3.3.5) also applies in this economy with public goods. To compute the the model, we need to re-estimate the migration cost elasticity $1/\nu$ consistent with the utility function (3.15). In Appendix (C.4.1) we show how to adapt the estimation methodology to the model with public goods. We estimate a value of $\nu = 1.89$ that we feed into the model to quantify the migration and welfare effects of the EU enlargement. We also need to compute the fraction of public goods in total consumption α^i, which we construct as final government consumption over total final consumption by country using consumption data from the WIOD.[42] Finally, we resort to data on labor income taxes from the OECD Tax Database.

[42]The values of α^i across countries range from 0.16 to 0.31, with a mean value of 0.21.

We now turn to quantify the migration and welfare effects of the EU enlargement in the model with public goods. Starting with the migration effects, we still find a very gradual increase in the stock of NMS nationals in EU-15 country as a consequence of the enlargement. In terms of the magnitudes, we find somewhat lower migration effects in the model with public goods. Specifically, three years after the EU enlargement (that is, in 2007) the stock of NMS nationals in EU countries increases by 0.02 percentage points, while ten years after the implementation, the stock raises by 0.22 percentage points. In steady state, the stock of NMS nationals in EU-15 countries increases by 0.52 percentage points as a result of the EU enlargement. In the presence of public goods, immigration strains public goods which introduces an additional source of congestion. As a consequence, the households' utility and incentives to migrate reduce compared to the economy without public goods. Across skills, we find that most of the migration, as a consequence of the enlargement, is low-skilled, similarly to our finding in Section 3.5.1. In the long run, the stock of NMS high-skilled workers in EU-15 countries increases by 0.10 percentage points or by about 361.8 thousands, while the stock of NMS low-skilled workers increases by 0.63 percentage points or by about 2.3 million.

We now turn to the analysis of the welfare effects of the EU enlargement in the presence of public goods. Overall, in the presence of public goods we find larger welfare gains for NMS countries, and smaller welfare gains for EU-15 countries, compared with the results in Section 3.5.1. This result is explained by the fact that EU-15 countries experience a net inflow of workers, which congests public goods and has a negative impact on welfare compared with a model without public goods. On the other hand, the net outflow of workers in NMS countries contributes to decongesting public goods, which has a positive effect on welfare. We still find that the largest winners are the NMS countries, and in particular the low-skilled workers. Welfare of NMS low-skilled workers increases 1.52%, while welfare for high-skilled workers increases 1.07%. On the other hand, we find smaller welfare effects for workers in EU countries. Welfare increases 0.09% for high-skilled workers and 0.03% for low-skilled workers. We find that aggregate NMS welfare increases 1.47%, while EU-15 welfare increases 0.05%. Aggregate welfare for Europe increases 0.29% as a result of the EU enlargement in the model with public goods.

Finally, Figure 3.9 presents the welfare effects from the EU enlargement in the presence of public goods. Poland and Hungary are the largest winners in this case, and the United Kingdom experiences welfare losses. Welfare losses for low-skilled workers in the U.K. are 0.43%, and high-skilled workers are now slightly worse off.

The Role of Scale Effects, Fixed Factors, and Trade Openness

In this section, we study the role of other mechanisms in shaping the welfare effects of the EU enlargement, namely, scale effects, fixed factors, and trade openness. Table 3.7 shows the results. Column (1) of the table reproduces the benchmark results, that is, the welfare effects from changes to migration and trade policies described in Section 3.5.1 and 3.5.2. In column (2), we shut down the scale effects (that is, we set the agglomeration elasticity equal to zero) in the benchmark model, but we let the other mechanisms operate. In this case, we still find that EU-15 and NMS countries gain from the enlargement, but welfare gains are a bit lower in EU-15 countries and larger in NMS countries compared with the model in which all mechanisms operate. In particular, the absence of scale effects subtracts 0.06 percentage points of welfare in EU-15 countries and adds 0.3 percentage points of welfare in NMS countries. The reason is that the net inflow of migrants in EU-15 results in an increase in productivity in the presence of scale

TABLE 3.7: Welfare effects under different model assumptions

		EU enlargement	No scale effects	Autarky, no congestion and scale effects
EU-15	*High skill*	0.231	0.141	0.083
	Low skill	0.123	0.065	-0.041
	Aggregate	0.144	0.080	-0.017
NMS	*High skill*	0.965	1.274	-0.010
	Low skill	1.464	1.782	0.453
	Aggregate	1.405	1.723	0.399
	Europe	0.359	0.360	0.054

Notes: This table shows the percentage change in welfare, measured as consumption equivalent, under different model assumptions. Column 1 presents the welfare effects due to the actual changes in migration and trade policies, Column 2 presents the welfare effects in a model without scale effects, and Column 3 shows the welfare effects in a model with trade autarky, without scale effects, and without congestion effects.

effects, and the NMS that have a net outflow of workers experience a productivity decline in the presence of scale effects.

Finally, in column (3) we compute the welfare effects under autarky, and where we also shut down all congestion effects (infrastructure and public goods) as well as scale effects. To do so, we first compute the equilibrium allocations when trade costs are set to infinite, and we then feed into the model the changes to migration and trade policies. Compared with the third column in Table 3.6 welfare is substantially different in a model without trade, scale and congestion effects; welfare losses for EU-15 are more than twice larger, and welfare gains for NMS countries are reduced by 30%. With this final counterfactual exercise we want to emphasize again the importance of accounting for trade, and other mechanisms of the model such as local fixed factors and scale effects when evaluating the welfare impact of migration and trade policies.

3.6 Conclusion

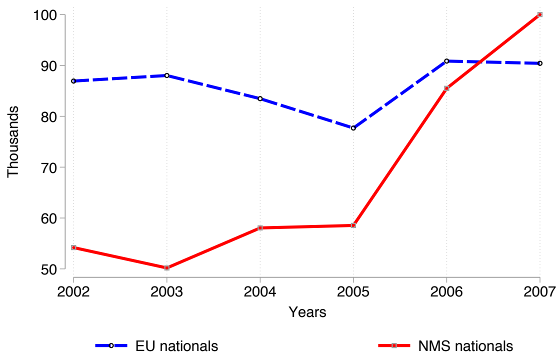
Migration and trade are two themes that, historically and nowadays, are central in Europe as well as in other regions of the world. The freedom of movement of workers and of goods are considered as two of the four fundamental freedoms guaranteed by EU law. At the same time, immigration into Europe during the enlargement process, as well as the influx of refugees from war-torn countries, are recent major shocks whose economic effects are hard to evaluate, since they interact with heterogeneous production structures, free intra-Community trade, and the European Union Customs Union. In this context, the international economics literature has made considerable advances on the quantification and understanding of the gains from economic integration, but most of the focus has been on the goods market, and less attention has been devoted to the factors market and to migration policy. In this paper we aim at making progress in this area.

We quantify the general equilibrium effects of trade and labor market integration. We show that in order to evaluate the economic effects of labor market integration it is crucial to take in to account the process of integration in the goods market. We find that the EU enlargement primarily fostered the migration of low-skilled workers and that trade policy helped to moderate migration flows and mitigate congestion effects. The largest winners were the new member states, and in particular their low-skilled workers, although we find positive welfare effects for high-skilled workers as well. Importantly, we find that in the absence of changes to trade policy, the EU-15 would have been worse off after the enlargement. This result is robust to the inclusion of other mechanisms in the model, like the presence of public goods financed with labor taxes.

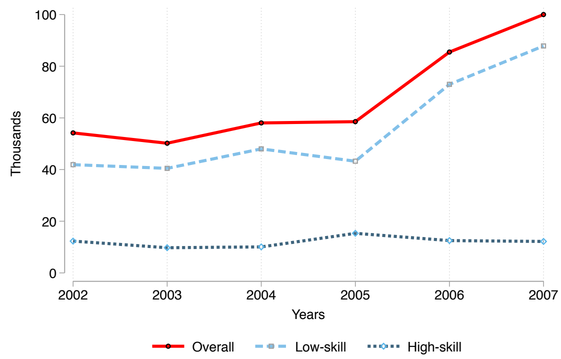
Our paper incorporates different but complementary elements in the analysis. We use reduced-form analysis that exploits migration policy changes to identify changes in migration costs and key elasticities. We build a rich dynamic general equilibrium model that includes important mechanisms considered in the literature to quantify the migration and welfare effects of actual changes to trade and migration policies. Among other things, we show quantitatively how the effects of labor market integration are affected by the extent to which countries are open to trade. Future work might aim at studying the distributional effects across sectors of the economy. Sectoral linkages are important for trade policy quantitative analysis and they might well be also for migration policy evaluation.

FIGURE 3.2: Migration flows and stocks of NMS nationals in the EU-15, 2002-2007

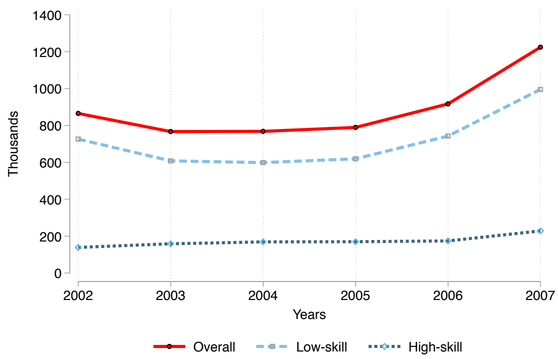
(A) Migration of EU-15 and NMS nationals to EU



(B) Migration of NMS nationals to EU, by skill

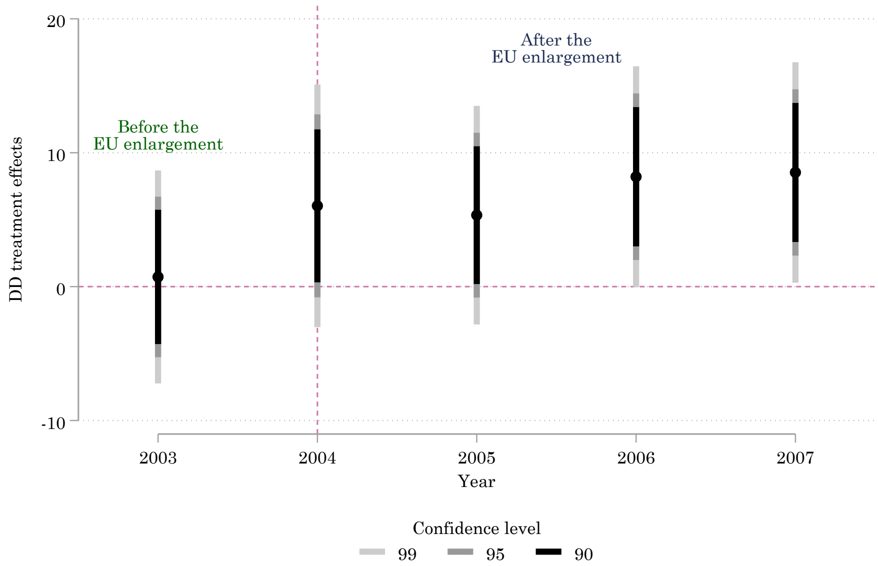


(C) Stock of NMS nationals in EU-15, by skill



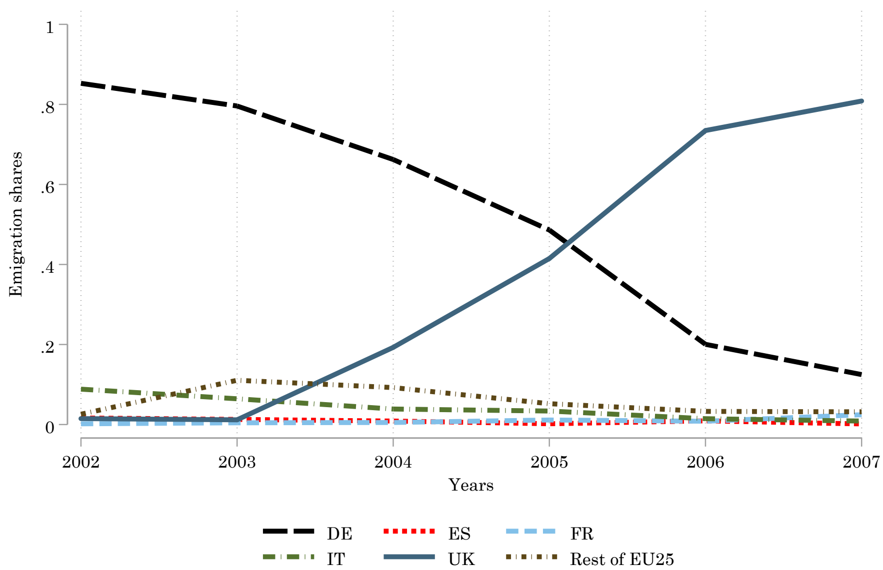
Note: Own elaboration using the data set on gross migration flows described in Section 3.4 and Appendix C.2.2. Migration flows includes 10 EU-15 countries and 7 NMS countries. EU-15 and NMS nationalities are defined in Section 3.4 and Appendix C.2.2 and cover all the EU-25 members. High-skill includes all individuals with at least tertiary education, while low skills include the residual workers with education up to post secondary non-tertiary education (see Appendix C.2.2).

FIGURE 3.3: Difference-in-difference estimates of the increase in the flow of NMS nationals migrating to the U.K. due to the EU enlargement



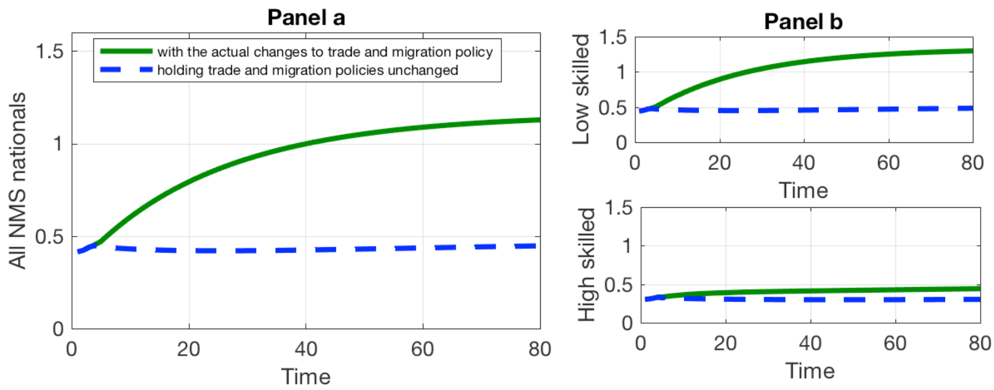
Note: The figure reports difference-in-difference point estimates, as well as the 99th, 95th, and 90th percentiles confidence intervals, of the year-by-year treatment effects of the EU enlargement on the flow of NMS nationals to the U.K.

FIGURE 3.4: U.K. leapfrogging Germany as the top destination for migrants from Poland



Note: The figure reports, for each year, migrants from Poland to EU-25 by country of destination as a share of total Polish migrants.

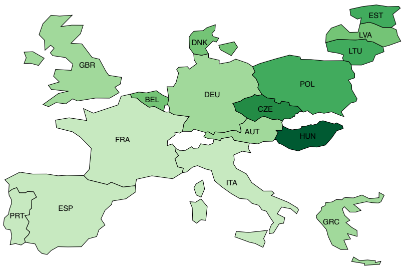
FIGURE 3.6: Evolution of the stock of NMS migrants in EU15 countries (percent)



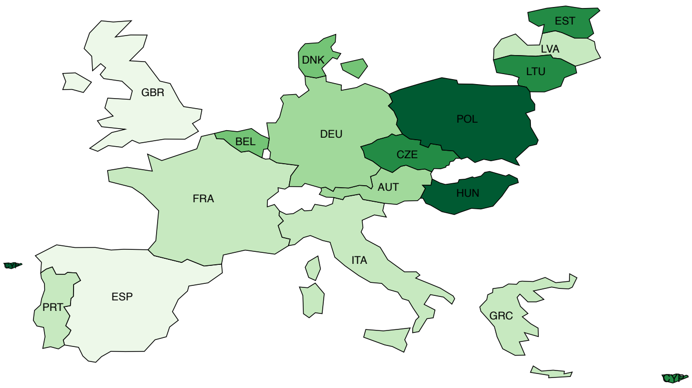
Notes: This figure presents the stock of NMS migrants in EU-15 countries. The green lines show the evolution of this stock with actual changes to trade and migration policies. The dashed lines show the evolution holding trade and migration policies unchanged. The panel, (left column) presents the results for all workers, and panel b (right column) presents the results for high and low-skilled workers.

FIGURE 3.7: Welfare effects, percent

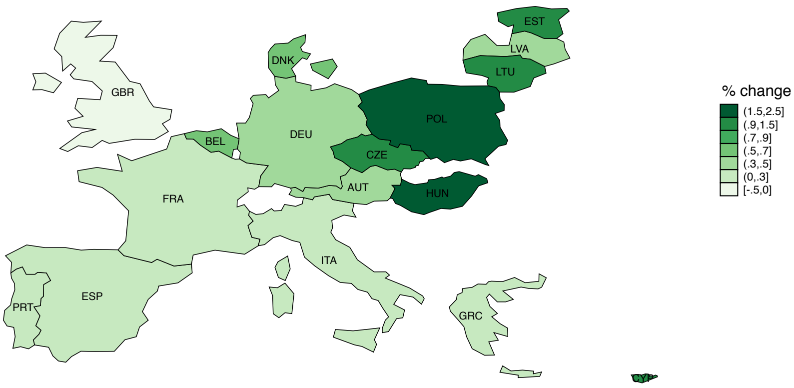
(A) High skill



(B) Low skill



(C) Aggregate



Notes: These figures present the welfare effects of the EU enlargement across different countries and skill groups.

FIGURE 3.8: Welfare effect of changes in the timing of migration policy

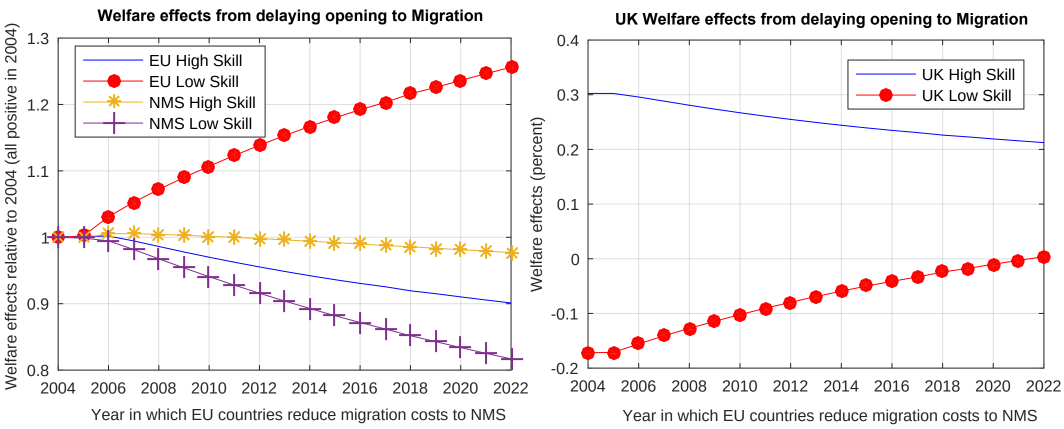
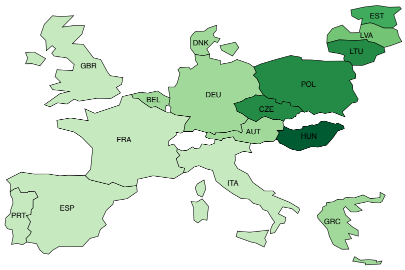
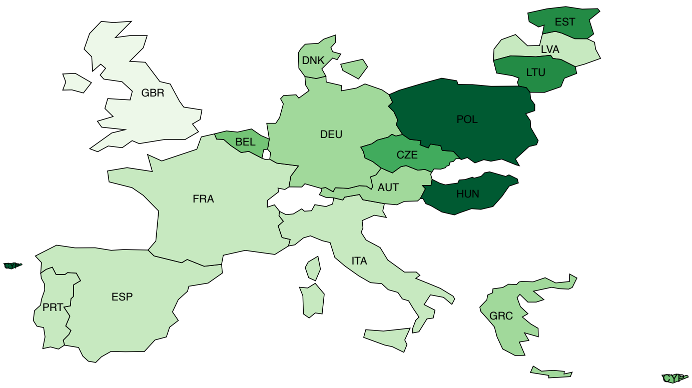


FIGURE 3.9: Welfare effects with public goods, percent

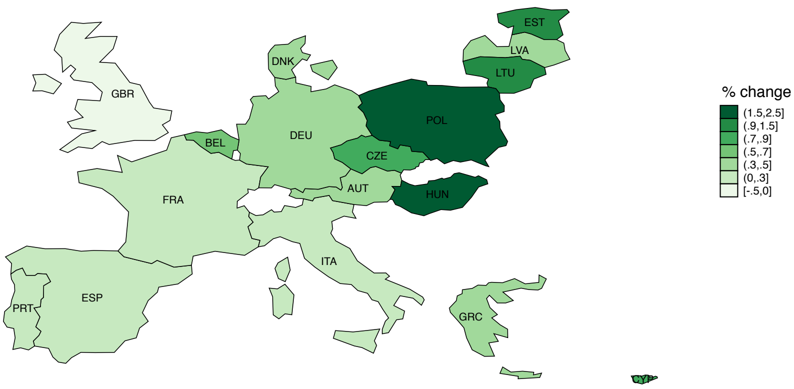
(A) High skill



(B) Low skill



(C) Aggregate



Notes: These figures present the welfare effects of the EU enlargement across different countries and skill groups with the presence of public goods.

Chapter 4

The Weather Effect: estimating the effect of voter turnout on electoral outcomes in Italy

This paper examines the effect of variation in voter turnout on electoral outcomes in Italy. I use data on the spatial distribution of turnout for 2008 and 2013 to examine how it can affect differences in electoral outcomes. Exploiting the exogenous variation in weather conditions across municipalities I use rainfalls to instrument for turnout levels: if non-voters systematically differ from habitual voters in terms of their characteristics or preferences, the effect of turnout on the electoral outcome can generate "extreme" outcomes. I find that bad weather decreases turnout and that a higher turnout favours the Movimento 5 Stelle, while both the Democrats and the Centre are negatively affected.

4.1 Introduction

The Italian political debate at the beginning of 2013 has been largely about the surprising outcome of the national elections held in February: indeed for the first time in history, a newly born movement - the "Movimento 5 Stelle" led by Beppe

Grillo (an ex-comedian) - entered the parliament with the highest share as a single party (25.5%).

The movement was born as a protest against the established political and bureaucratic system "that costs millions of Euros and creates inefficiencies": within only a few years it began a party with a longitudinal system of political recommendations, ranging from the left (green energy, strong welfare policies against unemployment) to the right/populist (no immigration, exit from the Euro zone), thus capturing the favour of millions of voters from both sides.

Moreover, because of the political crisis and the anticipated breakdown of the technician government led by Mario Monti, the Italian President Giorgio Napolitano, had been obliged to convene to new elections in February. This is very unusual because elections are usually held in summer to avoid inconvenience related to bad weather and to ensure that everyone can exercise the right to vote.

Starting from this empirical observation and exploiting the peculiarities of this specific case, I investigate the effect of voter turnout on electoral outcomes. This is an important topic in political science because, besides the importance of high political participation in "social" terms[1] , if non-voters systematically differ from habitual voters in terms of their characteristics, the effect of turnout on the electoral outcome can generate interesting outcomes; for instance, a higher turnout can either advantage the incumbent, the democrats, the "residual" parties or uniformly affect all the parties in the electoral arena.

Despite the attention that such an hypothesis received, few formal tests have been carried on. Probably, the most complete is (Gomez et al., 2007) where the authors find a negative effect of bad weather on voter turnout in US presidential elections. After them, many scholars start looking for similar results in different countries: (Eisinga et al., 2012) find a negative effect in Dutch national parliament

[1] A high level of voter turnout is not only preferable for expressive reasons, but also reduces the bias in terms of the unobserved difference between voters and non-voters, thus increasing the overall quality of political representation

elections; (Persson et al., 2013) claim that no significant effect of weather can be noticed in Swedish national elections and (Lind, 2013) states that in Norway rain may actually increase turnout. Present literature has not yet proved which effect, if any, the weather exerts on turnout.

Bad weather hypothesis is consistent both with rational choice ((Downs, 1957)) and socioeconomic status ((Verba and Nie, 1972)) model, providing another source of cost that discourages individual from taking part in political life. The major contribution is however on the technical side. Indeed, political economists have long looked for an instrument for turnout in order to overcome the endogenity problem that arise when it is used to explain electoral outcomes. Such instrument would help in understanding which party has the mostly committed electoral basis, which party would benefit from high (or low) turnout and could provide a possible explanation for recent electoral results. Once established that weather conditions are a good instrument for turnout this work looks at the effect of turnout on electoral outcomes. Compared to (Gomez et al., 2007) and the rest of the literature it is the first time that such an analysis is done in a multi-party environment.

Almost all the literature about the topic test a partisan hypothesis (or an incumbent hypothesis[2])meaning that parties will benefit differently from changes in turnout level. DeNardo ((DeNardo, 1980) , (DeNardo, 1986)) argues that the partisan composition of the electorate has a strong impact on the partisan effect, while Martinez and Gill ((Martinez and Gill., 2005)) use the "social class differences" argument to explain the difference in outcomes[3].The empirical evidence provided to explain the effect of turnout on electoral outcomes is mixed and unclear: some scholars use survey data on voters and non-voters to estimate

[2]An alternative hypothesis is that higher turnout disadvantages the incumbent: Grofman, Owen and Collet (Grofman et al., 1999) use the argument of growing unpopularity to corroborate their thesis.

[3]Empirical evidence is provided by Radcliff ((Radcliff, 1994)) and Erikson ((Erikson, 1995)).

the degree to which these two subgroups can influence the elections because of the differences in their preferences (see Martinez and Gill (Martinez and Gill., 2005), Citrin, Schikler and Sides (Citrin et al., 2003)), while other scholars directly regress the level of turnout on the electoral outcomes (Radcliff (Radcliff, 1994), Erikson (Erikson, 1995), Nagel and MacNulty (Nagel and McNulty, 1996)). However, neither approach provides a convincing methodological strategy to assess the causal relationship between turnout and electoral outcomes.

In this work I try to shed some light on the causal link between turnout and electoral outcomes using an instrumental variable approach that exploits the randomness of weather conditions in the election days as an instrument for voter turnout; I will then focus on the spatial autocorrelation of bad weather in certain regions to rule out this potential source of bias.

In section 4.2 I present the data and describe the methodology while in section 4.3 I present the results. In section 4.4 I discuss the spatial autocorrelation issue providing some tentative solutions and in section 4.5 I conclude.

4.2 Data and Methodology

4.2.1 Political data

In order to estimate the impact of turnout on electoral outcome, I use official electoral data (by parties) at the municipality level for the national elections held in 2008 and 2013 for both Chamber and Senate. The level of detail allow to have a sample of 7745 municipalities for which I observe vote share by parties in both Chamber and Senate; since the Italian law restricts the vote for the Senate only to the population with more than 25 years old, I can disentangle the amount of votes coming from young voters by manually subtracting the vote to the Senate from the ones to the Chamber. Moreover, I have data for voters and eligible voters in both Chamber and Senate at municipality level for both elections divided by gender. With this enormous amount of information I can compute different turnout, ranging from the total one - given by the percentage of eligible voters casting on the election - to female and male turnout and young voters' turnout. For the latter however, I make a non-trivial assumption; in fact, I need to assume that all the voters that turnout and are eligible for Senate, will vote for both the Chamber and the Senate. If this assumption holds, than I can compute the young voters' turnout by using the difference in eligible voters and actual voters in Chamber and Senate. Indeed, frequently in the data eligible voters express their preference for both political bodies, but some residual concern on how to treat municipalities with young voters' turnout greater than one is left unsolved (this is the case when eligible voters do not vote for the Senate hence the differences between voters for Chamber and Senate is disproportionately big).

The parties that I include in the analysis are the major parties: Democrats (PD) led by Pierluigi Bersani, People of Freedom (PDL) led by Silvio Berlusconi, Movimento 5 Stelle (M5S) led by Beppe Grillo, Scelta Civica (SC) led by Mario Monti, Centre (UDC) led by Pierferdinando Casini, Northern League (LN) led by Umberto Bossi and Left (SEL) led by Nichi Vendola. Finally, I have a large set of covariates ranging from measures of social capital at municipality level such as blood donation or participation to the 1974 divorce referendum to measures of economic performance such as GDP per capita, unemployment level and mean earnings.

4.2.2 Geographical informations

In order to capture the effect of weather on turnout, I have different measures of weather conditions (rain, visibility, temperature) gathered from the website ilmeteo.it for the 4 elections days (2 days in 2008 and 2 days in 2013); the variable that

I use in the estimation is rainfall, a dummy equal to one if in the election dyad in a given municipality I observe precipitation (in both days). Moreover, I have geographical information (altitude, distance from the sea, area, kilometres of coasts) at municipality level gathered from ISTAT (Italian statistical office) and municipality boundaries updated in 2011 (shape); these large amount of information is useful to have an understanding of the diffusion of the weather phenomena across the Italian Regional boundaries.

4.2.3 Methodology

The theoretical connection between turnout and electoral outcome is the following: if voters and non-voters systematically differ in their set of preferences, then different levels of turnout can generate very different electoral outcomes. It is however diffucult assuming that the decision to turn out is completely exogenous to the vote choices of the voter, i.e. there is selection into voting, thus the endogeneity issue arises.

A potential solution to the endogeneity problem would be an experimental design in which agents are "encouraged" or "forced" to vote according to a random assignment to the treatment (voters) or to the control (non-voters). In this case, since the assignment to treatment is random, the researcher can causally claim the impact of higher turnout artificially generated on the electoral outcome. This is because the random assignment would solve the problem of different preferences between voters and non-voters because the treated agents are chosen randomly among the whole population.

However, it is straightforward to notice that a similar experiment is hard to implement for ethical reasons; on the one hand it is not possible to force people to turnout while on the other hand, a Lab experiment that resemble the characteristics of real elections would never capture the complexity of the phenomena.

To find causal evidence of the effect of turnout on electoral outcomes, I use an instrumental variable (IV) approach exploiting the randomness of weather conditions (rainfalls) as an instrument for voters' turnout. The theoretical framework I refer to is a Local Average Treatment Effect (LATE) model with heterogeneous potential outcomes (Angrist and Pischke, (Angrist and Pischke., 2009)). Within this framework, rainfall will work as a suitable instrument for turnout if:

1. Is "as good as randomly assigned" (Angrist and Pischke (Angrist and Pischke., 2009)) and exogenous to electoral outcomes (independence);

2. It explains the differences in electoral outcomes only through turnout (exclusion restriction);

3. It is correlated with turnout-the endogenous variable-in the first stage (existence of first stage);

4. Has a monotonic relationship with turnout (monotonicity).

If these conditions hold, the IV will produce consistent estimates; however, whereas assumptions (3) and (4) can be tested using the available data, respectively with the first stage regression and a t-test of difference in means between the difference in turnout in treated places-where the dummy variable for rain is equal to one- and non-treated locations (or equivalently an OLS regression)[4], both the independence assumption and the exclusion restriction cannot be tested.

It seems legitimate to claim that a substantial part of the variation in electoral outcomes due to different weather conditions works through differences in turnout by changing the opportunity cost of peripheral voters. Substantially, assuming utility maximizing agents, an increase in the cost induced by bad weather would reduce the utility of voting. However, one can also argue that bad weather has a direct effect on voters' mood: for instance, bad weather would advantage

[4]The difference in means is .0144099 and it is significant at one per cent. The t-test is 11.7490.

conservative parties (people are in a bad mood because of the weather) while good weather would encourage people to ask for reforms. This in turn is equivalent of assuming that rainfalls have two different effects, a direct effect on voters' mood and a mediated one on different turnout levels. The argument of risk aversion is used in a work in progress paper by Bassi (Bassi, 2013) where she uses an experimental approach to test if weather conditions directly affect electoral outcomes in India; results show that after controlling for a wide set of individual characteristics, bad weather favours less risky candidates. This idea is partially ruled out by our IV estimations which point out that a worsening in weather conditions do not favour conservative parties (perceived as less risky); nevertheless, the existence of a direct channel cannot be completely tested using our data, but the relative magnitude of the latter with respect to the important indirect impact of rainfalls through turnout can justify the exclusion restriction.

Henceforth, no other factors like electoral law or politically driven alteration of the electoral race (e.g. a change in identification requirements) took place from 2008 to 2013, hence I can be confident that the main channel trough which a change in weather conditions will affect electoral outcome is turnout.

The IV Two Stage Least Squares (2SLS) estimation that I perform is the following:

$$\Delta Y_{ji} = \beta_0 + \beta_1 \Delta \hat{X}_i + \beta_2 \Delta M_i + \beta_3 FE + + \epsilon_{it} \tag{4.1}$$

and the First stage

$$\Delta X_{ji} = \beta_0 + \beta_1 \Delta Z_i + \beta_2 \Delta M_i + \beta_3 FE + + \epsilon_{it} \tag{4.2}$$

where:

- Δ Y is the vote share variation for a single party (j) in a given municipality (i) from 2008 to 2013;

- Δ Z is the variation in rainfalls (the instrument) equal to 1 if there is a worsening in weather condition from 2008 to 2013 in a given municipality, zero otherwise;
- M is a set of covariates (varying at municipality level and over time);
- FE is the geographical fixed effect;
- Δ X is the variation in turnout (the endogenous variable);
- μ and ϵ are the error terms;

The variable rainfall (Z) is equal to one if in the election dyad in a given municipality I observe rainfall (in both days) while the difference in rainfall (ΔZ) between the two elections is equal to one if there is a worsening in weather conditions, so that the dummy rainfall (Z) equals one in 2013 and zero in 2008[5]. I can employ less stringent measures of weather conditions (visibility, rainfalls in only one of the two days), but they all fail to identify the model in the first stage. Indeed, a marginal change in weather conditions would not change drastically the opportunity cost to turnout while a rainstorm can have a serious impact on turnout levels.

It is important to notice that I estimate a heterogeneous effect model with covariates implying that the independence assumption is conditional on covariates: in fact, the rainfalls differential (ΔZ) is random conditional on the geographical location of the municipality. In our case, conditioning is not necessary for the statistical identification of model - it holds both conditional and unconditional on covariates - but it is necessary from a theoretical point of view. Effectively, even though weather conditions are certainly exogenous to political decisions, conditioning on the municipality's altitude ensures that the volatility of electoral

[5] I do not distinguish among zero (equal) and minus one (better) because this would cause interpretation problems and provide little additional insight.

outcomes to weather conditions is smoothed across the Regions. In Figure 4.1 I present the physical map of Italian municipalities while in Figure 4.2 and in Figure 4.3 I show the distribution of rainfalls during the two elections[6]: is evident that the binary indicator for rainfall has some spatial patterns for the single election dyad, but the difference in rainfalls (see Figure 4.4) in a single municipality conditional on its altitude and given that the elections took place in very different periods of the year - one at the end of April while the other in mid-February - is as good as if randomly assigned.

4.3 Results

I begin by estimating the baseline OLS specification where I directly regress rainfalls on parties' shares. I estimate a first difference model with regional fixed effect and a set of controls; table 4.1 reports the results for the baseline OLS specification. Democrats (PD - column 1) benefits the most from a bad weather with a 0.8% increase in the party share in case of rainfalls while the Movimento 5 Stelle (M5S - column 3) is strongly and negatively affected from rainfalls with a decrease of 1.1%. The effect of rainfalls is also significant for the Centre (SC) led by Mario Monti (+0.49%), while it is not significant for the People of Freedom (PDL).

It is important to notice that I do not have data for 2008 elections for Movimento 5 Stelle (M5S) and Scelta Civica (SC), so I can only perform cross section estimation with regional fixed effects for these two parties. Nonetheless, this would not change the exclusion restriction of the IV specification, but it will only change the standard errors of the model.

In Table 4.2 I presents the results for the IV estimation[7]; I control for a set of covariates capturing the level of social capital, the GDP and other characteristics

[6]All the maps are obtained with municipality data in ArcGIS.

[7]The uncentered R2 is reported because of different intercepts among groups.

FIGURE 4.1: Altitude

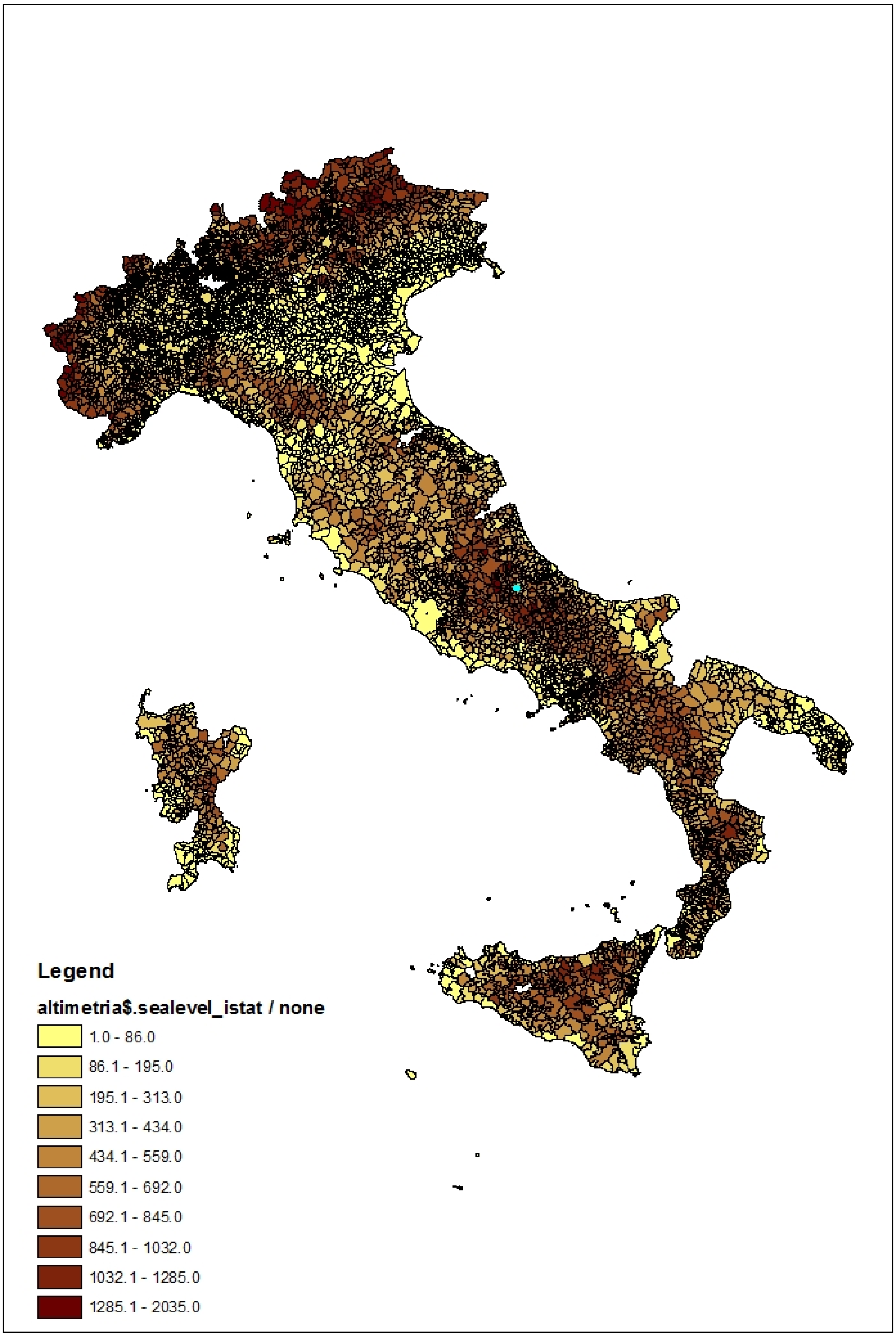


FIGURE 4.2: Rain 2008

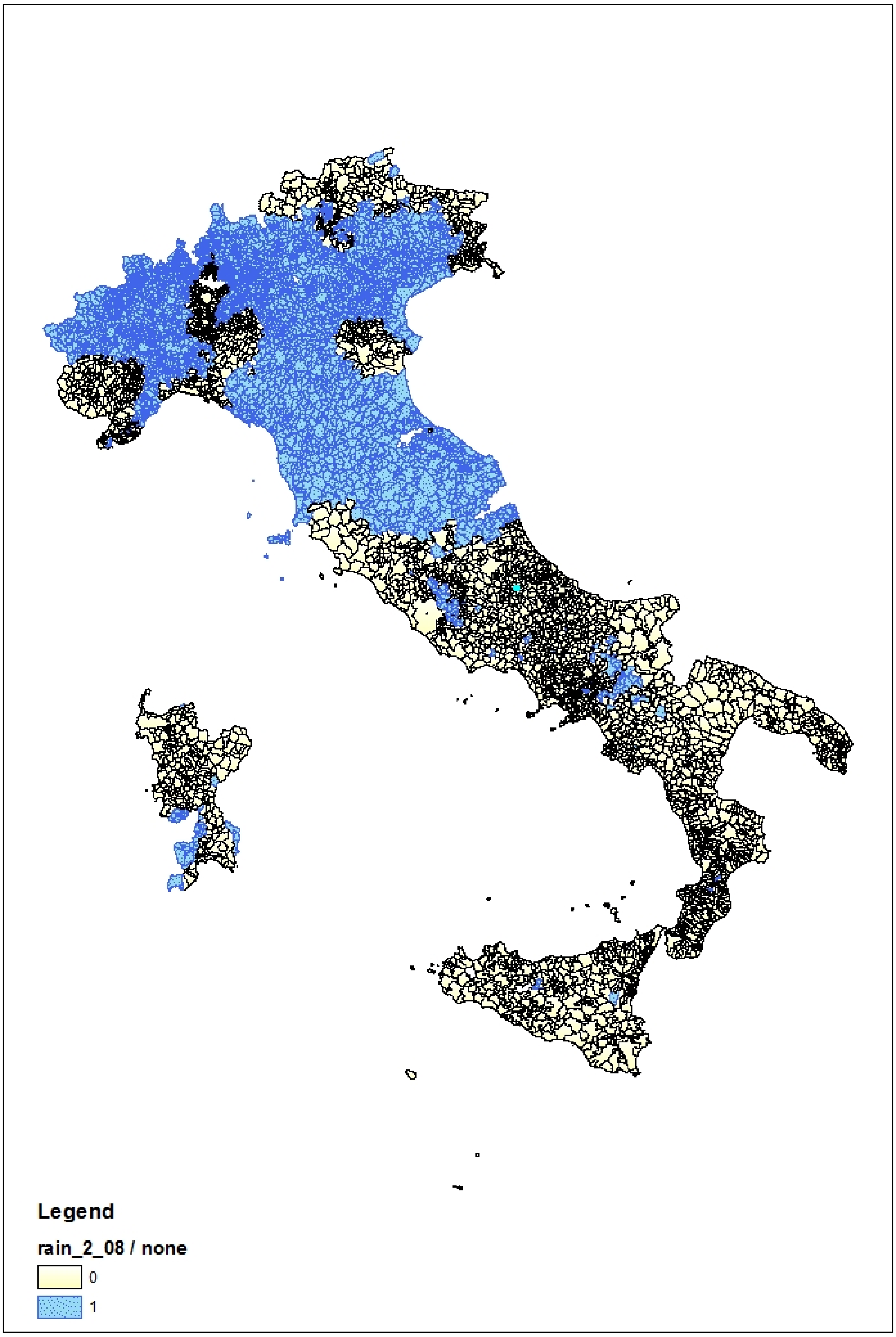


FIGURE 4.3: Rain 2013

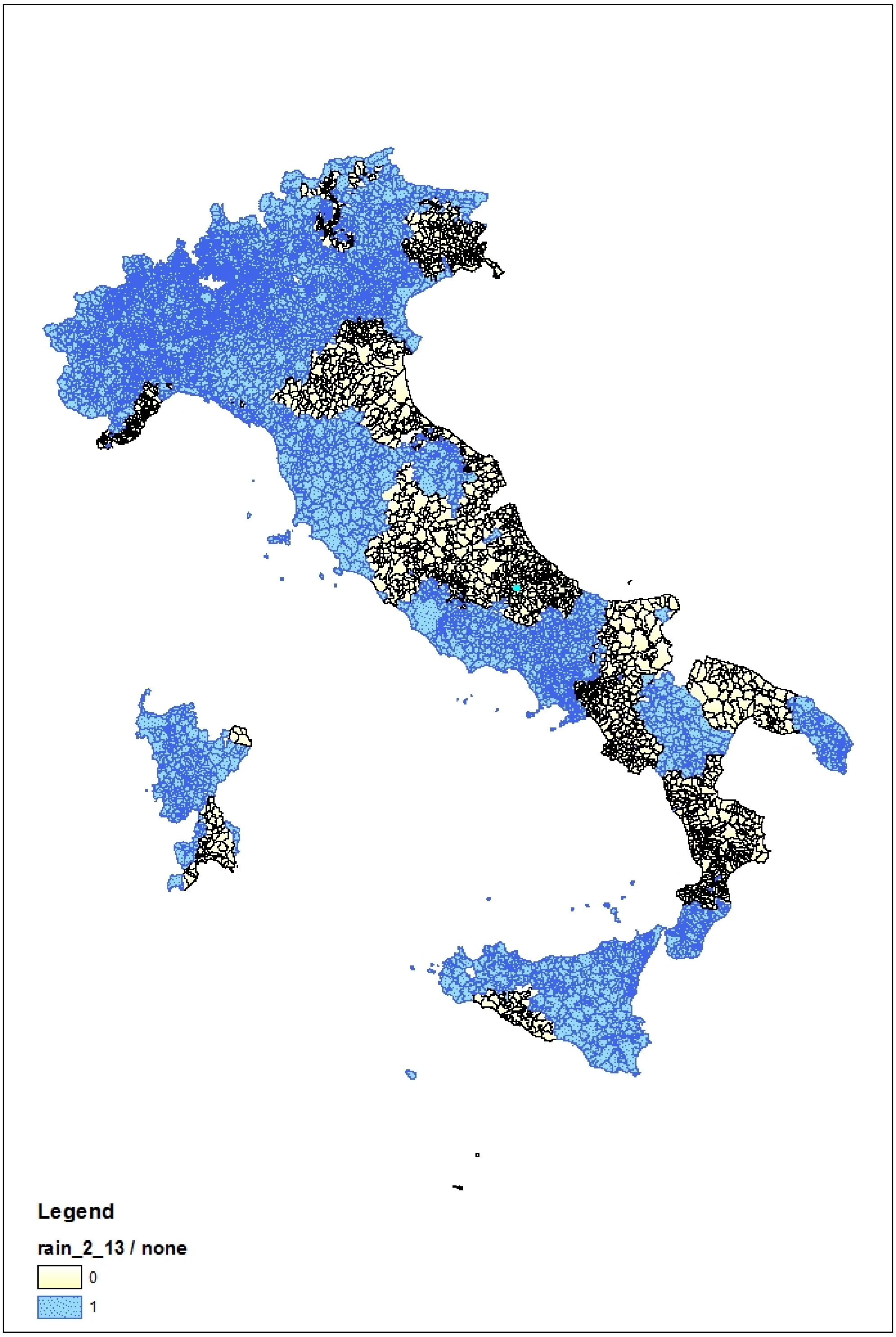


FIGURE 4.4: Rain Difference

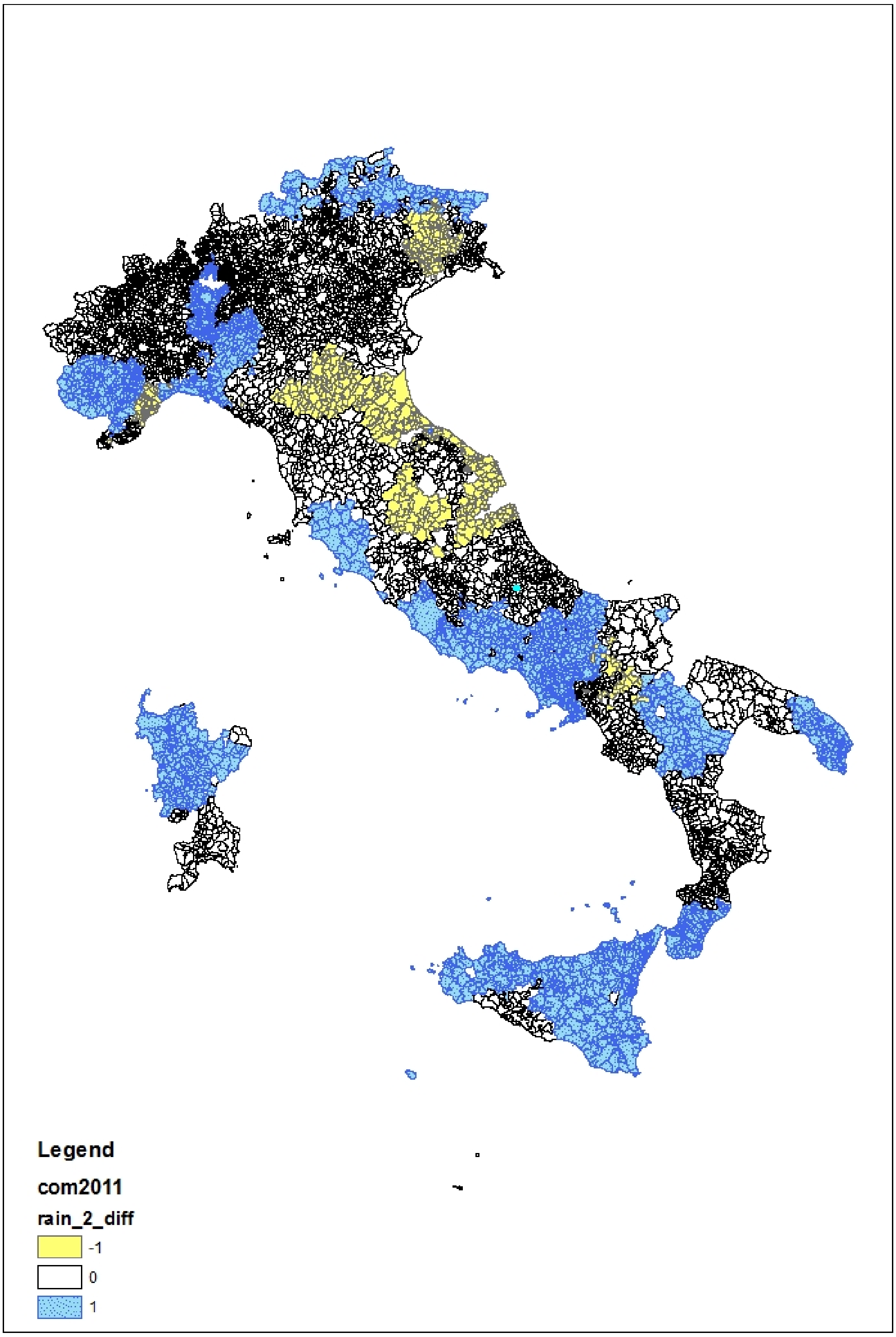


TABLE 4.1: Effect of rainfalls on electoral outcome (OLS)

VARIABLES	(1) PD	(2) PDL	(3) M5S	(4) SC
Rainfalls	0.00888***	0.000681	-0.0116***	0.00495***
	(0.00148)	(0.00177)	(0.00205)	(0.00124)
Altitude	YES	YES	YES	YES
Social Capital	YES	YES	YES	YES
FE	YES	YES	YES	YES
Observations	7,150	7,150	7,155	7,155
R-squared	0.415	0.381	0.432	0.359

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

and for the altitude of the municipality (Figure 1). Moreover, the introduction of the Regional fixed effects accounts for the potential bias generated by region specific unobservable, the geography of the place and partially for the spatial autocorrelation within Regions (discussed in Section 4.4).

In columns 1 and 4 I show the first stage regressions of rainfall on turnout; both coefficients are strongly significant (1%) with the expected negative sign. Indeed, the coefficients (columns 1 and 4) indicate that rainfall decrease turnout respectively by 0.7 and 1.4 percentage points. Results are robust to the F-test of excluded instruments with scores between 20 and 56.

The second stage regressions confirm the initial hypothesis showing that a higher turnout disproportionately favours the Movimento 5 Stelle (M5S - column 5): rainfall leads to a decrease in turnout of 1.47% which itself leads to a decrease in the vote share of the party of 1.15% ($-0.0147 * 0.788 = -0.01158$) while it negatively affects the Democrats (PD - column 1) decreasing their share by 0.88% ($-0.00681 * -1.295 = 0.0088$). This in turn implies that in absence of rainfall in the last political elections, the Movimento 5 Stelle would have gained an additional 1.15 percentage point, moving from 25.55% to 26.7%. On the one

TABLE 4.2: Effect of rainfalls on electoral outcome (IV)

VARIABLES	(1) First Turnout	(2) IV PD	(3) IV PDL	(4) First Turnout	(5) IV M5S	(6) IV SC
Rainfalls	-0.00681***			-0.0147***		
	(0.00150)			(0.00197)		
Turnout		-1.295***	-0.105		0.788***	-0.345***
		(0.334)	(0.261)		(0.170)	(0.0970)
Social Capital	YES	YES	YES	YES	YES	YES
Altitude	YES	YES	YES	YES	YES	YES
FE	YES	YES	YES	YES	YES	YES
F test	.	20.72	.	55.30		
R2	0.692	0.462	0.882	0.995	0.930	0.836
Observations	7,106	7,106	7,106	7,131	7,131	7,131

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

hand, the former finding captures the essence of the *exploit* of the party that intercepted the preferences of non-habitual voters; hence the vote share for the Movimento 5 Stelle is increasing in turnout. On the other hand, the result for the Democrats is capturing a counter intuitive behaviour: non-habitual voter would usually vote big parties[8], but surprisingly the Democrats' share drastically decreases with turnout. This result can be partly explained by both a weak electoral campaign and the austerity measures proposed - and largely opposed by most of the Italian population; the latter hypothesis is further confirmed by the negative coefficient (overall effect of 0.5%) for the Centre leaded by Mario Monti (SC - column 6) who firstly proposed the austerity measures.

As a robustness check, I perform the estimation splitting the voters' sample in

[8]To the best of my knowledge there is no literature about the difference in preferences between voters and non-voters in Italy and most of the literature on the topic is about US elections where only two parties compete in the race. In fact, with Democrats and Republicans only, the mostly tested hypotheses are the "partisan effect", "anti-incumbent effect" or the "volatility effect" (See Gomez et al(Gomez et al., 2007) and Hansford and Gomez (Hansford and Gomez, 2010)). I find some evidence of the anti-incumbent effect shown by the negative coefficient for the Centre leaded by Mario Monti.

TABLE 4.3: Effect of rainfalls on electoral outcome: Females

VARIABLES	(1) First Turnout	(2) IV PD	(3) IV PDL	(4) First Turnout	(5) IV M5S	(6) IV SC
Rainfalls	-0.00671***			-0.0150***		
	(0.00168)			(0.00223)		
Turnout		-1.313***	-0.107		0.771***	-0.338***
		(0.371)	(0.266)		(0.173)	(0.0972)
Social Capital	YES	YES	YES	YES	YES	YES
Altitude	YES	YES	YES	YES	YES	YES
FE	YES	YES	YES	YES	YES	YES
Observations	7,106	7,106	7,106	7,131	7,131	7,131
F test	.	15.98	15.98	.	45.26	45.26
R2	0.695	0.359	0.882	0.994	0.924	0.825

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

females and males; Table 3 and Table 4 present the results for the two samples. Observing the coefficients for males and females, I cannot find any significant difference in their behaviour: they do not differ in the sensitivity of turnout levels to rainfall; hence they show similar behaviours in the second stage regression.

Finally, I test the model for young voters (table 4.5) aged from 18 to 24 that voted for the first time, but the model has a small F-test. This can be because the distribution of young voter turnout is biased by the fact that I replace turnout levels greater than one with values of one, hence implying that in municipalities in which eligible voters do not cast for the Senate young voters have a very high turnout level.

TABLE 4.4: Effect of rainfalls on electoral outcome: Males

VARIABLES	(1) First Turnout	(2) IV PD	(3) IV PDL	(4) First Turnout	(5) IV M5S	(6) IV SC
Rainfalls	-0.00685***			-0.0142***		
	(0.00152)			(0.00190)		
Turnout		-1.286***	-0.104		0.814***	-0.356***
		(0.336)	(0.259)		(0.176)	(0.100)
Social Capital	YES	YES	YES	YES	YES	YES
Altitude	YES	YES	YES	YES	YES	YES
FE	YES	YES	YES	YES	YES	YES
Observations	7,106	7,106	7,106	7,131	7,131	7,131
F test	.	20.31	20.31	.	56.11	56.11
R2	0.622	0.442	0.883	0.996	0.928	0.837

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

TABLE 4.5: Effect of rainfalls on electoral outcome: Young voters

VARIABLES	(1) First Turnout	(2) IV PD	(3) IV PDL	(4) First Turnout	(5) IV M5S	(6) IV SC
Rainfalls	-0.0158**			-0.0137***		
	(0.00674)			(0.00338)		
Turnout		-0.572**	-0.105		0.817***	-0.357***
		(0.259)	(0.125)		(0.252)	(0.136)
Social Capital	YES	YES	YES	YES	YES	YES
Altitude	YES	YES	YES	YES	YES	YES
FE	YES	YES	YES	YES	YES	YES
Observations	6,583	6,583	6,583	6,588	6,588	6,588
F test	.	5.502	5.502	.	16.34	16.34
R2	0.0208	-0.943	0.862	0.987	0.864	0.741

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

4.4 Spatial Autocorrelation

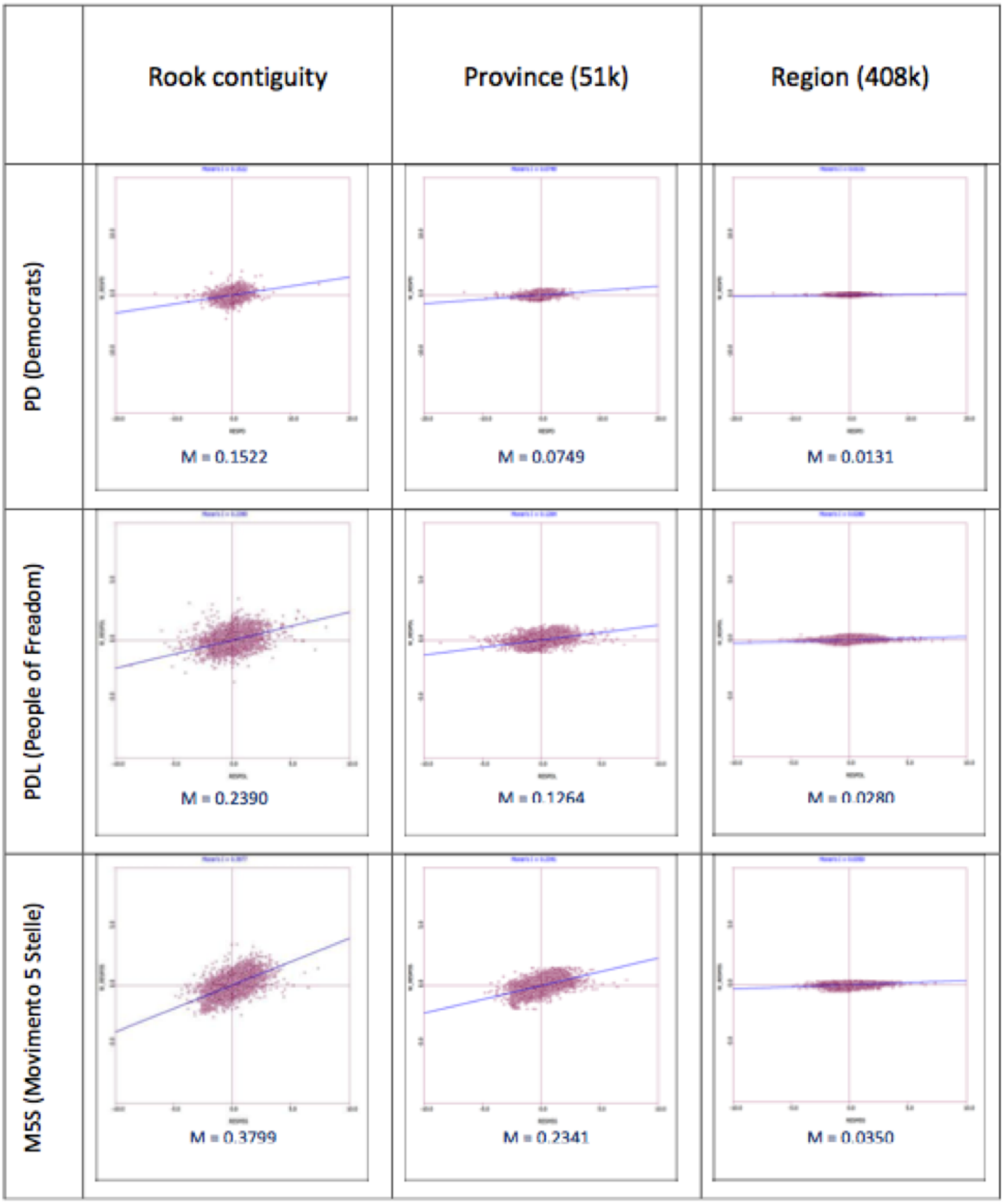
The instrument that I use for turnout in section 3 is rainfall, a dummy variable (equal to 1 if there are precipitations) not necessary randomly distributed across space[9](see Figure 4.2 and Figure 4.3); this potentially generates spatial autocorrelations of the residuals of the IV2SLS (two stage least squares model) regression across municipality in the same area. A weather phenomenon that is locally clustered can drive the results of our estimation; to smooth this source of bias I estimate a first differences fixed effect (FE) IV model controlling for the altitude of the municipality. The FE should control for any regional specific variable that is constant over time, thus it should capture some of the variability that is left in the residual term. Nonetheless, Region or Province-election specific variables could escape from our controls: this can be ideally tackled with Province-elections fixed effect, but the strategy is unfeasible in our case because I have only two elections and the interaction term would capture all the variability.

For a deeper understanding of the potential bias generated by the spatial autocorrelation, I perform the spatial analysis of the residuals of the IV model. The residuals are capturing what is left in explaining electoral outcomes once I account for the variation in turnout instrumented with rainfalls net of a number of controls at the municipality level (blood donation, altitude, participation to the 1974 divorce referendum). I compute the Moran's I (Moran, 1948) for all the parties (Figure 4.5 shows the results for the three main parties while the analysis of other parties is presented in the appendix) with different sets of weights ranging from the rook contiguity[10] to the aggregation of 51 municipalities (the average number of municipalities per Province) until 408 municipalities to resemble the

[9]It is exogenous to electoral outcome, but not randomly distributed across space.

[10]This is the most conservative specification because you consider as neighbours only the municipality that share a boarder. I do not implement Queen Contiguity because the specifications of interest pertains Provinces and Regions.

FIGURE 4.5: Moran's *I*



average Region. I decide to artificially aggregate municipality to "mimic" the average Province or Region instead of using the official grouping of municipalities in each Region or Province because residuals - and weather - should be autocorrelated in certain areas irrespective of the geographic boundaries that delimit the area itself. Thus, given the relevant heterogeneity in the municipalities' area, I follow Anselin (2002) arguing that the weighting scheme with the k-nearest neighbours avoids also the creation of "islands" (areas without neighbours) and forces an even distribution of neighbours per data point.

Results show that the Moran's I by Province range from a high 0.2341 for the Movimento 5 Stelle to a low 0.0749 for the Democrats (PD) while if I consider the Regions as the main aggregation area, I have value from 0.0131 (PD) to 0.0350 (M5S). Moreover, in order to highlight the clusters and their significance level I perform the LISA (Anselin, (Anselin, 1995))[11]statistic using the Province level as weighting scheme. Results (Figures from 5 to 7) underline the existence of some clusters, though with low significance (often below 5%).

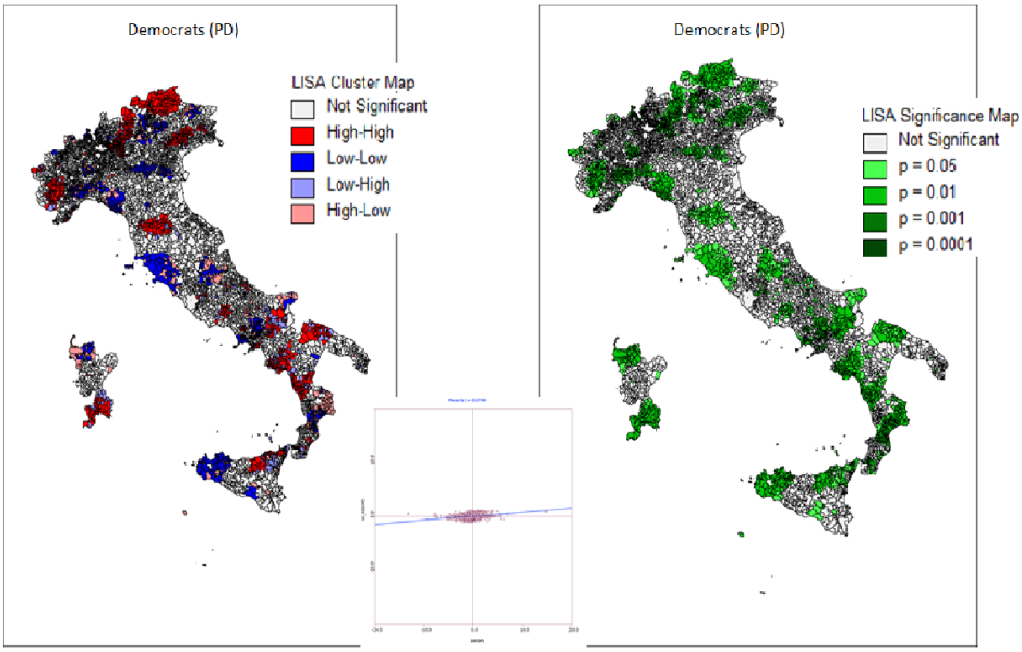
The Moran's I and the LISA statistics suggest that spatial autocorrelation is a residual concern in our model with respect to identification; therefore, I do not use a Spatial Error (SE) model accounting for autocorrelation in the error term because it would impose a structure to the former that could not be supported with sounding economic theory. However, I prefer to estimate the baseline model with robust standard errors that account for potential heteroskedasticity across municipalities (for completeness a SE model is presented in the appendix).

4.5 Concluding Remarks

Understanding the effect of turnout on electoral outcomes has been a central topic in the political debate for a long time and has captured the attention of political

[11]Local Indicator of Spatial Autocorrelation (LISA) is a local version of the Moran's I.

FIGURE 4.6: LISA Democrats (PD)

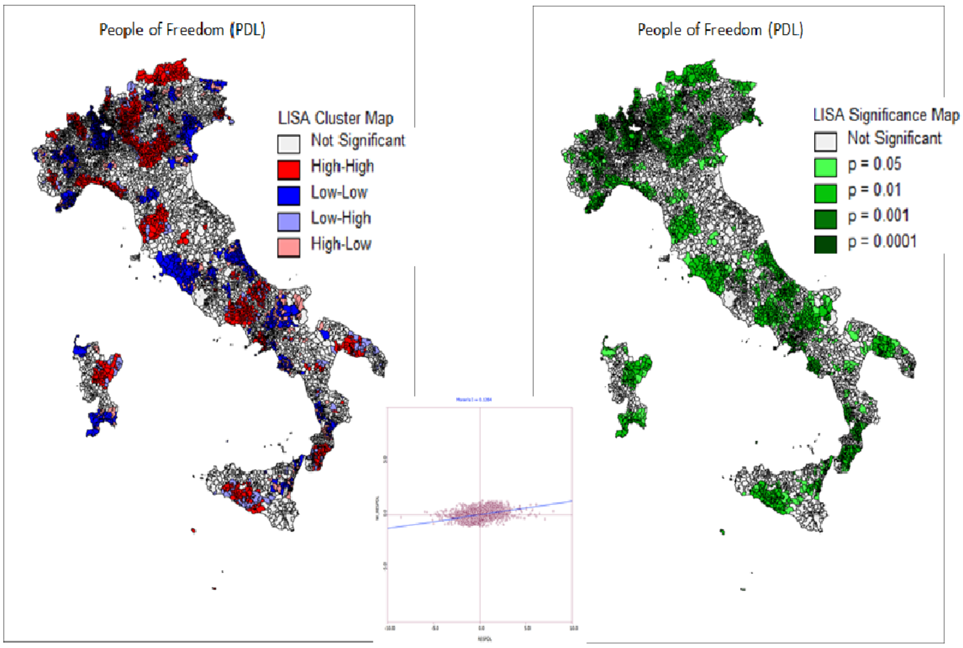


scientists in the recent past.

In this work I have tried to shed some light on the causal relationship between turnout and electoral outcomes using an IV fixed effects model where I instrument voter turnout with rainfalls. Results show that there is a significant effect of weather on turnout and that the latter generates differential outcomes depending on the parties: the incumbent as well as the traditional parties lose their vote share because of higher turnout (generated by good weather), while the new protest party (Movimento 5 Stelle) benefits from good weather conditions by capturing the preferences of non-habitual voters.

Being worried about the spatial autocorrelation of the residual terms in our main specification, I performed a spatial analysis of the clusters (Provinces or Regions). I computed Moran's I and LISA statistics using several weighting schemes for all the main parties; results suggest that spatial autocorrelation is a residual

FIGURE 4.7: LISA People of Freedom (PDL)

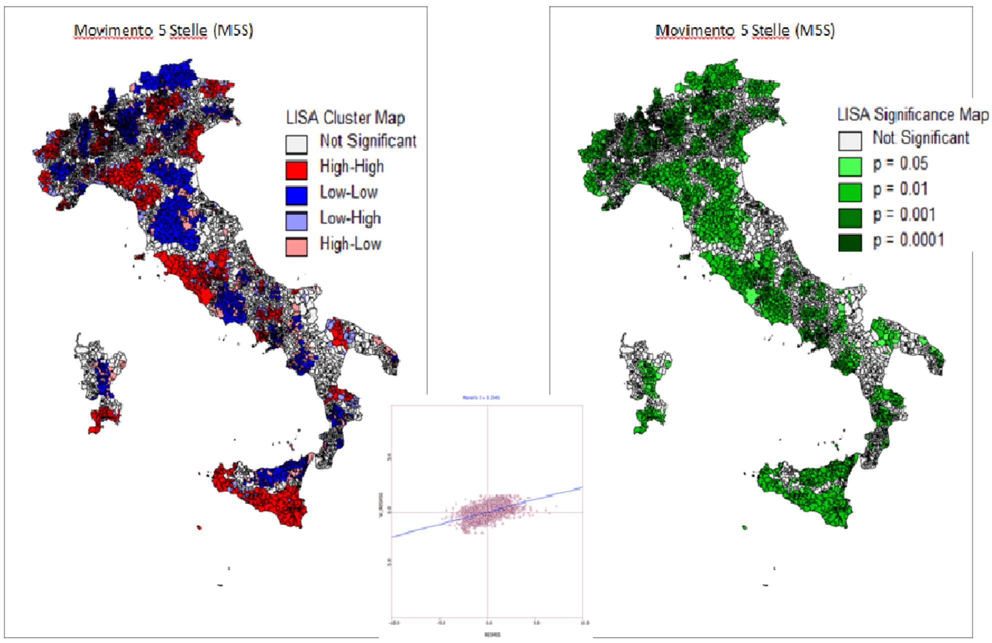


concern with respect to the identification strategy, thus it is not essential to use a spatial error model.

There are several possible future steps for this work. First, collecting data for a consistent number of municipality elections, I can try to introduce municipality fixed effects that should clean our estimates from any residual source of concern. Indeed, a long panel helps in isolating the single causal effect of turnout on electoral outcomes.

Second, I can collect post elections data surveying the Italian population on the effect of weather on their voting decision. This information would help us in understanding the magnitude of the direct channel of weather on parties' shares, hence disentangling the pure turnout effect.

FIGURE 4.8: LISA Movimento 5 Stelle (M5S)



Appendix A

Appendix to chapter 1

A.1 Construction of the dataset

One of the innovation of the paper is to bring together several data sources and construct an harmonized dataset on banks, credit relationships, firms and workers. In this appendix I describe in detail each dataset and the procedure followed to select the sample and construct the variables used in the analysis.

A.1.1 Credit registry (CRC)

CRC is the credit registry of the Central bank of Portugal. The dataset has a monthly frequency and records all the loans conceded to firms and individuals with value greater than 50 Euros from each bank in the Portuguese territory. It does not report credit given by foreign banks residing abroad to firms in the Portuguese territory, while it does record credit conceded to foreign owned firms residing in Portugal. The dataset includes several informations on each loan which I use to select a my sample.

I select regular credit to firms, excluding credit not yet materialized (potential) or any type of credit for which there is no expectation of being reimbursed or the expectation of being reimbursed is low (Overdue in a legal dispute or written-off in legal dispute for example).

The distinction between long and short term loans is made using a combination of two different variables: from 2009 onwards (2009 included) the dataset has precise information on loan maturity and allows me to select credit up to 1 year maturity. Before 2009, the dataset does not contain information on credit maturity, but instead reports the credit categories. Indeed, credit is categorized into commercial, discount funding, other funding and short term, medium and long term funding and other residual categories. I define a loan to be short term credit before 2009 if it is reported as a commercial, discount funding and other funding and short term. The structural difference in the way short term credit is defined does not create a mechanical drop in the supply of credit; in fact, looking at figure 1.3 the total amount of short term credit supplied in the economy starts decreasing between 2009 and 2010, while it still increases for the first year of the new classification, namely 2009. [1] Long term credit is calculated as the residual category, subtracting the value for short term credit from the total amount of credit received by the firm in a month.

The CRC dataset reports monetary values in current euros for each loan: I deflate all monetary values to 2013 euros using the monthly (aggregated to annual) Consumer Price index (CPI - Base 2008) by Special Aggregates from Statistics Portugal.

I select non financial corporations[2] and aggregate values to yearly level by taking the average of total short and long term firm credit across months.

[1] I double check that the categorization is meaningful by checking that the series of loans for a randomly selected sample of firms across the years 2008 and 2009 does not mechanically drop because of the structural change in the dataset.

[2] To select non financial corporations I use the first digit of the tax identifier and match the dataset with the full list of non financial corporations identified using the sector of activity from the matched employer-employee dataset (QP).

A.1.2 Central do balancos (BBS)

The bank balance sheet dataset (Central do balancos) includes the monthly balance sheet of all the financial institutions based in Portugal. For each institution, the dataset reports a detailed classification of assets and liabilities together with their characteristics and monetary values (in millions of Euros). I deflate all monetary values to 2013 euros using the monthly (aggregated to annual) Consumer Price index (CPI - Base 2008) by Special Aggregates from Statistics Portugal.

To construct the measure of exposure to the interbank borrowing market I proceed as follows: from the liability part of each bank balance sheet, I sum short term deposits with maturity up to 1 year and repos contracts where the counterpart is a foreign financial institution and divide the sum by the total assets of the bank. I exclude intra-group funding by flagging the transaction in which the counterpart is the the ultimate owner of the Portuguese affiliate.[3] I construct an alternative measure excluding the ECB as a counterpart and perform the estimation using this definition; results are qualitatively the same. The measure of foreign interbank borrowing is the average of the monthly borrowing for each bank across the 12 months.

Mergers & Acquisitions

Mergers and acquisitions have been very frequent in the Portuguese banking system in the last 2 decades. Many institutions, both big and very small ones, were involved in a process that led a consolidation of the banking system; the consolidation had its peak around 2000 with four of the top seven credit institutions in Portugal involved in mergers or acquisition processes.

[3]This happens only in 3 cases and for small banks that account for less that 1% of the total credit in a year. Details on the name of the bank or the business group are not included due to confidentiality.

The event per se does not alter the analysis of this paper, but the problem arises when the M&A events are accounted differently in bank balance sheet database and in the credit registry. To make the two dataset consistent, I have checked all the M&A events happened between 1998 and 2013 that involved institutions with at least 1% of total credit in a given month.

A.1.3 Matched employer-employee (Quadros de Pessoal)

Quadros de Pessoal, is a longitudinal dataset matching virtually all firms and workers based in Portugal.[4] Currently, the data set collects data on about 350,000 firms and 3 million employees from 1998 to 2013. The data are made available by the Ministry of Employment, drawing on a compulsory annual census of all firms in Portugal that employ at least one worker. Each year, every firm with wage earners is legally obliged to fill in a standardized questionnaire. Reported data cover the firm itself, each of its plants, and each of its workers. Variables available in the dataset include the firm's location, industry, total employment, sales, ownership structure (equity breakdown among domestic private, public or foreign), and legal setting. The worker-level data cover information on all personnel working for the reporting firms in a reference week. They include information on gender, age, occupation, schooling, hiring date, earnings, hours worked (normal and overtime), etc. The information on earnings includes the base wage (gross

[4] Public administration and non-market services are excluded. Quadros de Pessoal has been used by, amongst others, Cabral and Mata (2003) to study the evolution of the firm size distribution; by (Blanchard and Portugal, 2001) to compare the U.S. and Portuguese labour markets in terms of unemployment duration and worker flows; by (Cardoso and Portugal, 2005) to study the determinants of both the contractual wage and the wage cushion (difference between contractual and actual wages); by (Carneiro et al., 2012) who, in a related study, analyze how wages of newly hired workers and of existing employees react differently to the business cycle; by (Martins, 2009) to study the effect of employment protection on worker flows and firm performance. See these papers also for a description of the peculiar features of the Portuguese labour market.

pay for normal hours of work), seniority-indexed components of pay, other regularly paid components, overtime work, and irregularly paid components.[5] It does not include employers' contributions to social security. Each firm entering the database is assigned a unique, time-invariant identifying number which we use to follow it over time. The Ministry of Employment implements several checks to ensure that a firm that has already reported to the database is not assigned a different identification number. Similarly, each worker also has a unique identifier, based on a worker's social security number, allowing us to follow individuals over time. The administrative nature of the data and their public availability at the workplace—as required by the law—imply a high degree of coverage and reliability. The public availability requirement facilitates the work of the services of the Ministry of Employment that monitor the compliance of firms with the law (e.g., illegal work).

A.1.4 Combined dataset and data processing

Central do balancos (BBS) and the credit registry (CRC) are merged by means of bank identifiers, while the matched employer-employee dataset is merged to CRC using the firm identifier. As in (Cardoso and Portugal, 2005), I account for sectoral and geographical specificities of Portugal by restricting the sample to include only firms based in continental Portugal while excluding agriculture and fishery (Nace rev.1, 2-digit industries 1, 2, and 5) as well as minor service activities and extra-territorial activities (Nace rev.1, 2-digit industries 95, 96, 97, and 99). Concerning workers, I consider only single-job, full-time workers between 16 and 65 years old, and working between 25 and 80 hours (base plus overtime) per week. Each worker in Quadros de Pessoal (QP) has a unique identifier based

[5] It is well known that employer-reported wage information is subject to less measurement error than worker-reported data. Furthermore, the Quadros de Pessoal registry is routinely used by the inspectors of the Ministry of Employment to monitor whether the firm wage policy complies with the law

on her social security number. We drop from the sample a minority of workers with an invalid social security number and with multiple jobs. If a worker is employed in a particular year, we observe the corresponding firm identifier for that year. Since worker-level variables are missing in 2001, I follow (Mion and Opromolla, 2014) and (Mion et al., 2016) and assign a firm to workers in 2001 in the following way: if a worker is employed by firm A in 2002 and the year in which the worker had been hired (by firm A) is before 2001 or is 2001, then I assign the worker to firm A in 2001 as well; for all other workers, we repeat the procedure using 2003. In case neither 2002 nor 2003 allow us to assign a firm to a worker in 2001, we leave the information as missing. All the information in QP is collected during the month of November of each year. Worker-level variables refer to October of the same year. To control for outliers, I apply a trimming based on the hourly wage and eliminate 0.5 percent of the observations on both extremes of the distribution. Firm-level variables refer to the current calendar year (except firm total sales that refer to the previous calendar year). The location of the firm is measured according to the NUTS 3 regional disaggregation.

A.1.5 Definitions

Layer number. In the matched employer-employee data set, each worker, in each year, has to be assigned to a category following a (compulsory) classification of workers defined by the Portuguese law (see (Mion and Opromolla, 2014) and (Caliendo et al., 2015a)). Classification is based on the tasks performed and skill requirements, and each category can be considered as a level in a hierarchy defined in terms of increasing responsibility and task complexity. On the basis of the hierarchical classification and taking into consideration the actual wage distribution, we partition the available categories into occupations. We assign "Top executives (top management)" to occupation 3; "Intermediary executives (middle management)" and "Supervisors, team leaders" to occupation 2; "Higher-skilled professionals" and some "Skilled professionals" to occupation 1; and the remaining employees, including "Skilled professionals", "Semi-skilled professionals", "Non-skilled professionals", and "Apprenticeship" to occupation 0. The position of the workers in the hierarchy of the firm, starting from 0 (lowest layer, present in all firms) to 3 (highest layer, only present in firms with 3 layers of management).

Number of layers of management. A firm reporting c occupational categories will be said to have $L = c - 1$ layers of management: hence, in our data we will have firms spanning from 0 to 3 layers of management (as in CMRH). In terms of layers within a firm we do not keep track of the specific occupational categories but simply rank them. Hence a firm with occupational categories 2 and 0 will have 1 layer of management, and its organization will consist of a layer 0 corresponding to some skilled and non-skilled professionals, and a layer 1 corresponding to intermediary executives and supervisors.

Reorganization. Firms can reorganize by changing the hierarchical structure or not. In fact, in line with the hierarchy model described in (Caliendo and Rossi-Hansberg, 2012), firms might decide to drop(add) a management layer if the shock to the production scale is sufficiently large to make the fixed cost of an additional management layer high(low) compared to the benefit of the reduction in marginal cost due to the increase in productivity that the new manager brings to the firm by making the production workers more productive. On the other hand, if the shock to the production scale is not big enough, firms might chose to change the internal organization without changing the hierarchical structure. In the latter case, the firm might decide to decrease the number of employees in a specific layer or in any layers or decrease the wages of the workers to decrease the total wage bill of the firm.

Contract types.

Wage bill. A worker annual wage is computed adding the monthly base and overtime wages plus regular benefits and multiplying by 14. We apply a trimming of the top and bottom 0.5 per cent within each year. A firm wage bill is the sum of the annual wages of all its workers that satisfy the criteria listed above.

OLS TFP. Log total factor productivity computed from a standard three factors (labour, capital and materials) Cobb-Douglas production function model where output is measured by firm sales and the model is estimated via OLS. Separate estimations have been carried for each industry.

Wooldridge revenue-based productivity. Log total factor productivity computed from a standard two factors (labour and capital) Cobb-Douglas production function model where output is measured by firm value-added. [6]

Short term credit. Short term credit computed summing all the bank credit with maturity up to 1 year for a firm in a given calendar year.

A.2 Additional results

A.2.1 Productivity

To better understand the impact of credit supply shocks to the economy through the lenses of the organization of the firm, this section presents a description of the impact of credit shock on firm organization and productivity. The decision to reorganize production by adding or dropping a layer of management has been shown to be an important determinant of firm productivity (see (Caliendo et al., 2015a)). Indeed, (Caliendo et al., 2015a) show that when firms reorganize by

[6] See (Wooldridge, 2009).

adding a layer of management they are more productive, but they also increase the quantity produced to an extent that lowers the price charged by the firm and that in turns leads to a drop in revenue-based productivity. However, the decision to reorganize is endogenous as well as the amount of credit the firm uses; if one wants to study the impact of credit supply on firm productivity needs two different instrument, one for the credit supply and one for the reorganization itself. In absence of such an instrument, I report descriptive results of productivity changes correlated with firm reorganizations and negative credit supply shocks.

Table A.1 presents results for the estimation of productivity for firms that drop a management layer: a 10% drop in the supply of short term credit is correlated with a 0.48% increase in revenue productivity (column 1) and a 2.24% increase in sales per worker (column 3) while no effect is found on markup (column 2). Results are consistent with the findings in (Caliendo et al., 2015a): when firms are hit by a negative credit supply shock and reorganize by dropping a layer of management their productivity increases compared to firms that do not reorganize. It is crucial to notice that in this specification we are comparing two firms hit by a shock with the same intensity but with different reorganizational reaction: one of the two firms reorganizes by changing the hierarchical structure and dropping one management layer, while the other firm keeps constant the hierarchical structure while potentially reorganizing on the extensive and intensive margin within each layer—by changing the number of workers within each layer and its composition.

A formal test of the mechanism described by (Caliendo et al., 2015a) in this set-up would require data on quantity and prices as well as an additional instrument for change in the number of layers. Moreover, the general equilibrium effect is non trivial and it is difficult to argue that more flexibility in the labour market immediately translates into a more responsive reaction of firms to exogenous shocks that in turns leads to reorganizations and to an average increase in productivity in the economy. More investigation to deal with the selection problem in the estimation of the productivity effects and a framework that incorporates the organization of the firm and the credit constraint into a general equilibrium model are needed to understand the welfare implications of reorganizations.

A.2.2 Accounting for bank specialization

A major concern for the identification strategy presented in section A.2.2 is bank specialization. The identifying assumption behind the approach described in section A.2.2 is that—in expectation— changes in firms' credit demand are equally spread across all banks lending to the firm.[7]

If banks have advantages in specializing in a specific sector of activity and supply disproportionately more in the specialized sector compared to all others, a negative shock to that bank can have stronger effects for the firms in the sector in which the bank is specialized. Moreover, if a demand shock hits a sector more than other sectors at the same time as the credit shock, the assumption that the changes in firms' credit demand are equally spread across all banks lending to the firm does not hold. Both effects would lead to an additional reduction in the credit supply for the firms in the sector of the bank's specialization and ultimately bias the estimates of the elasticity of firm organization to credit supply.

I follow (Paravisini et al., 2015b) and construct an index of bank specialization by exploiting information on the universe of loans granted by each bank and the sector of activity of the firms receiving the loan. The index of banks specialization for each bank is equal to 1 if a bank i has an above the average exposure of loans in a two digit sector in the *Pre* period compared to all active banks in the Pre

[7] This approach is standard in the literature that empirically identifies bank credit supply shocks by controlling for demand shocks by mean of firm-time fixed-effects (see for example (Khwaja and Mian, 2008), (Paravisini, 2008), (Schnabl, 2012), (Paravisini et al., 2015b), (Chodorow-Reich, 2014) and (Jiménez et al., 2014))

period in Portugal. To test if bank specialization is a major concern in my set-up, I augment specification 1.1 interacting the measure of credit supply C_i with the measure of bank specialization and estimate equations 1.6 and 1.7 with the new terms. The new equation that I estimate is the following:

$$L_{ist} = \eta * ln(C_{it}) * Bankspecialization_i + \delta_i + \gamma_{st} + \epsilon_{ist} \tag{A.1}$$

Equation A.1 is estimated in first difference instrumenting the supply of credit as in equation 1.7. Table A.2 shows that the results of the estimation of equation A.1; in the first column 1 re-estimate the first stage regression for the augmented specification. The coefficient and the size of the f-test confirm the existence of a robust first stage even if one accounts for bank specializing in a specific sector of activity. In columns 2, 3 and 4 I estimate second stage for the three main outcomes, namely the wage bill of the firm and the wage bill de-trended and the number if employees. The coefficients on the instrumented credit supply confirm the results obtained in section 1.3.5 both in magnitudes and in significance, predicting an elasticity of 1.8% to a 10% reduction in short term credit for the wage bill of the firm and of 1.7% for the total number of workers. However, the row below shows the coefficients of the interaction between the supply of credit and the measure of bank specialization; interestingly, none of the interaction is significant and the signs are the opposite we would expect.[8]

[8]This is a test of bank specialization at 2 digit sectoral level which does not exclude the existence of bank specialization at a finer level of aggregation. More data would be needed to compute further test in the spirit of the paper by (Paravisini et al., 2015a).

TABLE A.1: Productivity

	(1)	(2)	(3)
Δ ln	*TFP*	*Markup*	*Sales/worker*
$\Delta\ ln\ \widehat{C}_i$	-0.048**	0.017	-0.224**
	(0.024)	(0.016)	(0.100)
Observations	1,533	1,533	1,533
Firm FE	Yes	Yes	Yes
Sector-time FE	Yes	Yes	Yes

Notes: This table reports the estimation of the second stage as defined in equation 1.7 in first differences for the period 2004-2013 conditional on dropping a layer of management; the table compares firms that drop a layer of management in response to the shock with firms that either keep the same organizational structure or add a management layer. FD_b is the measure of foreign dependence of bank b to the interbank borrowing market as a share of total assets of the bank in a pre-sample year, 2003. I estimate 1.7 using a linear function of FD, FD_b to construct the instrument. The dependent variables are log changes of the averages before and after the shock. In column 1, TFP is estimated using a standard procedure as defined by Levinson and Petrin. Robust standard errors in parenthesis.

TABLE A.2: Bank specialization

	(1)	(2)	(3)	(4)
Δ ln	C_i	*Wage bill*	*Wage bill det.*	*# workers*
$\sum_b w_{ib} * FD_b$	-1.228***			
	(0.204)			
$\Delta\ ln\ \widehat{C}_i$		0.185***	0.173***	0.169***
		(0.049)	(0.053)	(0.055)
$\Delta\ ln\ \widehat{C}_i$ * *Bank specialization*		-0.005	-0.004	-0.004
		(0.012)	(0.013)	(0.013)
Observations	12,657	13,266	13,266	13,266
First stage F-Stat	33.67	33.67	33.67	33.67
Sector FE	Yes	Yes	Yes	Yes

Notes: Notes: This table reports the estimation of the second stage as defined in equation 1.7 in first differences for the period 2004-2013 interacting the instrument with the measure of intensity is measure of bank specialization equal to one if the bank is above the median of specialization in a sector compared to the other banks in a pre-sample year, namely 2003. FD_b is the measure of foreign dependence of bank b to the interbank borrowing market as a share of total assets of the bank in a pre-sample year, 2003. I estimate 1.7 with the interaction for bank specialization using a linear function of FD, FD_b to construct the instrument. The dependent variables are log changes of the averages before and after the shock. The number of workers employed in the firm is the total amount of workers employed by the firm in the calendar year, the wage bill is the total amount of wages (base plus overtime) payed by the firm in each calendar year, the wage bill de-trended is the total amount of workers employed by the firm in the calendar year de-trended using a standard linear de-trending methodology to take out normal business cycle variation. Robust standard errors in parenthesis.

Appendix B

Appendix to chapter 2

B.1 Trade data

Statistics Portugal collects data on export and import transactions by firms that are located in Portugal on a monthly basis. These data include the value and quantity of internationally traded goods (i) between Portugal and other Member States of the EU (intra-EU trade) and (ii) by Portugal with non-EU countries (extra-EU trade). Data on extra-EU trade are collected from customs declarations, while data on intra-EU trade are collected through the Intrastat system, which, in 1993, replaced customs declarations as the source of trade statistics within the EU. The same information is used for official statistics and, besides small adjustments, the merchandise trade transactions in our dataset aggregate to the official total exports and imports of Portugal. Each transaction record includes, among other information, the firm's tax identifier, an eight-digit Combined Nomenclature product code, the destination/origin country, the value of the transaction in euros, the quantity (in kilos and, in some case, additional product-specific measuring units) of transacted goods, and the relevant international commercial term (FOB, CIF, FAS, etc.).[1] We were able to gain access to data from 1995 to 2005 for

[1] In the case of intra-EU trade, firms have the option of "adding up" multiple transactions only when they refer to the same month, product, destination/origin country, Portuguese region and port/airport where the transaction originates/starts, international commercial term, type of transaction (sale, re-sale,...etc.), and transportation mode. In the case of intra-EU

the purpose of this research. We use data on export transactions only, aggregated at the firm-destination-year level.

B.2 Matched employer-employee data

The second main data source, *Quadros de Pessoal*, is a longitudinal dataset matching virtually all firms and workers based in Portugal.[2] Currently, the data set collects data on about 350,000 firms and 3 million employees. As for the trade data, we were able to gain access to information from 1995 to 2005. The data are made available by the Ministry of Employment, drawing on a compulsory annual census of all firms in Portugal that employ at least one worker. Each year, every firm with wage earners is legally obliged to fill in a standardized questionnaire. Reported data cover the firm itself, each of its plants, and each of its workers. Variables available in the dataset include the firm's location, industry, total employment, sales, ownership structure (equity breakdown among domestic private, public or foreign), and legal setting. The worker-level data cover information on all personnel working for the reporting firms in a reference week. They include information on gender, age, occupation, schooling, hiring date, earnings, hours worked (normal and overtime), etc. The information on earnings includes the base wage (gross pay for normal hours of work), seniority-indexed components of pay, other regularly paid components, overtime work, and irregularly

trade, firms are required to provide information on their trade transactions if the volume of exports or imports in the current year or in the previous year or two years before was higher than 60,000 euros and 85,000 euros respectively. More information can be found at: "http://webinq.ine.pt/public/files/inqueritos/pubintrastat.aspx?Id=168"

[2] Public administration and non-market services are excluded. *Quadros de Pessoal* has been used by, amongst others, (Cabral and Mata, 2003) to study the evolution of the firm size distribution; by (Blanchard and Portugal, 2001) to compare the U.S. and Portuguese labor markets in terms of unemployment duration and worker flows; by (Cardoso and Portugal, 2005) to study the determinants of both the contractual wage and the wage cushion (difference between contractual and actual wages); by (Carneiro et al., 2012) who, in a related study, analyze how wages of newly hired workers and of existing employees react differently to the business cycle; by (Martins, 2009) to study the effect of employment protection on worker flows and firm performance. See these papers also for a description of the peculiar features of the Portuguese labor market.

paid components.[3] It does not include employers' contributions to social security.

Each firm entering the database is assigned a unique, time-invariant identifying number which we use to follow it over time. The Ministry of Employment implements several checks to ensure that a firm that has already reported to the database is not assigned a different identification number. Similarly, each worker also has a unique identifier, based on a worker's social security number, allowing us to follow individuals over time. The administrative nature of the data and their public availability at the workplace—as required by the law—imply a high degree of coverage and reliability. The public availability requirement facilitates the work of the services of the Ministry of Employment that monitor the compliance of firms with the law (e.g., illegal work).

B.3 Combined dataset and data processing

The two datasets are merged by means of the firm identifier. As in (Cardoso and Portugal, 2005), we account for sectoral and geographical specificities of Portugal by restricting the sample to include only firms based in continental Portugal while excluding agriculture and fishery (Nace rev.1, 2-digit industries 1, 2, and 5) as well as minor service activities and extra-territorial activities (Nace rev.1, 2-digit industries 95, 96, 97, and 99). Concerning workers, we consider only single-job, full-time workers between 16 and 65 years old, and working between 25 and 80 hours (base plus overtime) per week. Our analysis focuses on manufacturing firms only (Nace rev.1 codes 15 to 37) because of the closer relationship between the export of goods and the industrial activity of the firm. Even though

[3] It is well known that employer-reported wage information is subject to less measurement error than worker-reported data. Furthermore, the Quadros de Pessoal registry is routinely used by the inspectors of the Ministry of Employment to monitor whether the firm wage policy complies with the law.

we focus on manufacturing firms we use data *both* on manufacturing and non-manufacturing firms to build some of our variables, including export experience as well as the Nace rev.1 2-digit code, size, and productivity of the previous employing firm.

Each worker in *Quadros de Pessoal* (QP) has a unique identifier based on her social security number. We drop from the sample a minority of workers with an invalid social security number and with multiple jobs. If a worker is employed in a particular year, we observe the corresponding firm identifier for that year. Since worker-level variables are missing in 2001, we assign a firm to workers in 2001 in the following way: if a worker is employed by firm A in 2002 and the year in which the worker had been hired (by firm A) is before 2001 or is 2001, then we assign the worker to firm A in 2001 as well; for all other workers, we repeat the procedure using 2003. In case neither 2002 nor 2003 allow us to assign a firm to a worker in 2001, we leave the information as missing.

All the information in QP is collected during the month of November of each year. Worker-level variables refer to October of the same year. To control for outliers, we apply a trimming based on the hourly wage and eliminate 0.5 percent of the observations on both extremes of the distribution. We thank Anabela Carneiro for providing us with the conversion table between education categories (as defined in QP) and number of years of schooling. Firm-level variables refer to the current calendar year (except firm total sales that refer to the previous calendar year). The location of the firm is measured according to the NUTS 3 regional disaggregation. In the trade dataset, we restrict the sample to transactions registered as sales as opposed to returns, transfers of goods without transfer of ownership, and work done.

B.4 Definitions

Some concepts are recurring in the explanation of a majority of the tables and figures. We define them here.

Firm-level variables

Firm Age Firm age at time t is equal to the (log) difference between t and the year (minus one) the firm was created. The year the firm was created is replaced to missing whenever it is earlier than 1600.

Firm Export Status We divide firms into new, never, continuing, exiting and other exporters. Firm f at time t is a new exporter if the firm exports in t but not in $t-1$. If the opposite happens, the firm is an exiting exporter at time t. If the firm exports both in $t-1$ and in t it is a continuing exporter in t. If the firm does not export neither in $t-1$ nor in t then it is a never exporter in t. If the firm is not observed in $t-1$ then we classify it as other exporter in t. Never exporter is the reference category in the wage analysis.

Firm Productivity Firm (apparent labor) productivity at time t is equal to the (log) ratio between total sales (sales in the domestic market plus exports) and the number of all workers employed by the firm as resulting from the firm record.

Firm Size Firm size at time t is equal to the (log) number of all workers employed by the firm as resulting from the firm record.

Foreign Ownership A firm is defined as foreign-owned if 50 percent or more of its equity is owned by a non-resident.

Industry-level Exports They are obtained aggregating HS6 codes export data from the BACI dataset provided by CEPII and represent (log) aggregate exports of Portugal of products belonging to Nace rev.1 2-digit industries.

Share of Skilled Workers Share of firm's workers with 12 or more years of education.

Worker-level variables

Hourly Wage (Log) hourly wage is computed adding base and overtime wages plus regular benefits (at the month-level) and dividing by the number of regular and overtime hours worked in the reference week multiplied by $4.\bar{3}$. We apply a trimming of the top and bottom 0.5 per cent. Regular and overtime hours worked are set to (i) missing if (individually) greater than 480 per month, (ii) to zero if negative.

Hiring Date The year the worker was hired in the firm is a variable that is directly registered in QP. Since there are few instances when the hiring date changes from year to year for the same worker-firm spell, we create a robust version of the hiring date computed using the mode for each firm-worker spell. If there is a tie, we take the minimum year in the spell.

Tenure This variable is measured as the difference between the current year and the hiring date.

Country-groups

We partition export destinations into seven groups: Spain, other top 5 export destination countries (Italy, UK, France, and Germany), other EU countries (Austria, Belgium or Luxembourg, Denmark, Finland, Greece, Ireland, Netherlands, Sweden), OECD countries not belonging to the EU (USA, Australia, Canada, Switzerland, Czech Republic, Hungary, Iceland, Japan, South Korea, Mexico, Norway, New Zealand, Poland, Slovakia, Turkey), countries belonging to the Community of Portuguese Language Countries (CPLP in Portuguese—Angola, Brazil, Cape Verde, Guinea-Bissau, Mozambique, Sao Tome and Principe, and Timor-Leste), China, and the rest of the World. We adopted this partition because of the following reasons. First, Portugal is an economy deeply rooted into the European market. EU countries are special and we further divide them into top 5 destinations (based on the number of Portuguese exporting firms, as well as total exports, in 2005) and other EU countries. The strong cultural ties and proximity to Spain also require attention which is why we separately consider Spain. Exports to OECD as compared to non-OECD countries are likely to be different in terms of both exported products and quality range. At the same time, China and countries sharing language ties with Portugal are also likely to be characterized by different exports patterns.

Product-groups

We use the Isic rev2 3-digit classification to divide export products into 29 categories ranging from “Food manufacturing” (code 311) to “Other Manufacturing Industries” (code 390). The Isic rev2 is a widely used classification allowing to bridge products to industries and for which both information on the degree of product differentiation - borrowed from (Rauch, 1999) - and financial vulnerability - borrowed from (Manova et al., 2015) - is readily available. At the same time data on both trade and production across countries over 1995-2005 is easily accessible at this level of disaggregation from the CEPII (Centre d’Etude Prospectives et d’Informations Internationales) trade and production dataset. This data is needed to compute our measure of Chinese import penetration in country d for product p à la (Autor et al., 2014b). The 29 product categories we end up working with also represent a balance between a sufficient level of detail on the one side and the need to economise on the dimensionality of the dataset involved in estimations on the other side.

B.5 Wage analysis

The first step towards establishing a relationship between the export experience brought by managers into a firm and the firm's trade performance consists in assessing whether export experience corresponds to a wage premium. In this Section, we estimate a Mincerian wage equation to show that managers with export experience (as defined in Section 2.1.1) enjoy a sizeable wage premium. The premium is robust to controlling for worker and firm fixed effects, previous firm observables, job-change patterns, as well as a large set of worker and current firm time-varying observables. Moreover, managers with experience in one (or more) of the current destinations reached or products exported by their firm—i.e. *matched* destination- or product-specific export experience—enjoy an even higher wage premium.[4] These results confirm previous evidence in (Mion and Opromolla, 2014) for destination-specific experience and paint a new but similar portrait for product-specific experience.

We further enrich the analysis by looking at the experience premia accrued by different types of managers (general, production, financial and sales) and find results in line with a knowledge diffusion story. More specifically, we show that financial managers enjoy a basic export experience premium but no robust product- or destination-specific experience premium. General and production managers receive both a product- and a destination-specific experience premium but little or no basic experience premium. Sales managers benefit from a destination-specific experience premium while general managers get the largest premia in most cases. Crucially, we find little evidence of a wage premium for non-managers,

[4] See Section 2.1.1 for the definition of specific export experience.

which is the reason why in the trade performance analysis of Section 2.3 we focus on managers only. These results add the evidence coming from raw wage data shown in the previous Section.

There are caveats in our analysis as well as alternative explanations for the existence of a premium that do not involve the diffusion of valuable export-specific knowledge by managers. Though, such alternative explanations are at odds with the existence of an additional wage premium for specific export experience and, as we will show later on, potentially imply our premia are actually under-estimated. We discuss these issues in more detail in Section B.5.3.

B.5.1 Econometric model

Workers are indexed by i, *current* employing firms by f, *previous* employing firms by p, and time by t. Each worker i is associated at time t to a unique current employing firm f and a unique previous employing firm p. The baseline wage equation we estimate is:

$$\begin{aligned} w_{it} = {} & \beta_0 + \beta_1 Manager_{it} + \mathbf{Mobility}'_{\mathbf{it}}\mathbf{\Gamma_M} + \left(\mathbf{Mobility_{it}} \times Manager_{it}\right)' \mathbf{\Gamma_{Mm}} + \\ & + \beta_2 Experience_{it} + \beta_3 \left(Experience_{it} \times Manager_{it}\right) + \\ & + \beta_4 Matched\_Experience_{it} + \beta_5 \left(Matched\_Experience_{it} \times Manager_{it}\right) + \\ & + \mathbf{I}'_{\mathbf{it}}\mathbf{\Gamma_I} + \mathbf{P}'_{\mathbf{pt}}\mathbf{\Gamma_P} + \mathbf{C}'_{\mathbf{ft}}\mathbf{\Gamma_C} + \eta_i + \eta_f + \eta_t + \varepsilon_{it}, \end{aligned} \tag{B.1}$$

where w_{it} is the (log) hourly wage of worker i in year t, $Manager_{it}$ is a dummy indicating whether worker i is a manager at time t, the vector $\mathbf{Mobility_{it}}$ contains a set of dummies taking value one from the year t a worker changes employer for the 1^{st}, 2^{nd},..time, $Experience_{it}$ and $Matched\_Experience_{it}$ are dummies indicating whether worker i has, respectively, export experience and matched (destination or product; we estimate two separate regressions) export experience at time t, the vector $\mathbf{I_{it}}$ stands for worker i time-varying observables,[5] the vectors $\mathbf{P_{pt}}$ and $\mathbf{C_{ft}}$ refer to, respectively, the previous and current employing firm observables,[6] η_i (η_f) are individual (firm) fixed effects and η_t are time dummies.

The key parameters in our analysis are $\beta_2 + \beta_3$, i.e., the wage premium corresponding to export experience for a manager, and $\beta_4 + \beta_5$, i.e., the extra premium corresponding to matched export experience for a manager. β_2 and β_4 indicate, respectively, the premium related to export experience and matched export experience for a non-manager. Mobility of workers across firms is needed, according to our definition, to acquire export experience: $Experience_{it}$=1 if worker i has, among his/her previous employers, an exporting firm while $Matched\_Experience_{it}$=1 further requires the current employing firm to be exporting: (i) one or more of the products previous employers were exporting (experience in a product regressions); (ii) in at least one of the markets to which previous employers were exporting (experience in a destination regressions). In

[5] A worker's age, age squared, education, and tenure. See Section 2.1 and the Appendix for further details.

[6] Previous firm observables are size, productivity, and a dummy indicating whether the current and previous firms belong to the same industry or not. Current firm observables are size, productivity, share of skilled workers, export status, age, foreign ownership, mean and standard deviation of both age and education of managers, and industry-level exports. For previous firm variables, as well as for current firm variables requiring knowledge of managers' age and education, we add a set of dummies equal to one whenever the data are missing, while recoding missing values to zero. Previous employing firm information is not available for workers who enter the labor market in our time frame or workers who always stay in the same firm. We do this to maximize exploitable information. When we then turn to the trade performance analysis which is, as detailed above, representative of larger and more organizationally structured firms we simply discard missing observations. We consider both manufacturing and non-manufacturing firms in constructing previous employing firm variables. In specifications without fixed effects we add NUTS3 location and Nace rev.1 2-digit dummies as further controls. See Section 2.1 and the Appendix for further details.

other words, identification of export experience premia comes from workers moving across firms. To disentangle wage variations due to mobility from those related to export experience we consider the set of dummies $\mathbf{Mobility_{it}}$. We further interact $\mathbf{Mobility_{it}}$ with manager status $Manager_{it}$ to allow mobility to have a differential impact on managers and non-managers.

$\mathbf{Mobility_{it}}$, $Experience_{it}$, and $Matched\_Experience_{it}$, as well as their interaction with manager status, thus define a difference-in-difference setting with two treatments (acquiring export experience and eventually also matched export experience) and a control group of workers (managers and non-managers) changing employer *without acquiring export experience*.[7]

Equation (B.1) is first estimated without worker and firm fixed effects, then with firm fixed effects and finally with both sets of fixed effects. In all three cases we consider two specifications: with export experience only and with both export experience and matched export experience. As already indicated we present separate regressions Tables for experience in a destination and experience in a product. Last but least when focusing on the different types of managers we break down the $Manager_{it}$ dummy (and its interactions with experience) into 5 categories (general, production, financial, sales and other). All our specifications are estimated with OLS and we deal high-dimensional fixed effects building on the full Gauss-Seidel algorithm proposed by (Guimarães and Portugal, 2010). See the Appendix for further details.

[7]Our regression design is likely to actually underestimate the value of export experience. For example, mobility dummies would absorb some of the effect of the export-related learning to the extent greater knowledge leads managers to receive more job offers and hence move around more.

B.5.2 Results

Table B.1 and B.2 report the estimated export experience premia obtained from the different variants of (B.1) both for manager and non-managers. More specifically in Table B.1 we consider wage regressions with basic experience and experience in a destination while in Table B.2 we consider wage regressions with basic experience and experience in a product. The two Tables also show the significance levels of the premia, along with values of the F-statistics for managers' premia and T-statistics for non-managers' premia.[8] Tables B.4 to B.9 in the Tables Appendix provide information on all the other covariates. Such Tables show that coefficient signs and magnitudes are in line with previous research based on Mincerian wage regressions, i.e., wages are: higher for managers, increasing and concave in age, increasing in education and tenure, higher in larger, more productive, foreign-owned and older firms, higher in firms with a larger share of skilled workers.

The overall picture coming out from Tables B.1 and B.2 can be summarized as follows:

Export experience does pay for a manager. Columns (1) to (3) in the two Tables[9] point to a premium in between 11.5% (no fixed effects) and 2.7% (worker and firm fixed effects). The latter figure should be considered as extremely conservative because, due to the presence of worker fixed effects, we are identifying that coefficient from workers who are currently managers but were not managers in the past. Yet the 2.7% is economically big representing about half of the premium (5.8%) for being a manager in the estimation corresponding to column 3. At the same time the difference in the premium across specifications do suggest

[8] Managers' premia are obtained from sums of covariates' coefficients in equation (B.1). Therefore, their significance is tested with an F-statistic. Non-managers' premia correspond instead to individual coefficients in equation (B.1) and so the T-statistic is used.

[9] Note results are identical between the two Tables and rightly so.

TABLE B.1: Wage regression with basic experience and experience in a destination

Controls	(1)	(2)	(3)	(4)	(5)	(6)
			Export Experience Premia for Managers			
Export Experience	0.115^a	0.110^a	0.027^a	0.064^a	0.042^a	0.013^c
	(870.8)	(859.3)	(27.4)	(103.4)	(50.3)	(3.5)
Destination-Specific Exp. Experience				0.061^a	0.089^a	0.017^a
				(100.3)	(230.1)	(9.7)
			Export Experience Premia for non-Managers			
Export Experience	0.006^a	0.014^a	-0.003^c	0.022^a	0.010^a	-0.003
	(7.6)	(17.0)	(-1.7)	(21.8)	(10.6)	(-1.1)
Destination-Specific Exp. Experience				-0.028^a	0.007^a	-0.003
				(-25.4)	(6.5)	(-1.0)
Observations	4,006,826	4,006,826	4,006,826	4,006,826	4,006,826	4,006,826
R^2	0.598	0.697	0.925	0.598	0.697	0.925
Worker controls	X	X	X	X	X	X
Firm (current and past) controls	X	X	X	X	X	X
Firm FE		X	X		X	X
Worker FE			X			X

Notes: This Table reports export experience premia from the OLS estimation of several variants of the mincerian wage equation (B.1). The dependent variable is a worker's (log) hourly wage in euros. Export experience and matched (destination) export experience are dummies. See Section 2.1.1 for the definition of a manager and the export experience (and its refinements). Estimations include a number of covariates whose coefficients and standard errors are reported in the Tables Appendix. Worker-year covariates include a worker's age, age square, education, and tenure. Current firm-time covariates include firm size, productivity, share of skilled workers, export status, age, foreign ownership, mean and standard deviation of both age and education of managers, and industry-level exports. Previous firm-time covariates include firm size, productivity, and a dummy indicating whether current and previous employing firms industry affiliations coincide or not. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. Robust F-statistics (t-statistics) for managers (non-managers) premia in parentheses: $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

that managers with export experience are "better managers" and work for better paying firms. However, a premium remains when controlling for both firm and worker time-invariant heterogeneity indicating that export experience is not simply a proxy for managers' unobserved ability and/or selection into higher paying firms. Export experience is neither a trivial proxy for, as an example, a stronger bargaining position of a manager moving out of a successful/productive firm. We do control, in all specifications, for the size, productivity, and industry affiliation of the manager's previous firm. As shown in Tables B.4 to B.9 in the Tables Appendix managers that come from more productive firms *do* earn a higher

TABLE B.2: Wage regression with basic experience and experience in a product

Controls	(1)	(2)	(3)	(4)	(5)	(6)
			Export Experience Premia for Managers			
Export Experience	0.115^a	0.110^a	0.027^a	0.072^a	0.046^a	0.022^a
	(870.8)	(859.3)	(27.4)	(182.9)	(79.0)	(12.4)
Product-Specific Exp. Experience				0.061^a	0.100^a	0.007
				(127.1)	(360.9)	(1.7)
			Export Experience Premia for non-Managers			
Export Experience	0.006^a	0.014^a	-0.003^c	0.013^a	0.003^a	-0.008^a
	(7.6)	(17.0)	(-1.7)	(13.0)	(2.9)	(-3.5)
Product-Specific Exp. Experience				-0.012^a	0.025^a	0.006^a
				(-11.4)	(22.7)	(4.8)
Observations	4,006,826	4,006,826	4,006,826	4,006,826	4,006,826	4,006,826
R^2	0.598	0.697	0.925	0.598	0.697	0.925
Worker controls	X	X	X	X	X	X
Firm (current and past) controls	X	X	X	X	X	X
Firm FE		X	X		X	X
Worker FE			X			X

Notes: This Table reports export experience premia from the OLS estimation of several variants of the mincerian wage equation (B.1). The dependent variable is a worker's (log) hourly wage in euros. Export experience and matched (product) export experience are dummies. See Section 2.1.1 for the definition of a manager and the export experience (and its refinements). Estimations include a number of covariates whose coefficients and standard errors are reported in the Tables Appendix. Worker-year covariates include a worker's age, age square, education, and tenure. Current firm-time covariates include firm size, productivity, share of skilled workers, export status, age, foreign ownership, mean and standard deviation of both age and education of managers, and industry-level exports. Previous firm-time covariates include firm size, productivity, and a dummy indicating whether current and previous employing firms industry affiliations coincide or not. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. Robust F-statistics (t-statistics) for managers (non-managers) premia in parentheses: ${}^a p < 0.01$, ${}^b p < 0.05$, ${}^c p < 0.1$.

wage, but export experience *continues* to be positively and significantly associated to a wage premium for managers.

There is an additional premium for matched export experience for managers. Columns (4) to (6) in Table B.1 point to an additional premium accrued upon having destination-specific experience, with respect to just having basic experience, in between 8.9% (firm fixed effects) and 1.7% (worker and firm fixed effects). The corresponding figures for the product-specific experience premium are 10% and 0.7% even though the latter fails to be significant. Overall our findings suggest specific experience is an important feature of a manager's wage and are consistent with the hypothesis that managers diffuse valuable export-related knowledge. While the existence of a premium for export experience is also consistent with the diffusion of knowledge not *uniquely* related to exporting (e.g. R&D skills, organizational practices, etc.) the additional premium for matched experience does reinforce the view that export-specific knowledge is an important component of the knowledge diffusion. Furthermore, our results suggest that such knowledge proves to be very valuable when it is *market-specific* (product or destination).

There is limited evidence that export experience pays for non-managers. Non-managers premia across Tables B.1 and B.2 are substantially smaller than those corresponding to managers and less often significant. Given the key role of managers for export-specific activities, the weaker evidence for premia among non-managers is consistent with export experience entailing some valuable export-specific knowledge. Managers are "special" because exporting requires successfully performing a number of complex tasks and managers are the employees that are responsible for the most sophisticated tasks within a firm (see for example (Antras et al., 2006), (Caliendo and Rossi-Hansberg, 2012). Furthermore, managers are also different because they are in charge of marketing and commercialization activities. As suggested by (Arkolakis, 2010) and (Eaton et al., 2012), searching for customers and suppliers and learning about their needs play a key role in determining the success of a firm on the international market.

Table B.3 provides additional insights into the nature of export experience premia. More specifically, we now split managers into several categories depending on their specific role within a firm and compute manager-type specific premia. In the left panel of TableB.3 we jointly consider experience and destination-specific experience and run estimations with no fixed effects, firm fixed effects and both worker and firm fixed effects. In the right panel of Table B.3 we do the same for experience and product-specific experience. It is important to note that the use of worker fixed effects is particularly conservative within this context because, for example, premia referring to financial managers are identified across workers who are currently financial managers but were either not a manager or a different manager-type in the past.

Focusing on the most restrictive specifications – columns (3) and (6) – we find that financial managers enjoy a basic export experience premium but no robust product- or destination-specific experience premium. General and production managers receive both a product- and a destination-specific experience premium but little or no basic experience premium. Sales managers benefit from a destination-specific experience premium while general managers get the largest premia in most cases. We believe these results aligns with a knowledge diffusion story. More specifically, we believe that knowledge acquired in ares like sales and production is more prone to be destination- or product-specific while experience in financing activities should instead be of a more generic nature. As for general managers they need to have expertise in all such areas and so they are likely to hold overall more valuable knowledge to be diffused.

B.5.3 Endogeneity

Selection. For the estimated premia to have a causal interpretation we need, as is typically the case for Mincerian analyses, matching between firms and workers to be random *conditional* on covariates in (B.1). If we consider wages w_{ift} for all the possible firm-worker pairs this means we impose
$\mathbb{E}\left[\varepsilon_{ift}|\mathbf{X}_{ift}, d_{ift}=1\right]=\mathbb{E}\left[\varepsilon_{ift}|\mathbf{X}_{ift}\right]$ where $\mathbf{X}_{ift}$ is our set of covariates and fixed effects and d_{ift} is a dummy taking value one if worker i is employed by firm f at time t. Though admittedly restrictive, this hypothesis is made less strong by the

fact that we use a large battery of controls for worker, past employer, and current employer characteristics while accounting for unobserved time-invariant heterogeneity by means of both firm and worker fixed effects. Furthermore, it is actually quite plausible that selection induces a downward bias of our premia which are thus to be considered as conservative. For example, suppose wages w_{ift} reflect workers' productivity and that firm f hires the most productive worker from a set I. We would then have d_{ift}=$\mathbb{1}\left(\mathbf{X}'_{ift}\beta + \varepsilon_{ift} \geq \max_{i^* \in I} \mathbf{X}'_{i^*ft}\beta + \varepsilon_{i^*ft}\right)$, where $\mathbb{1}(.)$ is an indicator function. Under this assumption d_{ift} depends on both $\mathbf{X}'_{ift}$ and ε_{ift} while $\mathbb{E}\left[\varepsilon_{ift}|\mathbf{X}_{ift}, d_{ift} = 1\right]$ *decreases* in those components of the covariates vector $\mathbf{X}'_{ift}$ corresponding to a positive coefficient (like export experience) so inducing a downward bias.[10]

Omitted Variables. One caveat potentially applying to our analysis is that export experience might be a proxy for some omitted variables. For example, having being employed by an exporter could signal the unobserved ability of a manager if exporters screen workers more effectively (see for example (Helpman et al., 2010), (Helpman et al., 2012)). Another possibility is that workers (previously) employed by exporters could be expected to enjoy stronger wage rises over the course of their career—as would occur, given the (widely documented) productivity advantage of exporters, in the context of strategic wage bargaining and on-the-job search (see for example (Cahuc et al., 2006)).[11] We account for these issues in three ways. First, we use worker fixed effects to capture any time-invariant unobserved characteristic of the worker (including ability); second, we use key previous firm characteristics (size, productivity, and industry) suggested

[10]Intuitively, given that the firm f has chosen worker i ($d_{ift} = 1$), an increase in $\mathbf{X}'_{ift}\beta$ (think of this as the firm considering a manager with export experience with respect to one that has no experience) means that the unobserved component ε_{ift} needs not to be that large for worker i to be chosen: negative correlation between ε_{ift} and $\mathbf{X}'_{ift}\beta$ conditional on $d_{ift} = 1$.

[11]In these models workers employed by more productive/larger firms will, on average, receive better on-the-job offers from other firms.

by the strategic wage bargaining and on-the-job search literature as well as by the literature on inter-industry wage differentials (Gibbons and Katz, 1992) to control for the fact that features of previous jobs are expected to have an impact on the current salary; third, we use a refined definition of export experience that is more directly linked to the actual exporting activities undertaken by the worker's previous firms as well as being a feature that, unlike general ability, is more valuable to some firms than others —i.e. matched destination or product export experience. We find it considerably more difficult to argue that matched export experience does not correspond to valuable trade-specific knowledge acquired when working for an exporting firm.

Censoring. Export experience and matched export experience depend on the whole professional history of a worker. For some observations, this history is not entirely observed in our data, which exclusively covers the years 1995 to 2005. For those workers that we consider not having experience based on the observed data, it is possible that they acquired export experience before 1995. This is a problem of missing data due to censoring. To deal with this issue we use a different definition of export experience and matched export experience and explore its quantitative implications. More specifically, we impose experience to be acquired either in $t-1$ or $t-2$ and get rid of both 1995 and 1996 data. Results (available upon request) are qualitatively and quantitatively similar to our core findings.

B.6 High-dimensional fixed effects

All specifications in the paper are estimated with OLS. With large data sets, estimation of a linear regression model with two high-dimensional fixed effects poses some computational challenges (Abowd et al., 1999). However, the exact least-square solution to this problem can be found using an algorithm, based on the "zigzag" or full Gauss-Seidel algorithm, proposed by (Guimarães and Portugal, 2010). We use, for our estimations, the Stata user-written routine reg2hdfe implementing (Guimarães and Portugal, 2010)'s algorithm; this routine has also been used in (Carneiro et al., 2012), and (Martins and Opromolla, 2012). The main advantage of this routine is the ability to fit linear regression models with two or more high-dimensional fixed effects under minimal memory requirements. Moreover, the routine provides standard errors correctly adjusted for the presence of the fixed effects. We apply the reg2hdfe routine setting the convergence criterion for the iteration method to 0.001. As we are not interested in worker and/or firm fixed effects per se, we keep all observations for which covariates are available and not the largest connected group.

TABLE B.3: Wage regression with different types of managers and export experience

Controls	(1)	(2)	(3)	(4)	(5)	(6)
		Export Experience			**Export Experience**	
General manager	0.078^a	0.072^a	-0.001	0.116^a	0.110^a	0.020
	(13.1)	(12.9)	(0.0)	(29.1)	(30.5)	(1.2)
Production manager	0.053^a	0.049^a	0.018	0.041^a	0.047^a	0.025^b
	(11.2)	(10.9)	(1.5)	(8.3)	(12.1)	(4.1)
Financial manager	0.056^a	0.033^c	0.092^a	0.101^a	0.090^a	0.084^a
	(7.5)	(3.0)	(10.6)	(28.4)	(23.0)	(13.4)
Sales manager	-0.030	-0.024^a	0.012	0.021	0.031	0.042^c
	(1.4)	(1.1)	(0.2)	(1.0)	(2.4)	(3.3)
		Destination-Specific Exp. Experience			**Product-Specific Exp. Experience**	
General manager	0.482^a	0.428^a	0.091^a	0.432^a	0.385^a	0.058^a
	(298.1)	(262.8)	(15.4)	(231.7)	(208.7)	(6.8)
Production manager	0.132^a	0.158^a	0.036^b	0.169^a	0.184^a	0.026^c
	(56.1)	(86.4)	(5.4)	(105.1)	(132.7)	(3.5)
Financial manager	0.156^a	0.190^a	-0.015	0.110^a	0.134^a	-0.006
	(45.2)	(73.7)	(0.2)	(24.8)	(37.5)	(0.8)
Sales manager	0.212^a	0.221^a	0.039^c	0.164^a	0.173^a	0.000
	(59.6)	(76.6)	(3.0)	(44.0)	(55.7)	(0.0)
Observations	4,006,826	4,006,826	4,006,826	4,006,826	4,006,826	4,006,826
R^2	0.599	0.698	0.925	0.599	0.698	0.925
Worker controls	X	X	X	X	X	X
Firm (current and past) controls	X	X	X	X	X	X
Firm FE		X	X		X	X
Worker FE			X			X

Notes: This Table reports export experience premia from the OLS estimation of several variants of the mincerian wage equation (B.1). The dependent variable is a worker's (log) hourly wage in euros. In specifications (1) to (3) both export experience and destination-specific export experience are considered along with their interactions with dummies corresponding to different types of managers. In specifications (4) to (6) both export experience and product-specific export experience are considered along with their interactions with dummies corresponding to different types of managers. See Section 2.1.1 for the definition of a manager, manager types and for export experience (and its refinements). Estimations include a number of covariates whose coefficients and standard errors are reported in the Tables Appendix. Worker-year covariates include a worker's age, age square, education, and tenure. Current firm-time covariates include firm size, productivity, share of skilled workers, export status, age, foreign ownership, mean and standard deviation of both age and education of managers, and industry-level exports. Previous firm-time covariates include firm size, productivity, and a dummy indicating whether current and previous employing firms industry affiliations coincide or not. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. Robust F-statistics in parentheses: $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.4: Wage regression with basic experience and experience in a destination, controls (1st set, for Table B.1)

	(1)	(2)	(3)	(4)	(5)	(6)
Age (Years)	0.025^a	0.025^a	0.023^a	0.025^a	0.025^a	0.023^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age Squared (Years)	-0.000^a	-0.000^a	-0.000^a	-0.000^a	-0.000^a	-0.000^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education (Years)	0.041^a	0.040^a	0.003^a	0.041^a	0.040^a	0.003^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure (Years)	0.005^a	0.005^a	0.003^a	0.005^a	0.005^a	0.003^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Manager (0/1)	0.559^a	0.553^a	0.058^a	0.559^a	0.553^a	0.058^a
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
2nd Firm (or later)	-0.016^a	-0.004^a	0.014^a	-0.016^a	-0.004^a	0.014^a
	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.003)
3rd Firm (or later)	0.015^a	0.013^a	0.008^a	0.015^a	0.012^a	0.008^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
4th Firm (or later)	0.031^a	0.015^a	0.008^a	0.031^a	0.015^a	0.008^a
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
5th Firm (or later)	0.029^a	0.014^c	0.016^c	0.027^a	0.014^c	0.015^c
	(0.009)	(0.007)	(0.009)	(0.009)	(0.007)	(0.009)
6th Firm (or later)	0.030	0.051^b	0.020	0.029	0.051^b	0.020
	(0.027)	(0.024)	(0.025)	(0.026)	(0.024)	(0.025)
7th Firm (or later)	0.174	0.063	0.122	0.169	0.064	0.122
	(0.117)	(0.091)	(0.088)	(0.116)	(0.091)	(0.088)
2nd Firm (or later) and manag.	-0.065^a	-0.047^a	0.058^a	-0.065^a	-0.047^a	0.058^a
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
3rd Firm (or later) and manag.	0.037^a	0.027^a	0.054^a	0.040^a	0.029^a	0.055^a
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
4th Firm (or later) and manag.	0.029^b	0.018	0.040^a	0.032^b	0.020	0.040^a
	(0.014)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)
5th Firm (or later) and manag.	-0.023	-0.022	-0.056^b	-0.020	-0.019	-0.056^b
	(0.039)	(0.035)	(0.027)	(0.039)	(0.034)	(0.028)
6th Firm (or later) and manag.	0.059	0.068	-0.024	0.065	0.074	-0.021
	(0.110)	(0.106)	(0.060)	(0.107)	(0.102)	(0.060)
7th Firm (or later) and manag.	-0.709^b	-0.322^c	-0.252^b	-0.685^a	-0.306^c	-0.256^b
	(0.281)	(0.192)	(0.123)	(0.266)	(0.176)	(0.122)
Observations	4,006,826	4,004,447	3,609,284	4,006,826	4,004,447	3,609,284
R^2	0.598	0.697	0.925	0.598	0.697	0.925

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table includes the first set of controls for the regressions of Table B.1. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.5: Wage regression with basic experience and experience in a destination, controls (2nd set, for Table B.1)

	(1)	(2)	(3)	(4)	(5)	(6)
Firm Size (log)	0.030^a	0.012^a	0.054^a	0.030^a	0.012^a	0.054^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Apparent Labor Productivity (log)	0.075^a	0.006^a	0.005^a	0.076^a	0.006^a	0.005^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Exports PT	-0.058^a	0.047^a	0.067^a	-0.058^a	0.047^a	0.067^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Firm Age (log)	0.002^a	-0.003^a	0.001^a	0.002^a	-0.003^a	0.001^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Foreign Ownership (0/1)	0.026^a	0.014^a	0.006^a	0.026^a	0.014^a	0.006^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Share of Skilled Workers	0.160^a	-0.080^a	0.035^a	0.160^a	-0.080^a	0.035^a
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Size of Prev. Firm (0/1)	-0.005^a	0.053^a	-0.550^a	-0.007^a	0.053^a	0.090
	(0.001)	(0.001)	(0.206)	(0.001)	(0.001)	(0.209)
App. Prod. of Prev. Firm (0/1)	-0.273^a	-0.235^a	-0.097^a	-0.276^a	-0.235^a	-0.097^a
	(0.004)	(0.004)	(0.008)	(0.004)	(0.004)	(0.008)
Size of Previous Firm	-0.007^a	-0.004^a	0.002^a	-0.006^a	-0.005^a	0.002^a
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
App. Prod. of Previous Firm	0.030^a	0.024^a	0.010^a	0.030^a	0.024^a	0.010^a
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Sector of Previous Firm Equal	0.076^a		-1.367^a	0.077^a		-1.051^a
	(0.001)		(0.280)	(0.001)		(0.281)
d_age_mg	0.008^c	-0.003	0.030^a	0.008^c	-0.002	0.030^a
	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.004)
d_educ_mg	-0.080^a	-0.025^a	-0.008^b	-0.080^a	-0.025^a	-0.008^b
	(0.004)	(0.005)	(0.003)	(0.004)	(0.005)	(0.003)
Avg. Managers' Age	0.001^a	0.000^a	-0.000^a	0.001^a	0.000^a	-0.000^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Std. Dev. Managers' Age	0.001^a	0.000^a	0.000^a	0.001^a	0.000^a	0.000^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Avg. Managers' Education	0.004^a	0.001^a	-0.000^b	0.004^a	0.001^a	-0.000^b
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Std. Dev. Managers' Education	0.002^a	-0.001^a	-0.000^b	0.002^a	-0.001^a	-0.000^b
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Export Exp. (0/1)	0.006^a	0.014^a	-0.004^c	0.022^a	0.010^a	-0.003
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Observations	4,006,826	4,004,447	3,609,284	4,006,826	4,004,447	3,609,284
R^2	0.598	0.697	0.925	0.598	0.697	0.925

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table includes the second set of controls for the regressions of Table B.1. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.6: Wage regression with basic experience and experience in a destination, controls (3rd set, for Table B.1)

	(1)	(2)	(3)	(4)	(5)	(6)
New Exporter (0/1)	-0.006^a	0.000	0.001	-0.005^a	-0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Continuing Exporter (0/1)	-0.017^a	0.006^a	0.006^a	-0.015^a	0.005^a	0.006^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Exiting Exporter (0/1)	0.009^a	0.003^a	0.003^a	0.009^a	0.004^a	0.003^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Other Exporter (0/1)	-0.004^a	0.003^a	0.003^a	-0.003^a	0.003^a	0.003^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Sector of Previous Firm Diff		-0.056^a	-1.384^a		-0.056^a	-1.069^a
		(0.001)	(0.280)		(0.001)	(0.281)
Sector of Prev. Firm (0/1)			-1.918^a			-0.963^a
			(0.250)			(0.251)
Matched Export Exp. (0/1)				-0.028^a	0.007^a	-0.001
				(0.001)	(0.001)	(0.001)
Constant	0.131			0.129		
	(.)			(.)		
Observations	4,006,826	4,004,447	3,609,284	4,006,826	4,004,447	3,609,284
R^2	0.598	0.697	0.925	0.598	0.697	0.925

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table includes the third set of controls for the regressions of Table B.1. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.7: Wage regression with basic experience and experience in a product, controls (1st set, for Table B.2)

	(1)	(2)	(3)	(4)	(5)	(6)
Age (Years)	0.025^a	0.025^a	0.023^a	0.025^a	0.025^a	0.023^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age Squared (Years)	-0.000^a	-0.000^a	-0.000^a	-0.000^a	-0.000^a	-0.000^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education (Years)	0.041^a	0.040^a	0.003^a	0.041^a	0.040^a	0.003^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure (Years)	0.005^a	0.005^a	0.003^a	0.005^a	0.005^a	0.003^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Manager (0/1)	0.559^a	0.553^a	0.058^a	0.560^a	0.553^a	0.058^a
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
2nd Firm (or later)	-0.016^a	-0.004^a	0.014^a	-0.016^a	-0.005^a	0.014^a
	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.003)
3rd Firm (or later)	0.015^a	0.013^a	0.008^a	0.015^a	0.012^a	0.008^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
4th Firm (or later)	0.031^a	0.015^a	0.008^a	0.031^a	0.015^a	0.008^a
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
5th Firm (or later)	0.029^a	0.014^c	0.016^c	0.028^a	0.014^c	0.016^c
	(0.009)	(0.007)	(0.009)	(0.009)	(0.007)	(0.009)
6th Firm (or later)	0.030	0.051^b	0.020	0.030	0.050^b	0.020
	(0.027)	(0.024)	(0.025)	(0.027)	(0.024)	(0.025)
7th Firm (or later)	0.174	0.063	0.122	0.173	0.065	0.123
	(0.117)	(0.091)	(0.088)	(0.116)	(0.091)	(0.088)
2nd Firm (or later) and manag.	-0.065^a	-0.047^a	0.058^a	-0.067^a	-0.050^a	0.058^a
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
3rd Firm (or later) and manag.	0.037^a	0.027^a	0.054^a	0.038^a	0.027^a	0.054^a
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
4th Firm (or later) and manag.	0.029^b	0.018	0.040^a	0.031^b	0.019	0.040^a
	(0.014)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)
5th Firm (or later) and manag.	-0.023	-0.022	-0.056^b	-0.020	-0.018	-0.056^b
	(0.039)	(0.035)	(0.027)	(0.039)	(0.035)	(0.028)
6th Firm (or later) and manag.	0.059	0.068	-0.024	0.060	0.067	-0.024
	(0.110)	(0.106)	(0.060)	(0.107)	(0.102)	(0.061)
7th Firm (or later) and manag.	-0.709^b	-0.322^c	-0.252^b	-0.690^a	-0.306^c	-0.253^b
	(0.281)	(0.192)	(0.123)	(0.266)	(0.174)	(0.122)
Observations	4,006,826	4,004,447	3,609,284	4,006,826	4,004,447	3,609,284
R^2	0.598	0.697	0.925	0.598	0.697	0.925

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table includes the first set of controls for the regressions of Table B.2. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.8: Wage regression with basic experience and experience in a product, controls (2nd set, for Table B.2)

	(1)	(2)	(3)	(4)	(5)	(6)
Firm Size (log)	0.030^a	0.012^a	0.054^a	0.030^a	0.011^a	0.054^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Apparent Labor Productivity (log)	0.075^a	0.006^a	0.005^a	0.075^a	0.006^a	0.005^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Exports PT	-0.058^a	0.047^a	0.067^a	-0.058^a	0.047^a	0.067^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Firm Age (log)	0.002^a	-0.003^a	0.001^a	0.002^a	-0.003^a	0.001^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Foreign Ownership (0/1)	0.026^a	0.014^a	0.006^a	0.026^a	0.014^a	0.006^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Share of Skilled Workers	0.160^a	-0.080^a	0.035^a	0.160^a	-0.081^a	0.035^a
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Size of Prev. Firm (0/1)	-0.005^a		-0.550^a	-0.006^a		0.087
	(0.001)		(0.206)	(0.001)		(0.209)
App. Prod. of Prev. Firm (0/1)	-0.273^a	-0.235^a	-0.097^a	-0.275^a	-0.233^a	-0.097^a
	(0.004)	(0.004)	(0.008)	(0.004)	(0.004)	(0.008)
Size of Previous Firm	-0.007^a	-0.004^a	0.002^a	-0.006^a	-0.005^a	0.002^a
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
App. Prod. of Previous Firm	0.030^a	0.024^a	0.010^a	0.030^a	0.024^a	0.010^a
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Sector of Previous Firm Equal	0.076^a		-1.367^a	0.077^a		-1.058^a
	(0.001)		(0.280)	(0.001)		(0.281)
d_age_mg	0.008^c	-0.003	0.030^a	0.008^c	-0.002	0.030^a
	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.004)
d_educ_mg	-0.080^a	-0.025^a	-0.008^b	-0.080^a	-0.025^a	-0.008^b
	(0.004)	(0.005)	(0.003)	(0.004)	(0.005)	(0.003)
Avg. Managers' Age	0.001^a	0.000^a	-0.000^a	0.001^a	0.000^a	-0.000^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Std. Dev. Managers' Age	0.001^a	0.000^a	0.000^a	0.001^a	0.000^a	0.000^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Avg. Managers' Education	0.004^a	0.001^a	-0.000^b	0.004^a	0.001^a	-0.000^b
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Std. Dev. Managers' Education	0.002^a	-0.001^a	-0.000^b	0.002^a	-0.001^a	-0.000^b
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Export Exp. (0/1)	0.006^a	0.014^a	-0.004^c	0.013^a	0.003^a	-0.008^a
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Observations	4,006,826	4,004,447	3,609,284	4,006,826	4,004,447	3,609,284
R^2	0.598	0.697	0.925	0.598	0.697	0.925

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table includes the second set of controls for the regressions of Table B.2. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.9: Wage regression with basic experience and experience in a product, controls (3rd set, for Table B.2)

	(1)	(2)	(3)	(4)	(5)	(6)
New Exporter (0/1)	-0.006^a	0.000	0.001	-0.006^a	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Continuing Exporter (0/1)	-0.017^a	0.006^a	0.006^a	-0.017^a	0.004^a	0.006^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Exiting Exporter (0/1)	0.009^a	0.003^a	0.003^a	0.009^a	0.004^a	0.003^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Other Exporter (0/1)	-0.004^a	0.003^a	0.003^a	-0.003^a	0.003^a	0.003^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Sector of Prev. Firm (0/1)		-0.053^a	-1.918^a		-0.052^a	-0.972^a
		(0.001)	(0.250)		(0.001)	(0.251)
Sector of Previous Firm Diff		-0.056^a	-1.384^a		-0.053^a	-1.074^a
		(0.001)	(0.280)		(0.001)	(0.281)
Matched Export Exp. (0/1)				-0.012^a	0.025^a	0.006^a
				(0.001)	(0.001)	(0.001)
Constant	0.131			0.130		
	(.)			(6.429)		
Observations	4,006,826	4,004,447	3,609,284	4,006,826	4,004,447	3,609,284
R^2	0.598	0.697	0.925	0.598	0.697	0.925

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table includes the third set of controls for the regressions of Table B.2. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.10: Wage regression with different types of managers and export experience, controls (1st set, for Table B.3)

	(1)	(2)	(3)	(4)	(5)	(6)
Age (Years)	0.026^a	0.025^a	0.023^a	0.026^a	0.025^a	0.023^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age Squared (Years)	-0.000^a	-0.000^a	-0.000^a	-0.000^a	-0.000^a	-0.000^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education (Years)	0.041^a	0.040^a	0.003^a	0.041^a	0.040^a	0.003^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure (Years)	0.005^a	0.005^a	0.003^a	0.005^a	0.005^a	0.003^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Other manager (0/1)	0.500^a	0.478^a	0.049^a	0.501^a	0.478^a	0.049^a
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
General manager (0/1)	0.432^a	0.520^a	0.098^a	0.432^a	0.520^a	0.098^a
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Production manager (0/1)	0.713^a	0.713^a	0.090^a	0.713^a	0.713^a	0.090^a
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Financial manager (0/1)	0.728^a	0.730^a	0.079^a	0.729^a	0.731^a	0.079^a
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Sales manager (0/1)	0.801^a	0.812^a	0.136^a	0.802^a	0.812^a	0.136^a
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
2nd Firm (or later)	-0.017^a	-0.005^a	0.014^a	-0.017^a	-0.005^a	0.014^a
	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.003)
3rd Firm (or later)	0.015^a	0.012^a	0.008^a	0.015^a	0.012^a	0.008^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
4th Firm (or later)	0.031^a	0.015^a	0.008^a	0.031^a	0.015^a	0.008^a
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
5th Firm (or later)	0.027^a	0.014^c	0.016^c	0.028^a	0.014^c	0.016^c
	(0.009)	(0.007)	(0.009)	(0.009)	(0.007)	(0.009)
6th Firm (or later)	0.029	0.050^b	0.019	0.029	0.050^b	0.020
	(0.026)	(0.024)	(0.025)	(0.026)	(0.024)	(0.025)
7th Firm (or later)	0.170	0.062	0.123	0.173	0.064	0.124
	(0.116)	(0.091)	(0.088)	(0.116)	(0.092)	(0.088)
2nd Firm (or later) and manag.	-0.045^a	-0.029^a	0.057^a	-0.046^a	-0.031^a	0.058^a
	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)
3rd Firm (or later) and manag.	0.038^a	0.027^a	0.054^a	0.035^a	0.025^a	0.053^a
	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)
4th Firm (or later) and manag.	0.030^b	0.019	0.040^a	0.028^b	0.018	0.040^a
	(0.013)	(0.012)	(0.013)	(0.013)	(0.012)	(0.013)
5th Firm (or later) and manag.	-0.012	-0.014	-0.053^c	-0.012	-0.014	-0.054^b
	(0.038)	(0.033)	(0.027)	(0.038)	(0.032)	(0.027)
6th Firm (or later) and manag.	0.051	0.066	-0.019	0.046	0.061	-0.022
	(0.094)	(0.091)	(0.061)	(0.094)	(0.091)	(0.061)
7th Firm (or later) and manag.	-0.623^b	-0.233	-0.261^b	-0.625^b	-0.232	-0.258^b
	(0.266)	(0.171)	(0.124)	(0.266)	(0.169)	(0.124)
Constant	0.114			0.115		
	(15.504)			(10.468)		
Observations	4,006,826	4,004,447	3,609,284	4,006,826	4,004,447	3,609,284
R^2	0.599	0.698	0.925	0.599	0.698	0.925

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table includes the first set of controls for the regressions of Table B.3. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.11: Wage regression with different types of managers and export experience, controls (2nd set, for Table B.3)

	(1)	(2)	(3)	(4)	(5)	(6)
Firm Size (log)	0.030^a	0.011^a	0.054^a	0.029^a	0.011^a	0.054^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Apparent Labor Productivity (log)	0.075^a	0.007^a	0.005^a	0.075^a	0.006^a	0.005^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Exports PT	-0.058^a	0.047^a	0.067^a	-0.057^a	0.047^a	0.067^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Firm Age (log)	0.002^a	-0.003^a	0.001^a	0.002^a	-0.003^a	0.001^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Foreign Ownership (0/1)	0.027^a	0.015^a	0.006^a	0.027^a	0.015^a	0.006^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Share of Skilled Workers	0.164^a	-0.079^a	0.035^a	0.164^a	-0.079^a	0.035^a
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Size of Prev. Firm (0/1)	0.054^a		-0.006^a			
	(0.001)	(0.001)		(0.001)		
App. Prod. of Prev. Firm (0/1)	-0.273^a	-0.229^a	-0.096^a	-0.272^a	-0.228^a	-0.095^a
	(0.004)	(0.004)	(0.008)	(0.004)	(0.004)	(0.008)
Size of Previous Firm	-0.006^a	-0.005^a	0.002^a	-0.006^a	-0.005^a	0.002^a
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
App. Prod. of Previous Firm	0.030^a	0.023^a	0.010^a	0.030^a	0.023^a	0.010^a
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Sector of Previous Firm Equal	0.077^a		-2.617^a	0.077^a		-2.621^a
	(0.001)		(0.245)	(0.001)		(0.245)
d_age_mg	0.010^b	0.001	0.030^a	0.010^b	0.001	0.030^a
	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.004)
d_educ_mg	-0.079^a	-0.026^a	-0.008^b	-0.079^a	-0.026^a	-0.008^b
	(0.004)	(0.005)	(0.003)	(0.004)	(0.005)	(0.003)
Avg. Managers' Age	0.001^a	0.000^a	-0.000^a	0.001^a	0.000^a	-0.000^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Std. Dev. Managers' Age	0.001^a	0.000^a	0.000^a	0.001^a	0.000^a	0.000^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Avg. Managers' Education	0.004^a	0.001^a	-0.000^b	0.004^a	0.001^a	-0.000^b
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Std. Dev. Managers' Education	0.002^a	-0.001^a	-0.000^b	0.002^a	-0.001^a	-0.000^b
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Export Exp. (0/1)	0.023^a	0.011^a	-0.003	0.013^a	0.003^a	-0.008^a
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Observations	4,006,826	4,004,447	3,609,284	4,006,826	4,004,447	3,609,284
R^2	0.599	0.698	0.925	0.599	0.698	0.925

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table includes the second set of controls for the regressions of Table B.3. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.12: Wage regression with different types of managers and export experience, controls (3rd set, for Table B.3)

	(1)	(2)	(3)	(4)	(5)	(6)
New Exporter (0/1)	-0.005^a	-0.000	0.001	-0.006^a	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Continuing Exporter (0/1)	-0.015^a	0.004^a	0.006^a	-0.017^a	0.004^a	0.006^a
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Exiting Exporter (0/1)	0.008^a	0.003^a	0.003^a	0.008^a	0.004^a	0.003^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Other Exporter (0/1)	-0.003^a	0.003^a	0.003^a	-0.004^a	0.003^a	0.003^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Sector of Previous Firm Diff		-0.056^a	-2.635^a		-0.053^a	-2.638^a
		(0.001)	(0.245)		(0.001)	(0.245)
Sector of Prev. Firm (0/1)			-2.619^a		-0.053^a	-2.623^a
			(0.245)		(0.001)	(0.245)
Matched Export Exp. (0/1)	-0.029^a	0.005^a	-0.002	-0.013^a	0.024^a	0.006^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.114			0.115		
	(15.504)			(10.468)		
Observations	4,006,826	4,004,447	3,609,284	4,006,826	4,004,447	3,609,284
R^2	0.599	0.698	0.925	0.599	0.698	0.925

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table includes the third set of controls for the regressions of Table B.3. See the Appendix for details on covariates. All specifications include year dummies, and those not including fixed effects also contain region (NUTS-3) and industry (NACE 2-digits) dummies. $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.13: Probability to Start and Continue Exporting to a Specific Destination, controls (for Table 2.5)

	(1)	(2)	(5)	(6)
Firm Size (log)	0.030^a	0.027^a	0.126^a	0.124^a
	(0.006)	(0.006)	(0.014)	(0.014)
App. Labor Productivity (log)	0.005^b	0.005^b	0.010^b	0.010^b
	(0.002)	(0.002)	(0.004)	(0.004)
Firm Age (log)	0.003	0.004	0.008	0.008
	(0.004)	(0.004)	(0.010)	(0.010)
Foreign Ownership (0/1)	0.001	0.000	0.004	0.004
	(0.002)	(0.002)	(0.004)	(0.004)
Exports PT	0.005	0.004	0.003	0.003
	(0.005)	(0.005)	(0.008)	(0.008)
Share of Skilled Workers	-0.002	-0.003	0.012^c	0.012^c
	(0.002)	(0.002)	(0.006)	(0.006)
Avg. Managers' Age	-0.002	-0.001	-0.000	0.000
	(0.002)	(0.002)	(0.004)	(0.004)
Std. Dev. Managers' Age	0.001	0.000	0.002	0.001
	(0.001)	(0.001)	(0.003)	(0.003)
Avg. Managers' Education	0.000	-0.000	-0.001	-0.001
	(0.002)	(0.002)	(0.005)	(0.005)
Std. Dev. Managers' Education	-0.001	-0.001	-0.001	-0.002
	(0.001)	(0.001)	(0.003)	(0.003)
Avg. FE Managers	0.003	0.003	0.002	0.002
	(0.003)	(0.003)	(0.008)	(0.008)
Std. Dev. FE Managers	-0.002	-0.003^c	0.015^a	0.014^a
	(0.002)	(0.002)	(0.005)	(0.005)
Observations	166,860	166,860	52,124	52,124
R^2	0.175	0.176	0.256	0.257
Firm FE	X	X	X	X
Destination-Year Dummies	X	X	X	X

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table reports OLS and IV estimator coefficients and standard errors for the control covariates of our model of firm's entry and continuation into a foreign destination (2.2). Estimation results for the main covariates, as well as more details regarding the econometric model and estimation techniques, are provided in the Table 2.5. All specifications include destination-year dummies. All covariates, except destination-year dummies, have been divided by their respective standard deviation in order to deliver a comparable metric. Standard errors clustered at the firm-level in parentheses: $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.14: Probability to Start and Continue Exporting a Specific Product, controls (for Table 2.6)

	(1)	(2)	(5)	(6)
Firm Size (log)	0.011^{a}	0.009^{a}	0.076^{a}	0.061^{a}
	(0.002)	(0.002)	(0.016)	(0.016)
App. Labor Productivity (log)	0.002^{a}	0.002^{a}	0.009	0.007
	(0.001)	(0.001)	(0.006)	(0.006)
Firm Age (log)	-0.001	0.000	-0.011	-0.005
	(0.001)	(0.001)	(0.015)	(0.015)
Foreign Ownership (0/1)	0.001	0.001	0.003	0.001
	(0.001)	(0.001)	(0.005)	(0.005)
Exports PT	0.002	0.001	0.013	0.012
	(0.001)	(0.001)	(0.014)	(0.014)
Share of Skilled Workers	0.002^{b}	0.001	0.001	-0.002
	(0.001)	(0.001)	(0.009)	(0.009)
Avg. Managers' Age	-0.001^{b}	-0.001	0.002	0.009
	(0.001)	(0.001)	(0.006)	(0.006)
Std. Dev. Managers' Age	0.000	0.000	0.007	0.004
	(0.000)	(0.000)	(0.005)	(0.005)
Avg. Managers' Education	-0.001	-0.001	-0.000	-0.003
	(0.001)	(0.001)	(0.008)	(0.008)
Std. Dev. Managers' Education	-0.001^{b}	-0.001^{b}	-0.001	-0.004
	(0.000)	(0.000)	(0.004)	(0.004)
Avg. FE Managers	0.001	0.001	0.001	0.003
	(0.001)	(0.001)	(0.012)	(0.013)
Std. Dev. FE Managers	0.001	0.001	-0.008	-0.015^{c}
	(0.001)	(0.001)	(0.007)	(0.008)
Observations	775,675	775,675	40,125	40,125
R^2	0.070	0.073	0.205	0.214
Firm FE	X	X	X	X
Product-Year FE	X	X	X	X

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table reports OLS and IV estimator coefficients and standard errors for the core covariates of our model of firm's starting and continuing exporting a specific product (2.2). Estimation results for the main covariates, as well as more details regarding the econometric model and estimation techniques, are provided in the Table 2.6. All specifications include product-year dummies. All covariates, except destination-year dummies, have been divided by their respective standard deviation in order to deliver a comparable metric. Standard errors clustered at the firm-level in parentheses: $^{a}p < 0.01$, $^{b}p < 0.05$, $^{c}p < 0.1$.

TABLE B.15: (Log) Value of Exports to a Specific Destination Conditional on Entry or Continuation, controls (for Table 2.7)

	(1)	(2)	(5)	(6)
Firm Size (log)	0.148	0.141	0.892^a	0.875^a
	(0.184)	(0.184)	(0.069)	(0.069)
App. Labor Productivity (log)	0.044	0.045	0.109^a	0.107^a
	(0.055)	(0.055)	(0.026)	(0.026)
Firm Age (log)	-0.201	-0.198	-0.073^c	-0.069^c
	(0.171)	(0.171)	(0.042)	(0.042)
Foreign Ownership (0/1)	-0.006	-0.006	0.012	0.010
	(0.073)	(0.073)	(0.024)	(0.024)
Exports PT	0.128	0.128	0.043	0.041
	(0.159)	(0.159)	(0.051)	(0.051)
Share of Skilled Workers	-0.009	-0.013	0.060^c	0.055
	(0.108)	(0.108)	(0.035)	(0.035)
Avg. Managers' Age	0.012	0.012	-0.009	-0.004
	(0.070)	(0.070)	(0.020)	(0.020)
Std. Dev. Managers' Age	-0.014	-0.015	0.000	-0.004
	(0.056)	(0.056)	(0.013)	(0.013)
Avg. Managers' Education	-0.066	-0.067	-0.004	-0.008
	(0.084)	(0.083)	(0.024)	(0.024)
Std. Dev. Managers' Education	-0.075	-0.075	-0.008	-0.012
	(0.051)	(0.051)	(0.013)	(0.013)
Avg. FE Managers	0.017	0.016	-0.026	-0.024
	(0.150)	(0.150)	(0.037)	(0.037)
Std. Dev. FE Managers	0.016	0.015	0.033	0.026
	(0.084)	(0.083)	(0.021)	(0.022)
Observations	6,732	6,732	45,023	45,023
R^2	0.478	0.478	0.506	0.507
Firm FE	X	X	X	X
Destination-Year Dummies	X	X	X	X

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table reports OLS and IV estimator coefficients and standard errors for the control covariates of our model of firm's entry and continuation into a foreign destination (2.2). Estimation results for the main covariates, as well as more details regarding the econometric model and estimation techniques, are provided in the Table 2.7. All specifications include destination-year dummies. All covariates, except destination-year dummies, have been divided by their respective standard deviation in order to deliver a comparable metric. Standard errors clustered at the firm-level in parentheses: $^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$.

TABLE B.16: (Log) Value of Exports of a Specific Product Conditional on Entry or Continuation, controls (for Table 2.8)

	(1)	(2)	(5)	(6)
Firm Size (log)	-0.136	-0.159	0.352^{a}	0.262^{b}
	(0.154)	(0.153)	(0.103)	(0.103)
App. Labor Productivity (log)	-0.120^{b}	-0.121^{b}	0.122^{a}	0.111^{a}
	(0.060)	(0.060)	(0.031)	(0.030)
Firm Age (log)	-0.153	-0.140	-0.109	-0.063
	(0.128)	(0.131)	(0.127)	(0.126)
Foreign Ownership (0/1)	-0.000	-0.003	-0.050	-0.061^{c}
	(0.048)	(0.048)	(0.034)	(0.034)
Exports PT	0.022	0.001	-0.043	-0.044
	(0.149)	(0.150)	(0.095)	(0.101)
Share of Skilled Workers	-0.136	-0.140	-0.047	-0.072
	(0.101)	(0.102)	(0.062)	(0.065)
Avg. Managers' Age	-0.099	-0.091	-0.027	0.008
	(0.068)	(0.067)	(0.033)	(0.035)
Std. Dev. Managers' Age	-0.081	-0.085^{c}	0.029	0.015
	(0.050)	(0.050)	(0.023)	(0.024)
Avg. Managers' Education	0.004	0.018	-0.041	-0.054
	(0.083)	(0.083)	(0.038)	(0.039)
Std. Dev. Managers' Education	0.054	0.058	-0.029	-0.044^{c}
	(0.048)	(0.047)	(0.022)	(0.023)
Avg. FE Managers	0.126	0.116	0.036	0.059
	(0.139)	(0.139)	(0.068)	(0.068)
Std. Dev. FE Managers	-0.007	0.003	0.016	-0.028
	(0.077)	(0.077)	(0.046)	(0.051)
Observations	11,853	11,853	29,033	29,033
R^2	0.419	0.421	0.440	0.445
Firm FE	X	X	X	X
Product-Year Dummies	X	X	X	X

Robust standard errors in parentheses
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Notes: This Table reports OLS and IV estimator coefficients and standard errors for the control covariates of our model of firm's entry and continuation into a foreign destination (2.2). Estimation results for the main covariates, as well as more details regarding the econometric model and estimation techniques, are provided in the Table 2.8. All specifications include product-year dummies. All covariates, except destination-year dummies, have been divided by their respective standard deviation in order to deliver a comparable metric. Standard errors clustered at the firm-level in parentheses: $^{a}p < 0.01$, $^{b}p < 0.05$, $^{c}p < 0.1$.

TABLE B.17: Probability to Start Exporting in Angola; controls (for Table 2.4)

VARIABLES	(1) 1 pse	(2) 2 pse	(3) 3 pse	(4) 4 pse
Firm Size (log)	0.019^a	0.023^a	0.023^a	0.022^b
	(0.002)	(0.009)	(0.009)	(0.009)
App. Labor Productivity (log)	0.011^a	0.007^c	0.007^c	0.007^c
	(0.002)	(0.004)	(0.004)	(0.004)
Firm Age (log)	0.012^a	0.013^b	0.012^c	0.013^c
	(0.002)	(0.007)	(0.007)	(0.007)
Foreign Ownership (0/1)	-0.002^c	0.002	0.002	0.002
	(0.001)	(0.004)	(0.004)	(0.004)
Exports PT	-0.005^a	0.029^a	0.028^a	0.028^a
	(0.001)	(0.008)	(0.008)	(0.008)
Share of Skilled Workers	-0.001	0.005	0.004	0.005
	(0.002)	(0.004)	(0.004)	(0.004)
Avg. Managers' Age	0.001	0.002	0.002	0.002
	(0.001)	(0.003)	(0.003)	(0.003)
Std. Dev. Managers' Age	0.000	-0.004^c	-0.004^b	-0.004^b
	(0.002)	(0.002)	(0.002)	(0.002)
Avg. Managers' Education	0.001	-0.002	-0.002	-0.002
	(0.002)	(0.004)	(0.004)	(0.004)
Std. Dev. Managers' Education	0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Observations	28,420	28,420	28,420	28,420
R^2	0.024	0.383	0.384	0.384

Notes: This Table reports OLS estimator coefficients and standard errors for the control covariates of our model of firm's entry into a foreign destination (2.2) focused on Angola. Estimation results for the main covariates, as well as more details regarding the econometric model and estimation techniques, are provided in the Table 2.4. All covariates, have been divided by their respective standard deviation in order to deliver a comparable metric. Standard errors clustered at the firm-level in parentheses: ${}^a p < 0.01$, ${}^b p < 0.05$, ${}^c p < 0.1$.

TABLE B.18: Probability to Continue Exporting a Specific Product to a Specific Destination; Interaction with Chinese Import Penetration; controls (for Table 2.11)

	(1)
Firm Size (log)	0.121^{a}
	(0.014)
App. Labor Productivity (log)	0.011^{a}
	(0.004)
Firm Age (log)	0.006
	(0.010)
Foreign Ownership (0/1)	0.004
	(0.004)
Exports PT	0.002
	(0.008)
Share of Skilled Workers	0.012^{c}
	(0.006)
Avg. Managers' Age	0.001
	(0.004)
Std. Dev. Managers' Age	0.002
	(0.003)
Avg. Managers' Education	-0.001
	(0.005)
Std. Dev. Managers' Education	-0.002
	(0.003)
Avg. FE Managers	0.000
	(0.008)
Std. Dev. FE Managers	0.014^{a}
	(0.005)
Observations	1,514,409
R^2	0.302
Firm FE	X

Notes: This Table reports OLS estimator coefficients and standard errors for the control covariates of an enriched version of our model of firm's continuation into a foreign destination (2.2). Estimation results for the main covariates, as well as more details regarding the econometric model and estimation techniques, are provided in the Table 2.11. All covariates, except destination-year and product-year dummies, have been divided by their respective standard deviation in order to deliver a comparable metric. Standard errors clustered at the firm-level in parentheses: $^{a}p < 0.01$, $^{b}p < 0.05$, $^{c}p < 0.1$.

Appendix C

Appendix to chapter 3

C.1 EU Accession and the Freedom of Movement of Workers

In this Appendix we describe in detail the process that resulted in the entry of ten new countries into the European Union in 2004, i.e. the EU membership process.

The process of joining the EU broadly consists of 4 stages. It is in essence based on the prospective member's ability of satisfying the accession criteria—also called the "Copenhagen criteria" after the European Council in Copenhagen in 1993 which defined them. The accession criteria have a political (stability of institutions guaranteeing democracy, the rule of law, human rights, and respect for and protection of minorities), economic (a functioning market economy and the capacity to cope with competition and market forces) and administrative/institutional (capacity to effectively implement EU law, and ability to take on the obligations of membership) component. The four stages that characterize the membership process are the following.

1. *Official candidate for membership*. A country wishing to join the EU submits a membership application to the Council of the European Union, which asks the European Commission to assess the applicant's ability to meet the Copenhagen criteria. If the Commission's opinion is positive, membership

negotiations cannot start until all EU governments agree, in the form of a unanimous decision by the EU Council. Negotiations take place between ministers and ambassadors of the EU governments and the candidate country in what is called an intergovernmental conference.

2. *Negotiations*. The negotiation process includes three stages: screening, definition of counterparties' negotiation positions, and closing of the negotiations. In the screening phase, the European Commission, together with the candidate country, prepares a detailed report of how well the candidate country is prepared in each of the 36 Chapters of the EU Law, spanning all major economic, social, and institutional aspects (e.g the free movement of goods, justice, and defense policy). If the results of the screening are satisfactory the Commission makes a recommendation to open negotiations. The candidate country then has to submit its position on every chapter of EU Law, and the EU must adopt a common position. Negotiations then continue until the candidate's progress is considered satisfactory in any field.

3. *Accession Treaty*. Once negotiations are successfully concluded, the Accession Treaty (containing the detailed terms and conditions of membership, all transitional arrangements and deadlines, as well as details of financial arrangements and any safeguard clauses) is prepared.

4. *Support and Ratification*. The Accession Treaty becomes binding once (i) it wins the support of the EU Council, the Commission, and the European Parliament; (ii) it is signed by the candidate country and representatives of all existing EU countries; and (iii) it is ratified by the candidate country and every individual EU country, according to their constitutional rules.

Table C.1 shows the date of application, the accession date, as well as population for each NMS country.

TABLE C.1: NMS Countries Characteristics

	Date of Application	Accession Date	2004 Population
Cyprus	July 3rd, 1990	May 1st, 2004	1.01
Estonia	November 24th, 1995	May 1st, 2004	1.36
Hungary	March 31st, 1994	May 1st, 2004	10.11
Latvia	October 13th, 1995	May 1st, 2004	2.26
Lithuania	December 8th, 1995	May 1st, 2004	3.34
Malta	July 3rd, 1990	May 1st, 2004	0.40
Poland	April 5th, 1994	May 1st, 2004	38.18
Czech Republic	January 17th, 1996	May 1st, 2004	10.20
Slovakia	June 27th, 1995	May 1st, 2004	5.37
Slovenia	June 10th, 1996	May 1st, 2004	2.00

Notes: 2004 population (in millions) from the World Bank World Development Indicators. Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship.

C.1.1 Migration Policies

The new members states had to comply with the fundamental principles of the European Union. Article 6 of the Treaty on the European Union states that "The Union is founded on the principles of liberty, democracy, respect for human rights and fundamental freedoms, and the rule of law, principles which are common to the member states." The freedom of movement of workers is considered as one of the four fundamental freedoms guaranteed by EU law (*acquis communautaire*), along with the free movement of goods, services, and capital.[1] EU law effectively establishes the right of EU nationals to freely move to another member state, to take up employment, and reside there with their family members, as well as protects against any possible discrimination, on the basis of nationality, in employment-related matters.

[1] As effectively and concisely defined by Article 45 (ex Article 39 of the Treaty Establishing the European Community) of the Treaty on the Functioning of the European Union, the freedom of movement of workers entails "the abolition of any discrimination based on nationality between workers of the member states as regards employment, remuneration and other conditions of work and employment", (Council of the European Union, 2012).

The Accession Treaty of 2003 ((European Union, 2003)) allowed the "old" member states to temporarily restrict—for a maximum of 7 years—the access to their labor markets to citizens from the accessing countries, with the exception of Malta and Cyprus.[2] These temporary restrictions were organized in three phases according to a 2+3+2 formula: During an initial period of 2 years (May 1st, 2004 to April 30th, 2006), member states, through national laws, could regulate the access of workers from all new member states, except Malta and Cyprus; member states could then extend their national measures for an additional 3 years (until April 30th, 2009), upon notification to the European Commission; an additional extension for other 2 years was possible in case the member state notified the European Commission of a serious disturbance in its labor market or threat thereof.[3] The transitional arrangements were scheduled to end irrevocably seven years after accession—i.e. on April 30th, 2011.

Figure C.1 shows the set of bilateral arrangements before the 2004 enlargement (Panel a), and during each of the three phases (Panels b, c, and d). A blue cell means that there are no restrictions in place in flowing from the origin to the destination country, i.e. EU law on free movement of workers apply. A yellow (mixed blue-yellow) cell means that some restrictions are in place during (part of) the phase.

Before 2004. Panel (a) shows that, before the 2004 enlargement, workers could flow freely within the EU-15 member states but not between EU-15 and NMS as

[2]These restrictions could only be applied to workers but not to the self-employed. They only applied to obtaining access to the labor market in a particular member state, not to the freedom of movement across member states. Once a worker has been admitted to the labor market of a particular member state, Community law on equal treatment as regards remuneration, social security, other employment-related measures, and access to social and tax advantages is valid.

[3]The EU-25 member states that decide to lift restrictions can, throughout the remainder of the transitional period, be able to reintroduce them, using the safe-guard procedure set out in the 2003 Accession Treaty, should they undergo or foresee disturbances on their labor markets. Notwithstanding the restrictions, a member state must always give preference to EU-2 (Malta and Cyprus) and EU-8 workers over those who are nationals of a non-EU country with regard to access to the labor market.

well as between NMS countries.

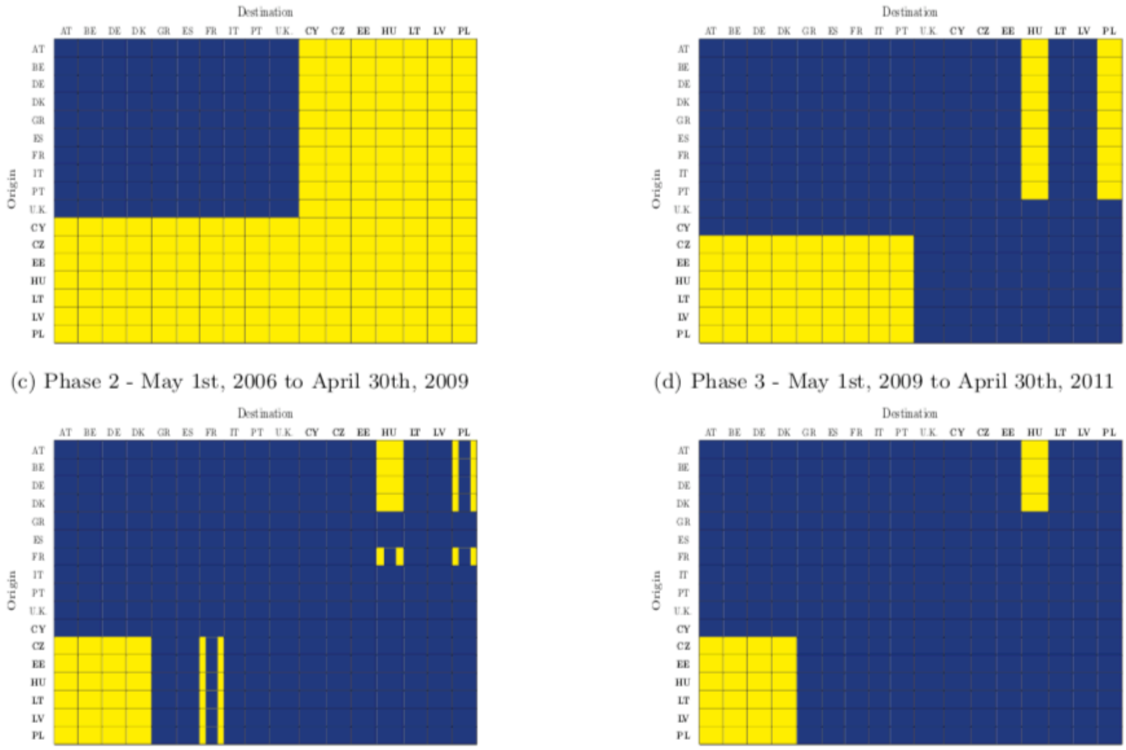
Phase 1. On May 1st, 2004, the U.K. (together with Ireland and Sweden) opens its borders to NMS countries, which reciprocate by opening their borders to British citizens. All the other EU-15 countries keep applying restrictions to NMS countries, except to Cyprus and Malta. All NMS countries decide to open their border to EU-15 member states, except for Hungary, Poland, and Slovenia which apply reciprocal measures. Finally, NMS countries lift all restrictions among each others.

Phase 2. On May 1st, 2006, Greece, Portugal, and Spain, followed by Italy on July 27th, lift restrictions on workers from EU-8 countries. As a consequence, Hungary and Poland drop their reciprocal measures towards these four member states. Slovenia lifts its reciprocal measures on May 25th, 2006, Poland on January 17th, 2007, while Hungary simplifies its reciprocal measures on January 1st, 2008. During phase 2, The Netherlands (on May 1st, 2007), Luxembourg (on November 1st, 2007), and France (on July 1st, 2008) also lift restrictions on workers from EU-8 countries.

Phase 3. Belgium, Denmark, Germany and Austria keep restricting access to their labor markets under national law. Hungary applies (simplified) reciprocal measures, limiting access to its labor market for workers from EU-15 member states that restrict the access of Hungarian workers.

Belgium and Denmark opened their labor market to NMS countries on May 2009, while Austria and Germany opened their labor markets at the end of the transitional period, on May 2011.

FIGURE C.1: Migration restrictions: transitional arrangements between EU-15 and NMS



(a) Before the 2004 Enlargement

(b) Phase 1 - May 1st, 2004 to April 30th, 2006

(c) Phase 2 - May 1st, 2006 to April 30th, 2009

(d) Phase 3 - May 1st, 2009 to April 30th, 2011

Note: Origin countries on the rows, destination countries on the columns. EU-15 member states (AT, BE, DE, DK, GR, FR, IT, PT, U.K.) followed by NMS countries (CY, CZ, EE, HU, LT, LV, PL)) in bold. A blue cell means that there are no migration restrictions in place in flowing from the origin to the destination country, i.e. EU law on free movement of workers apply. A yellow (mixed blue-yellow) cell means that some migration restrictions are in place during (part of) the phase.

C.1.2 Trade Policies

New member states became part of the European Union Customs Union, and of the European common commercial policy.[4] The customs union implies that members apply the same tariffs to goods imported from the rest of the world,

[4]The customs union initiated with the Treaty of Rome in 1957, kick-started on July 1st 1968, and it is regulated by the Treaty on the Functioning of the European Union. The common commercial policy is also set down in the Treaty on the Functioning of the European Union.

and apply no tariffs internally among members.[5] The common commercial policy covers trade in goods and services, intellectual property rights, and foreign direct investment. As a consequence of the EU enlargement process, the new member states automatically entered into international trade agreements to which the EU is a party, and forwent their own existing agreements.[6]

C.2 Data

C.2.1 List of Countries

The sample includes 17 European countries and a constructed rest of the world (RoW). Of our 17 countries, 10 are pre-2004 EU members and 7 countries joined the EU in 2004. The list of pre-2004 EU members includes Austria, Belgium, Germany, Denmark, Spain, France, Greece, Italy, Portugal, and the United Kingdom while the new members are Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Latvia and Poland. Overall, these 17 countries cover about 91 percent of the population of the 25 members of the European Union in 2004.

We assign Ireland, The Netherlands, Malta, Sweden and Slovenia to the RoW aggregate because their EU-LFS country surveys do not contain sufficient information regarding the country of residence 12 months before the worker was interviewed. Specifically, Ireland does not provide information on the country of

[5]Once the goods have cleared customs, they can circulate freely or be sold anywhere within the EU customs territory. Import duties collected by customs remain an important source of income for the EU. In 2013, they represented nearly 11 percent of the EU budget, which amounts to §15.3 billion. Besides common tariffs, an important aspect of the customs union is the implementation of common and streamlined procedures across the union regardless of where in the EU the goods are declared. Reduced time, homogeneity of rules, and lower uncertainty can be significant factors in boosting trade relationships ((Hummels et al., 2007), (Hummels and Schaur, 2013), (Martincus et al., 2015), (Handley and Limao, 2015)).

[6]The entry of the new member states into the EU common commercial policy also had an impact in terms of bargaining power. While all the ten new EU member states were already part of the WTO before 2004, from 2004 on they participate to the WTO's activities through the European Commission. EU trade policy is in fact carried on by the European Commission, on behalf of the European Union, working closely with the member states and keeping informed the European Parliament.

origin for any year in the survey, making it impossible to construct migration flows from any country in the sample to Ireland. The country surveys for the Netherlands and Malta are available from 2006 and 2009 onward respectively, hence after the enlargement of the European Union. The case of Sweden presents two different problems: first, data before 2005 contain information on the country of residence 12 months before only if this is Sweden itself. Moreover, in 2005 and 2006 there is no information on the country of origin in the Swedish survey. Finally, in the Slovenian survey information on the country of origin is available from 2008 on only.

We also assign Bulgaria, Slovakia, Luxembourg, Romania and Finland to the RoW due to missing information on the nationality of the workers. More specifically, Romania has information on nationality only from 2004 onward, Bulgaria has no information on nationality before 2008, Slovakia has no information before 2003 while Finland does not distinguish the nationality of the countries involved in the 2004 enlargement from the nationality of Bulgaria and Romania, which entered the European Union in 2007.

C.2.2 Construction of the Data-set on Gross Migration Flows

Data on gross migration flows by country of origin, destination, nationality, skill, and year are constructed from the micro data of the European Labour Force Survey (EU-LFS). For each individual surveyed, the questionnaire reports the country in which the individual resided 12 months before—besides reporting the current country of residence, the year and week in which the individual was interviewed, and a sampling weight that makes the survey representative at the national level. We refer to the country in which the survey was carried out as "destination", and to the country in which the interviewed individual was living

12 months before as "origin". The questionnaire also reports information regarding the age, education, and nationality of the worker. We focus on individuals between 15 and 65 years old, and use the information reported to infer if the individual is a migrant—in case the country where she resides today is different from the one she was residing one year before—as well as the origin country, and the year of migration.

Frequency, Completeness, and Date of Migration

From 1983 to 1997, the European Labour Force Survey was conducted only in spring (quarter 1 or 2 depending on the country). Since 1998, the transition to a quarterly continuous survey (with reference weeks spread uniformly throughout the year) has been gradually conducted by member states. Some countries first introduced a continuous annual survey (meaning the reference weeks were uniformly distributed throughout the spring quarter) and then switched to a quarterly collection, whereas others moved directly to a quarterly continuous survey. For simplicity, we make every survey continuous quarterly. We emphasize that the reason for doing this is just practical. The procedure outlined below does not affect our results in any way since our analysis is carried on at the destination-origin-nationality-skill-year level and the procedure operates instead at the intra-annual level.

1. For each survey we count the number of weeks in which interviews were carried on.

2. We multiply the sampling weight associated to each interview by the number of weeks covered in the survey and divide by 52.

3. We compute a representative week by averaging out the sampling weight associated to each interview, by destination, origin, and year.

4. We assign the representative week to any week not originally covered by the survey, thereby ending up with 52 weeks for each country of destination and year.

We make three further corrections to the EU-LFS survey. First, in a minority of instances in some surveys—about 1.8 percent of the individuals, once accounting for sampling weights—interviewed individuals could, instead of indicating the specific country of origin, refer to a broad group.[7] When the broad group is “European Union (EU-15)” we re-assign individuals to each individual EU-15 country proportionally, by destination and year, on the basis of all the other observations in which information on the specific country of origin is available. When the broad group is either “Other European Economic Area", "Other Central and Eastern Europe", or "Other Europe" we re-assign individuals to each individual NMS country proportionally, by destination and year, on the basis of all the other observations in which information on the specific country of origin is available. When the broad group is “Other or stateless” we re-assign, by destination and year, individuals to the RoW. When the country of origin is missing we re-assign individuals to all other countries proportionally, by destination and year, on the basis of all the other observations in which information on the specific country of origin is available.

Second, for a few destination-origin-year-months the information is not complete. In those cases, we use a standard interpolation procedure when the missing information is between two years in which we have data, or backward projection if the missing year is at the beginning of the series.[8] Since the analysis carried

[7] This can also happen because of confidentiality concerns, which may differ on a country-by-country basis due to national legislation, especially before the country joins the European Union.

[8] Interpolation is performed for the U.K. in 2008, and France in 2003, 2004 and 2005. Backward projection is used for Latvia in 2001, 2002 and 2003, Czech Republic in 2001, Italy in 2001, 2002, 2003, and 2004, Slovakia in 2001 and 2002.

TABLE C.2: Nationality mapping - before 2004

Code	Label	EU-15 survey	NMS8 survey
		Before 2004	
0	Nationals	EU-15	NMS8
111	EU-15	EU-15	EU-15
911	Non EU-15	NMS8 or other **	NMS8 or other **
800	Non-National/Non-Native *	EU-15, NMS8 or other **	EU-15, NMS8 or other *
		After 2004	
0	Nationals	EU-15	NMS8
1	EU-15	EU-15	EU-15
2	NMS10	NMS8	NMS8
Multiple codes	Other categories	Other	Other

Notes: * Non-National/Non-Native in case the distinction EU/Non-EU is not possible
** NMS8 using levels of "other" flows based on 2004-8 data, residual belongs to "other"

on in the paper refers to the 2002-2007 period and some of the destination-origin-year-months with incomplete observations refer to countries that we drop from the analysis, the potential impact of the interpolations and projections on the results is even smaller.

Third, the survey does not report the exact date of migration but only the country in which the interviewed individual was living 12 months before. In other words, an individual that is interviewed in April of 2006 in the United Kingdom and declares that 12 months before she was living in Poland could have migrated out of Poland any time in the previous 12 months. Therefore, we spread the sampling weight associated to this individual to the previous 12 months.

Nationality

The EU-LFS contains information on the nationality of the interviewed individuals. However, mainly because of country-specific privacy regulations, the variable “nationality” has different categories before and after 2004. Specifically, before 2004 the variable “nationality” takes only four values: "Nationals" (code 0), "EU-15" (code 111), "Non EU-15" (code 911), and "Non-National/Non-Native" (code 800) in case the distinction EU-15/Non-EU-15 is not available. After 2004, the category "Non EU-15" has been expanded to distinguish between "New member states NMS10" (code 2) and other countries or groups of countries we will refer to as "other categories". Our goal is to create the following three nationality categories: "EU-15", "NMS10" and "Other". In order to do so we have to redistribute individuals from the "Non EU-15" category before 2004 into "NMS10" and "Other", as well as redistribute individuals from the "Non-National/Non-Native" category before 2004 into "EU-15", "NMS10" and "Other". We now describe the procedure to construct the nationality dimension of our migration data.[9]

In order to construct the nationality we need to deal with the *number* of people with nationality "Other" (different from EU-15 and NMS nationals). We assume that the accession of NMS countries does not affect the flow of "other" nationals within the EU28. For every destination and origin country pair, and for every year, we compute the number of "other" nationals for the period 2004 onward. We then take the simple average—at the destination-origin level— over the period 2004-2008 and we subtract it to the codes 800 and 911 before 2004.[10] In practice, we do the following:

1. For the 800 group, we do a preliminary step: we split the 800 group in EU-15 and non EU-15 nationals using the average 2004-2008 shares of nonEU-15 within non-natives. In practice, we do the following: consider an 800 observation—for a given destination-origin-year-week—with weight x: the number of successes, n, from a Binomial with probability equal to the average share described above and number of experiments equal to x is the number

[9]After 2004, the surveys for Latvia report the category NMS13 instead of distinguishing between NMS10 and NMS3. When creating nationalities described below, we use NMS13 in place of NMS10 for Latvia.

[10]For destination-origin pairs that appear before 2004 but not after, we assign, for each destination, the average share across all origins. Note that in more than 99 percent of the cases this happens when country of origin is missing.

of "nonEU-15" associated to the observation. Then, $x - n$ is the number of EU-15 associated to the observation. In other words, we assume that each person summarized by the observation has an equal and independent probability of being "nonEU-15". Note that it is important to apply a Binomial to each observation because we want to preserve the information regarding the reference week. We will use this information later on when we compute the emigration shares.

2. Then, for every 911 and 800-turned-nonEU-15 observation, we apply a similar procedure to split between NMS8 and "other" nationals. In practice, we do the following:

   (a) We compute the average number of "Other" post 2004 *divided by the sum of the weights of the 911 and 800-turned-nonEU-15 observations*.

   (b) We consider one of the 911 or 800-turned-nonEU-15 observations—for a given destination-origin-year-week—with weight x: the number of successes, n, from a Binomial with probability equal to the average share described in (a) and number of experiments equal to x is the number of "other" associated to the observation. Then, $x - n$ is the number of NMS8 nationals associated to the observation. In other words, we assume that each person summarized by the observation has an equal and independent probability of being "other". Note that, here as well, it is important to apply a Binomial to each observation because we want to preserve the information regarding the reference week. We will use this information later on when we compute the emigration shares.

We define 3 nationalities, "EU-15", "NMS10" and "Other" based on table C.2.

The Case of Poland The variable nationality for Poland is available only since 2004 and it only includes three codes: 0 "National / Native of own Country", 5 "EU28", and 8 "Europe outside EU28". In order to separate EU-15 from NMS10 nationals, we construct an alternative nationality variable for Poland applying the origin-year-specific shares of EU-15, NMS10, and Other nationals computed for Hungary to the survey for Poland. We choose Hungary as a reference because, just like Poland and unlike other NMS countries, it applies reciprocal measures to EU-15 nationals. Poland lifted the reciprocal measures on January 1st, 2007, while Hungary simplified the reciprocal measures on January 1st, 2008.

Education

The EU-LFS contains information on the education level of the interviewed individuals. Each individual is assigned an education level according to the International Standard Classification of Education (ISCED 1997). We use the ISCED classification to split individuals into two education levels, defining as high-skilled all the individuals with at least tertiary education. We assign to the low-skilled group the residual workers with education up to post secondary non-tertiary education. When information on education is missing, we proceed as follows: if in a destination-origin-year-week we only observe individuals with either high skill (low skill) or missing education, we assume all the individuals with missing education to be low-skilled (high-skilled). If in a destination-origin-year-week we observe individuals with high skill, low skill and missing education, we proportionally split the missings to high and low skill. Finally, if for a destination-origin-year-week we do not have any information on education, we proportionally assign education using the average annual shares of high and low skill migrants for that same destination-origin-year or destination-origin.

Stocks and Flows

Our goal is to construct a data set of migration flows that is internally consistent. Let's consider a given nationality-skill pair. For each country-sector-year pair (i, v, t) we potentially have two separate measures of the stock of individuals: the first measure comes directly from the EU-LFS (i, t) survey; the second measure can be constructed from the set of EU-LFS $\{(i, t+1)\}_i$ surveys for the following year. For example, the Polish survey of 2006 provides a measure of the number of low-skill NMS nationals working in sector v in Poland in 2006. However, another measure can be constructed using the surveys for all countries in 2007—including the survey for Poland—reporting immigrants that were working in sector v in Poland the year before. Let's define the first measure as $S_{06}^{PL,v}$ and the second measure as $\tilde{S}_{06}^{PL,v}$. If $S_{06}^{PL,v} > \tilde{S}_{06}^{PL,v}$ we can conjecture that the difference $\left(S_{06}^{PL,v} - \tilde{S}_{06}^{PL,v}\right)$ captures migrants from Poland to the RoW. To the contrary, if $S_{06}^{PL,v} < \tilde{S}_{06}^{PL,v}$ we can replace $S_{06}^{PL,v}$ with $\tilde{S}_{06}^{PL,v}$, and adjust the migration flows between $t-1$ and t accordingly. The following algorithm captures this idea.

1. Consider a given nationality, skill level, time interval $t \in [0, ..., T]$, and set of countries $i \in \{EU, NMS, ROW\}$ where EU is the set of our 10 EU countries, NMS is the set of our 7 NMS countries, and ROW is a residual set of countries (that must be commonly defined in each survey).

2. Let $S_t^{i,v}$ be the stock of people in country i-sector v-year t according to country i survey in year t. Let $F_{t-1,t}^{ijuv}$ be the flow of migrants from sector u in country i to sector v in country j between $t-1$ and t according to country j survey in year t.

3. Consider $t = T$.

   (a) For each country and sector iu in $t = T-1$, it must be the case that either

i. $S^{iu}_{T-1} > \sum_j \sum_v F^{ijuv}_{T-1,T}$ (the stock is higher than the sum of the outflows) or

ii. $S^{iu}_{T-1} < \sum_j \sum_v F^{ijuv}_{T-1,T}$ (the stock is lower than the sum of the outflows).

(b) In the first case, we assume that the difference between the stock and the flows represents migration from i to ROW. In order to determine the sector of destination we use the average matrix for all other destinations, i.e.

$$\tilde{F}^{iROWuv}_{T-1,T} = \left(S^{iu}_{T-1} - \sum_j \sum_v F^{ijuv}_{T-1,T} \right) \sum_{j \neq ROW} \left[\left(F^{ijuv}_{T-1,T} / \sum_v F^{ijuv}_{T-1,T} \right) \right] /17$$

for all v. Housekeeping: We also set $\tilde{F}^{ijuv}_{T-1,T} = F^{ijuv}_{T-1,T}$ for all $j \neq ROW$, and $\tilde{S}^{iu}_{T-1} = S^{iu}_{T-1}$.

(c) In the second case:

i. We trust the flows and update the stock in $T-1$, i.e. we set $\tilde{S}^{iu}_{T-1} = S^{iu}_{T-1} + \left[\left(\sum_j \sum_v F^{ijuv}_{T-1,T} \right) - S^{iu}_{T-1} \right]$;

ii. We also update the inflows, between $T-2$ and $T-1$ to be consistent with the new stock $\tilde{S}^{jv}_{T-1}$. We do so by assigning the difference between $\tilde{S}^{jv}_{T-1}$ and S^{jv}_{T-1} to inflows from ROW. In order to determine the sector of origin we use the average matrix for all other countries of origin, i.e.

$$\tilde{F}^{ROWjuv}_{T-1,T} = \left(\tilde{S}^{jv}_{T-1} - S^{iv}_{T-1} \right) \sum_{i \neq ROW} \left[\left(F^{ijuv}_{T-1,T} / \sum_u F^{ijuv}_{T-1,T} \right) \right] /17$$

for all u. Housekeeping: We also set $\tilde{F}^{ijuv}_{T-1,T} = F^{ijuv}_{T-1,T}$ for all $j \neq ROW$, and $\tilde{F}^{iROWuv}_{T-1,T} = 0$ for all uv.

(d) Housekeeping: we set $\tilde{S}^{iv}_{T} = S^{iv}_{T}$ for all $i \neq ROW$.

4. Consider now $t = T - 1$ and loop back to point 3.

After having performed the algorithm described above, we have the flows of migrants for each pair of countries-sectors as well as the stock of people in each country, sector, and year, but we do not have information on the stock of people in the RoW, as well as their distribution across sectors. We use information on population levels and on the share of population between 15 and 64 years old from the World Bank World Development Indicators database to construct the stock of people in the rest of world in 2002.[11] We further use the average year-nationality-skill-sector share from our 17 countries (EU members plus NMS countries) and apply them to the RoW population to split people in the relevant groups for our analysis.

Some destination-origin-nationality-skill-year sequences of migration flows consists in sequences of zeros followed by positive values. While sequences of tiny values followed by larger flows do not represent an issue, sequences of zeros followed by positive values cannot be handled by the model. We perform the following procedure to, essentially, replace zeros with small positive values. We start from the stock of individuals in 2002, which includes three zeros: high skill EU nationals in Estonia and Latvia, and low skill EU nationals in Lithuania. We compute the average ratio of low to high skill EU nationals across NMS countries and apply the (inverse) ratio to the stock of high (low) skill to turn the zeros into positive values. Then we consider the migration shares and set them to be equal to the average migration share by year, nationality and skill group across countries if the migration share is equal to zero. In case the average migration share is missing, we compute the average across years. At the end of this procedure, we use the new migration shares and the new stock for 2002 to recompute the stocks

[11] Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. The values used are midyear estimates.

and flows by skill, nationality, origin, destination and year. At the end of the procedure described above, we have a set of flows of workers by country of origin, destination, nationality and skill in each year and a consistent set of stocks. We perform a number of checks that confirm that the share of population by destination, as well as the change in the share of population between 2002 and 2007, again by destination, is not significantly affected.

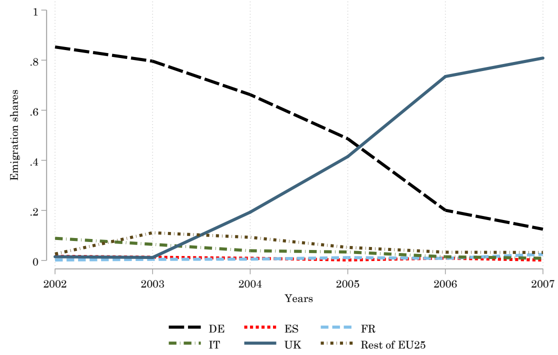
Migration Data Checks

In this appendix, we provide some external validation for our constructed gross migration data. First, we compare the final migration data set with the raw data in terms of (i) the share of each country population relative to the aggregate population, and (ii) the ratio between low and high skill workers. In terms of the share of each country population relative to the aggregate population we find that the correlation between the raw and final data is 0.998 in 2002, the first year in the sample. The correlation between the 2002-2007 changes of the same shares is 0.542. In terms of the ratio of low to high skill workers, the cross-country correlation between the raw and final data is 0.996, while the correlation between the 2002-2007 changes is 0.865. Overall, we conclude that the data comparison in terms of population shares and skill ratio is quite satisfactory.

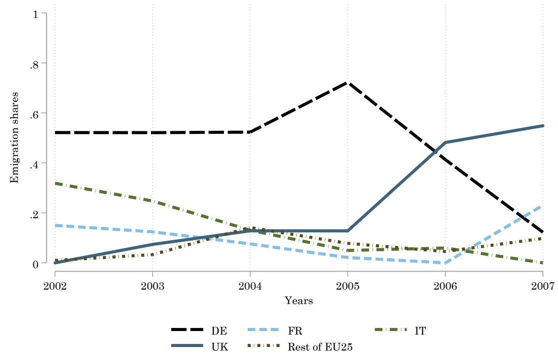
Second, we compare the migration data set with migration information coming from alternative data sources: Statistics Denmark and the UK Office for National Statistics. As mentioned above, it is not easy to find accessible and comparable migration data. The UK is of particular interest given the role it played in the 2004 EU enlargement, while Denmark is particularly well known for collecting precise statistical information. We find that the correlation between the immigration shares into Denmark, by year and country of origin, based on Statistics Denmark information and based on our data is 0.79 for the 2003-2007 period.

FIGURE C.2: Top migration destinations from Poland, share of NMS nationals by skill, 2002-2007

(A) Low skill



(B) High skill



Note: These figures show the migration share out of Poland for low-skill and high skill NMS nationals for the top 3 migration destinations in 2002 or 2007, plus the aggregate share for all other EU countries.

The correlation between the UK Office for National Statistics aggregate inflow of migrants from NMS and the inflow based on our data is 0.93 for the 2003-2007 period.[12]

[12]Denmark: Statistics Denmark series on immigration by sex, age, citizenship, country of last residence and time are published in the StatBank, INDVAN time series. These data include persons who took up residence in Denmark and who had resided abroad before. The data come from the CPR, the central population register. We select people between 15 and 64 years, aggregate the data by year and country of origin, and build immigration shares by dividing by the corresponding Denmark population from the World Bank World Development Indicators database. UK: We use the UK Office for National Statistics "Revised Net Long-Term International Migration" time series. These data include long-term migrants, i.e. those that change their usual country of residence. The primary data source is the International Passanger Survey (IPS), a continuous voluntary survey conducted at all principal air and sea routes and the channel tunnel. Slovenia and Slovakia are included in the UK Office for National Statistics sample but not in our data, while Cyprus is included in our data but not in the UK Office for National Statistics sample.

Finally, we use our migration data set to investigate a number of specific migration patterns that have either been documented in the literature, or that have been prominently featured in the press and are part of the public awareness. We focus on three migration routes: (i) from Poland to Germany/UK, (ii) Portugal to France, and (iii) Italy to Germany/France/UK. The 2011 German Census reports that about 2.7 million people whose country of birth is Poland live in Germany.[13] While Germany has been, for several reasons throughout history, the main European destination for Polish emigrants, (Dustmann et al., 2015) notes that ”Whereas Germany was the main destination in 1997, absorbing about 27 percent of the Polish emigrant population, the largest destination country in 2007 was the UK (with 31 percent of all emigrants).”[14] Figure C.2, using our data on migration flows, clearly shows the leapfrogging of Germany by the UK in terms of main European destination for emigration, both for low-skilled and high-skilled NMS nationals. Just like for Poland, a large fraction of the Portuguese population lives abroad, and France has traditionally been the main European destination for Portuguese migrants.[15] The 2011 French Census reports that about 6 percent of the Portuguese population lives in France. After France, the other top four countries in terms of Portuguese-born people in 2011 are Spain, Luxembourg, Germany, and Belgium. Our data set on gross flows of migrants for the 2002-2007 period confirms this ranking. The third case we consider features another country which has experienced throughout history large outflows of population: Italy. According to the 2011 Italian Census, the top four countries in terms of stock of Italian-born population are France, Germany, Switzerland,

[13]The 2011 Population and Housing Census marks a milestone in census exercises in Europe. For the first time, European legislation defined in detail a set of harmonized high-quality data from the population and housing censuses conducted in the EU Member States.

[14]The figures mentioned in (Dustmann et al., 2015)’s quote come from the Polish Labour Force Survey, a rotating quarterly panel conducted in Poland by the Polish Central Statistical Office. The survey registers the country of present residence for individuals who are part of the household but who have been residing abroad for more than 3 months.

[15]The New York Times article “Pictures Tell the Story of Portuguese in France” captures the importance of the Portuguese presence in France in the 1960s.

and the United Kingdom. Once again, with the exclusion of Switzerland our data is entirely consistent with the information coming from the census.

C.2.3 Bilateral Trade

The bilateral trade flows between each state in the sample are computed using information from the WIOD database ((Timmer et al., 2015a)). We keep the set of countries consistent with the migration data and we pool all the remaining countries in the rest of the world. Values are in US dollars at current prices.

Table C.3 shows the share of NMS, EU-15, and Rest of the World, into either NMS or EU-15 imports or exports. The table points to three patterns. First, the larger trade integration among NMS countries, whose average weight into imports or exports increases by 60 and 50 percent, respectively within 5 years. Second, the larger weight of NMS in EU-15's trade, which increases by about 30 percent, within 5 years. Third, both EU-15 and NMS countries tend to trade more with the Rest of the World, and less with EU-15 countries themselves. All patterns are consistent with the reductions in tariffs, between EU-15 and NMS, among NMS countries, and between EU and the Rest of the World discussed in Section 3.2.2.

Tariffs

The bilateral tariff data are constructed using the information in the WITS database. We use effectively applied rates and we combine information from two different datasets, the TRAINS data set and the WTO data set; the two datasets are compatible because TRAINS combines information from different sources, among which WTO data. We start from the TRAINS data set, which is the most complete of the two and we proceed as follows to make the series complete:

TABLE C.3: Imports and exports shares, EU-15 and NMS, 2002 and 2007

Imports shares

	NMS importing from:			*EU-15 importing from:*		
	Other NMS	EU-15	RoW	NMS	Other EU-15	RoW
2002	5.7	52.6	41.7	3.9	46.9	49.2
2007	9.1	48.0	43.0	5.2	42.3	52.5
Change	+3.4	-4.6	+1.3	+1.3	-4.6	+3.3

Exports shares

	NMS exporting to:			*EU-15 exporting to:*		
	Other NMS	EU-15	RoW	NMS	Other EU-15	RoW
2002	6.2	54.6	39.2	3.8	43.8	52.4
2007	9.3	50.1	40.6	4.9	40.8	54.3
Change	+3.1	-4.5	+1.4	+1.1	-3.0	+1.9

Notes: This table shows the weighted average imports and exports shares for NMS and EU-15 countries. Averages have been constructed using the WTO and TRAINS tariff data, as described in Section 3.4 and Appendix C.2.3, using the same set of ten EU-15 countries and seven NMS countries as in our data set on gross migration flows. The remaining countries are aggregated into the Rest of the World (RoW).

1. Use average EU-25 tariff applied to NMS8 to replace missing tariff when the destination country of the exported good is a EU-15 country and the origin belongs to the NMS8 group.

2. Use average EU27 tariff applied to NMS2 to replace missing tariff when the destination country of the exported good is a EU-15 country and the origin country belongs to the NMS2 group.

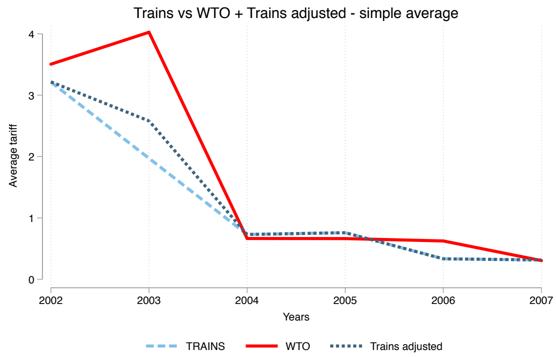
3. If the two criteria above do not fill the missing cells:

   (a) Use WTO values to impute Trains values if WTO is not missing

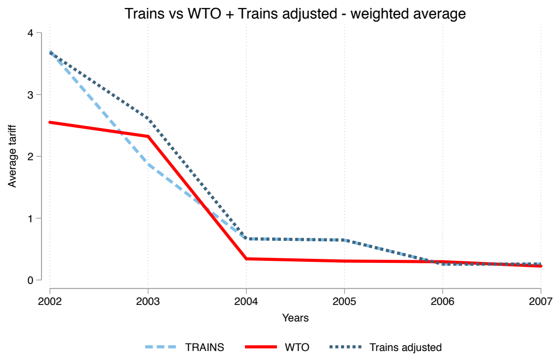
   (b) Missing values for 2003 are replaced with values from 2002. This could happen because some NMS lowered their tariff before the formal access to the European Union. We do not replace the missing values with

FIGURE C.3: Tariffs data

(A) Simple average



(B) Weighted average



zeros, but we impute the non-zero value of the previous year.

(c) If we have missings in one year, we interpolate using the values of the year before. This is the case for Lithuania in 2000.

(d) If all the values for a country are missing, we construct an average tariff of similar countries and impute that value. This is the case for Latvia for which we do not observe tariffs when exporters goods abroad; we thus use the average tariffs applied to the exports of Lithuania and Estonia.

We follow the same procedure using simple tariffs and weighted tariffs—where weights are given by the amount of exports—and we obtain two complete sets of tariffs for each country in our sample over time.

Figure C.3 reports the comparison among the simple and weighted average TRAIN tariff, the WTO tariff, and the tariff we construct using the methodology described above.

C.2.4 Real Wages Share of Labor Compensation in Value Added

We compute the share of labor compensation in value added at the national level using information from the socio economic accounts in the WIOD database. To construct the series of real wages we use the information on the price levels of the countries in our sample from the Penn World Tables. We use the variable "Price level of CCON, equal to the PPP (ratio of nominal CON to CCON) divided by the nominal exchange rate (National currency per USD)" which in other words is just the ratio of expenditure at local prices to that at reference prices measured in the currency of the base country—in our case the US.

Because the PPP is in units of the currency of country j per unit of the currency of the base country, it is common to divide it by the nominal exchange rate to obtain what is called the "price level" of country j (see (Feenstra et al., 2015)). Moreover, we the WIOD database provides also information on the employment level of each country over time, which constitutes the denominator of the formula for real wages.

C.2.5 Portuguese Matched Employer-Employee Data

Employer-employee data come from *Quadros de Pessoal*, a longitudinal data set matching virtually all firms and workers based in Portugal.[16] Reported data

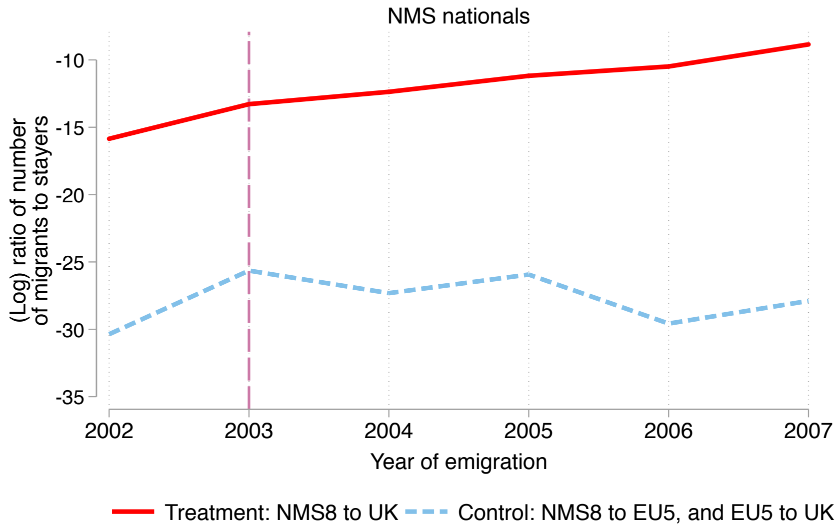
[16] Public administration and non-market services are excluded. *Quadros de Pessoal* has been used by, among others, \cite{Cabral03} to study the evolution of the firm size distribution; by \cite{Blanchard01} to compare the U.S. and Portuguese labor markets in terms of unemployment duration and worker flows; by \cite{Cardoso05} to study the determinants of both the contractual wage and the wage cushion (difference between contractual and actual wages); by \cite{Carneiro12} who, in a related study, analyze how wages of newly hired workers and of existing employees react differently to the business cycle; by \cite{Martins09c} to study the effect

cover the firm itself, as well as each of its workers. Each firm and each worker entering the database are assigned a unique, time-invariant identifying number which can be used to follow firms and workers over time.

Currently, the data set collects data on about 350,000 firms and 3 million employees. Each year, every firm with wage earners is legally obliged to fill in a standardized questionnaire. Reported data cover the firm itself, each of its plants, and each of its workers. The worker-level data cover information on all personnel working for the reporting firms in a reference week. They include information on gender, age, occupation, schooling, hiring date, earnings, hours worked (normal and overtime), etc. The information on earnings includes the base wage (gross pay for normal hours of work), seniority-indexed components of pay, other regularly paid components, overtime work, and irregularly paid components.[17] It does not include employer's contributions to social security.

The administrative nature of the data and their public availability at the workplace—as required by the law—imply a high degree of coverage and reliability. The public availability requirement facilitates the work of the services of the Ministry of Employment that monitor the compliance of firms with the law (e.g., illegal work).

FIGURE C.1: Log odds of migrating to the U.K. vs. staying in a NMS country for NMS nationals, treatment and control flows, 2002-2007



Note: Treatment flows in solid red, control flows in dashed blue. The pink vertical dashed line marks the beginning of the treatment period.

C.3 Change in Migration Costs: Placebo Plots and Residual Cases

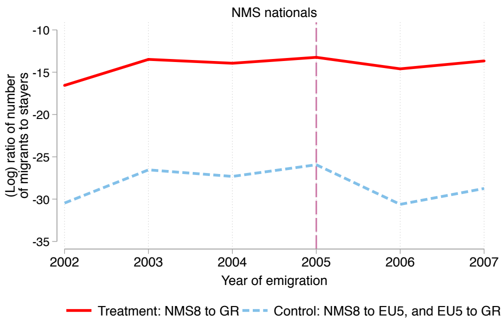
In Section 3.4.1, we described the methodology used to identify changes in migration costs for the main events in our sample period: the United Kingdom opening to NMS countries in 2004, followed by Greece, Italy, Spain, and Portugal in 2006, and NMS countries opening their respective labor markets to each other and (mostly) to EU-15 countries in 2004. We also ran a number of placebo experiments to support our identification strategy. In this appendix we provide additional support for the identification strategy by showing, in sub-appendix

of employment protection on worker flows and firm performance. See these papers also for a description of the peculiar features of the Portuguese labor market.

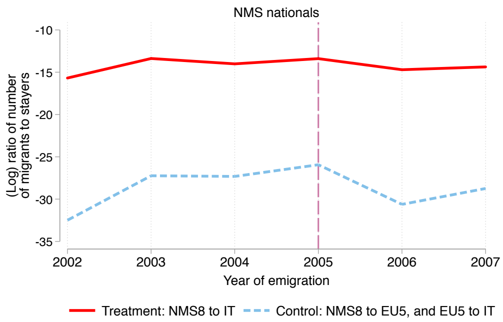
[17]It is well known that employer-reported wage information is subject to less measurement error than worker-reported data. Furthermore, the Quadros de Pessoal registry is routinely used by the inspectors of the Ministry of Employment to monitor whether the firm wage policy complies with the law.

FIGURE C.2: Log odds of migrating to Greece/Italy/Spain/Portugal vs. staying in a NMS country for NMS nationals, treatment and control flows, 2002-2007

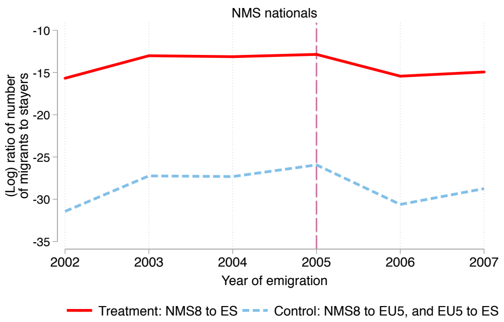
(A) Greece



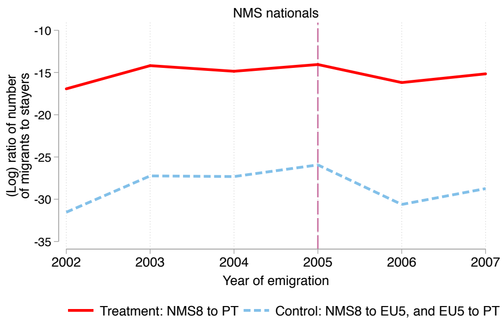
(B) Italy



(C) Spain



(D) Portugal



Note: Treatment flows in solid red, control flows in dashed blue. The pink vertical dashed line marks the beginning of the treatment period.

C.3.1, a series of plots that allow to evaluate the common trend assumption. Sub-appendix C.3.2 reports similar plots for the placebo experiments.

C.3.1 Common Trend Assumption

Figure C.1 shows the evolution over time of the (log) odds of migrating vs. staying (equation 3.10) for the treated and control groups of NMS nationals. The treated group is represented by the NMS to U.K. flow of NMS nationals, with the treatment period being after 2003. The control group is represented by the NMS to EU-5 and EU-5 to U.K. flows of NMS nationals. The figure clearly conveys two messages: First the odds for both the treated and control groups were increasing before the 2004 enlargement; second, when comparing the pre-treatment and treatment periods, the change in the odds of migrating is clearly positive for the treated group and close to zero for the control group. These patterns are consistent with a substantial reduction in migration costs from NMS to the United Kingdom.

Turning to the southern European destinations, Figure C.2 reports the evolution of the (log) odds for Greece, Italy, Spain, and Portugal—with the treatment period being after 2005. Overall, the comparison between the log odds of the treatment and the control groups before the policy changes confirms that the control groups represent a good measure of counterfactual log odds in the absence of a policy change. Except for the case of Greece, the odds of migrating vs. staying decreases, from the pre-treatment to the treatment period, both for the control and the treated groups *but significantly less for the latter*, pointing to a positive contribution associated to a reduction in migration costs.

C.3.2 Placebo Experiment

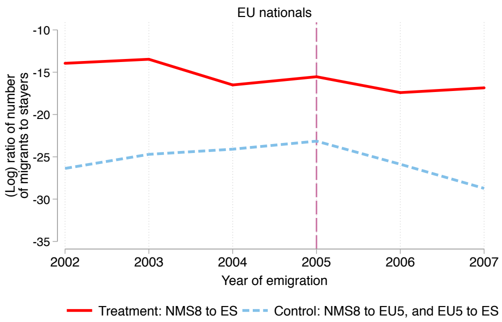
As shown in Section 3.2.1, a placebo experiment confirms the prior that EU nationals did not experience any significant change in the cost of migrating back to Europe from NMS countries. Figure C.3 reports the evolution of the (log) odds for the treated and control groups.

C.4 International Migration Elasticity

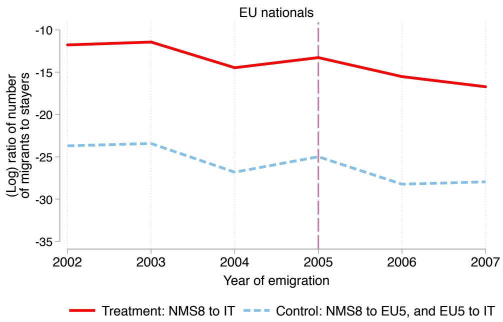
In this appendix we describe in detail the estimation method used to find the international migration elasticity in Section 3.4.2. We estimate the international migration elasticity, $1/\nu$, by adapting the method presented in (Artuç and McLaren,

FIGURE C.3: Log odds of migrating vs. staying for EU nationals (Placebo), from NMS countries to Greece/Italy/Spain/Portugal, treatment and control, 2002-2007

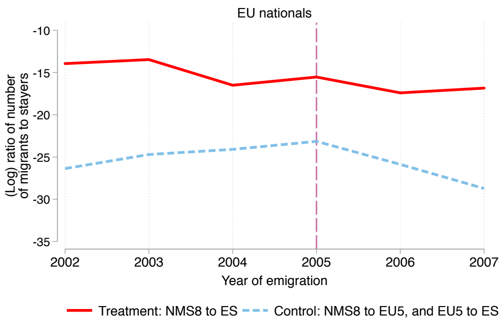
(A) Greece



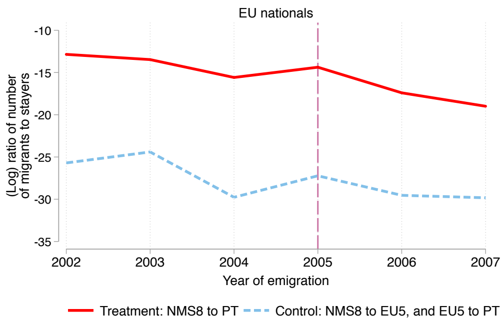
(B) Italy



(C) Spain



(D) Portugal



Note: Treatment flows in solid red, control flows in dashed blue. The pink vertical dashed line marks the beginning of the treatment period.

2015) to our theory and data. The method has two stages: first the Poisson regression stage where we estimate value differences and the migration cost function, normalized by ν, for every time period. Second, the Bellman equation stage, where we insert the estimated value differences into a Bellman equation and construct a linear regression to retrieve the international migration elasticity, $1/\nu$.[18]

[18]Since we estimate the elasticity using only flows of EU nationals within EU-15 we drop the n subscript.

The estimation method relies on the following two equilibrium conditions from the model: the migration share equation

$$\mu_{t,s}^{ij} = \frac{\left[\exp\left(\beta V_{t+1,s}^{j} - m_{t,s}^{ij}\right)\right]^{1/\nu}}{\sum_{k=1}^{N}\left[\exp\left(\beta V_{t+1,s}^{k} - m_{t,s}^{ik}\right)\right]^{1/\nu}}, \tag{C.1}$$

and the Bellman equation

$$\begin{aligned} V_{t,s}^{i} = \log\left(C_{t,s}^{i}\right) + \nu \log\left[\sum_{k=1}^{N}\left[\exp\left(\beta V_{t+1,s}^{k} - m_{t,s}^{ik}\right)\right]^{1/\nu}\right] = \\ = \log\left(w_{t,s}^{i}/P_{t}^{i}\right) + \beta E_t V_{t+1,s}^{i} + \Omega_{t,s}^{i}, \end{aligned} \tag{C.2}$$

where

$$C_{t,s}^{i} = \frac{w_{t,s}^{i}}{P_{t}^{i}}$$

is the consumption aggregator, and

$$\Omega_{t,s}^{i} = \nu \log \sum_{k=1}^{N}\left[\exp\left(\beta\left(V_{t+1,s}^{k} - V_{t+1,s}^{i}\right) - m_{t,s}^{ik}\right)\right]^{1/\nu}$$

is the option value of migration.

First stage: Poisson regression The first stage is a fixed-effect estimation—based on the migration share equation and bilateral gross migration flows data—to estimate value differences and the migration cost function normalized by ν.

The estimating equation can be derived as follows. In the migration share equation (C.1), multiply both numerator and denominator on the right hand side by $\left[\exp\left(-\beta V_{t+1,s}^{i}\right)\right]^{1/\nu}$,

$$\mu_{t,s}^{ij} = \frac{\left[\exp\left(\beta\left(V_{t+1,s}^{j} - V_{t+1,s}^{i}\right) - m_{t,s}^{ij}\right)\right]^{1/\nu}}{\sum_{k=1}^{N}\left[\exp\left(\beta\left(V_{t+1,s}^{k} - V_{t+1,s}^{i}\right) - m_{t,s}^{ik}\right)\right]^{1/\nu}}.$$

Then multiply both sides by the mass of agents $L^i_{t,s}$,

$$L^i_{t,s}\mu^{ij}_{t,s} = \frac{\left[\exp\left(\beta\left(V^j_{t+1,s} - V^i_{t+1,s}\right) - m^{ij}_{t,s}\right)\right]^{1/\nu}}{\sum_{k=1}^{N}\left[\exp\left(\beta\left(V^k_{t+1,s} - V^i_{t+1,s}\right) - m^{ik}_{t,s}\right)\right]^{1/\nu}} L^i_{t,s},$$

and rewrite as

$$L^i_{t,s}\mu^{ij}_{t,s} = \exp\left(\frac{\beta}{\nu}V^j_{t+1,s} - \frac{\beta}{\nu}V^i_{t+1,s} - \frac{1}{\nu}m^{ij}_{t,s} + \log L^i_{t,s} - \frac{1}{\nu}\Omega^i_{t,s}\right). \tag{C.3}$$

We interpret the equation above as Poisson pseudo-maximum likelihood. The first stage regression is then

$$Z^{ij}_{t,s} = \exp\left(\lambda^j_{t,s} + \alpha^i_{t,s} - \frac{1}{\nu}m^{ij}_{t,s}\right) + \varepsilon^{ij}_{t,s}, \tag{C.4}$$

where $Z^{ij}_{t,s} = L^i_{t,s}\mu^{ij}_{t,s}$ asymptotically is the mass of agents with skill s moving from i to j in t, $\lambda^j_{t,s}$ is a destination-skill-time fixed effect, $\alpha^i_{t,s}$ is an origin-skill-time fixed effect.

The estimation of (C.4) can be done pooling the observations associated to all years and skills in the data. Since we estimate the migration elasticity using only flows of EU nationals within EU-15 we assume that bilateral migration costs do not vary over time and skills, that is $m^{ij}_{t,s} = m^{ij}$ for all $\{t, s\}$ pairs. Note, however, that the cost of migrating out of country i, and into country j, is still potentially skill-dependent because of $\alpha^i_{t,s}$, and $\lambda^j_{t,s}$, respectively. Finally, $\varepsilon^{ij}_{t,s}$ is a random disturbance of relative migration costs.

The $\lambda^j_{t,s}$ and $\alpha^i_{t,s}$ terms are not separately identified, so without loss of generality we set $\lambda^1_{t,s} = 0$ (or equivalently choose cell $\lambda^1_{t,s}$ as the omitted category for the fixed effects). Similarly, not all m^{ij} are separately identified, so without loss of generality we set all $m^{i,1}$ and m^{1j} to zero. Overall, this is equivalent to defining the destination-skill-time fixed effects as

$$\lambda^j_{t,s} = \frac{\beta}{\nu}\left(E_t V^j_{t+1,s} - E_t V^1_{t+1,s}\right) - \frac{1}{\nu} m^{1j}, \tag{C.5}$$

and the origin-skill-time fixed effects as

$$\alpha^i_{t,s} = -\frac{\beta}{\nu}\left(E_t V^i_{t+1,s} - E_t V^1_{t+1,s}\right) + \log L^i_{t,s} - \frac{1}{\nu}\Omega^i_{t,s} - \frac{1}{\nu} m^{i,1}.$$

Note that the migration option value for an agent with skill s living in country i in year t can be written as

$$\frac{1}{\nu}\Omega^i_{t,s} = -\lambda^i_{t,s} - \alpha^i_{t,s} + \log L^i_{t,s} - \frac{1}{\nu}\left(m^{i,1} - m^{1j}\right). \tag{C.6}$$

Analogously to (Silva and Tenreyro, 2006), we use Poisson Pseudo Maximum Likelihood (PPML) to estimate equation (C.4). This implies that, if we write the estimating equation (C.4) in the form $W^{ij}_{t,s} = \exp\left(x^{ij}_{t,s}\gamma_{t,s}\right) + \varepsilon^{ij}_{t,s}$, where $x^{ij}_{t,s}$ is a vector of dummy variables and $\gamma_{t,s}$ is the vector of parameters to be estimated, then we choose the parameters to solve the first-order condition

$$\sum_t \sum_{ij} \left[W^{ij}_{t,s} - \exp\left(x^{ij}_{t,s}\gamma_{t,s}\right)\right] x^{ij}_{t,s} = 0.$$

Second stage: Bellman equation In stage 1 we have estimated the destination-skill-time and origin-skill-time fixed effects $\lambda^j_{t,s}$ and $\alpha^i_{t,s}$. The second stage rewrites the Bellman equation (C.2) as an estimating equation using the estimated values from the first stage.

Using (C.2), we can write

$$\frac{\beta}{\nu} E_t V^i_{t+1,s} = \frac{\beta}{\nu}\left[\log\left(\frac{w^i_{t+1,s}}{P^i_{t+1}}\right) + \beta E_t V^i_{t+2,s} + \Omega^i_{t+1,s}\right].$$

Using (C.6) to substitute out the continuation value $\Omega^i_{t+1,s}$, and using the expression for the destination-skill-time fixed effects (C.5), we get

$$\begin{aligned} \lambda^i_{t,s} + \tfrac{\beta}{\nu} E_t V^1_{t+1,s} + \tfrac{1}{\nu} m^{1,i} &= \tfrac{\beta}{\nu} \log \left(\tfrac{w^i_{t+1,s}}{P^i_{t+1}} \right) \\ + \tfrac{\beta^2}{\nu} E_t V^1_{t+2,s} - \beta \alpha^i_{t+1,s} &+ \beta \log L^i_{t+1,s} - \tfrac{\beta}{\nu} \left(m^{i,1} - m^{1,i} \right). \end{aligned} \tag{C.7}$$

Define

$$\phi^i_{t,s} = \lambda^i_{t,s} + \beta \alpha^i_{t+1,s} - \beta \log L^i_{t+1,s}, \tag{C.8}$$

and

$$\xi_{t,s} = \frac{\beta^2}{\nu} E_t V^1_{t+2,s} - \frac{\beta}{\nu} E_t V^1_{t+1,s},$$

and rewrite (C.7) as

$$\phi^i_{t,s} = \xi_{t,s} + \kappa^i + \frac{\beta}{\nu} \log \left(\frac{w^i_{t+1,s}}{P^i_{t+1}} \right) + \epsilon^i_{t,s}, \tag{C.9}$$

where $\phi^i_{t,s}$ is the dependent variable constructed from Stage 1 estimates using (C.8), $\xi_{t,s}$ is a time-skill dummy, $\kappa^i = -(\beta/\nu)\left(m^{i,1} - m^{1,i}\right)$ is a country fixed effect, and $\epsilon^i_{t,s}$ is the regression residual. The remaining right hand-side variables are all taken from the data: $\log\left(w^i_{t+1,s}/P^i_{t+1}\right)$ is the (log) real wage; $\log\left(L^i_{t+1}\right)$ is the lead of the (log) population in country i. We estimate (C.9) as an IV regression, using two-period lagged values of real wages as instruments similar to (Artuç et al., 2010), and clustering standard errors at the country level.

We build wages, for each country i and year $t \in [2002 - 2009]$, as the ratio of the economy-wide "Labour compensation" (in millions of national currency) and "Number of persons engaged" (in thousands) from the WIOD Socio-Economic Accounts (SEA) data set ((Timmer et al., 2015b)). Then, we use the purchasing-power-parity adjusted real exchange rate from version 9.0 of the Penn World Tables to compare wages across countries and time ((Feenstra et al., 2015)). To

TABLE D.1: International Migration Elasticity, Second Stage Estimates

	Baseline	With public good
$1/\nu$	0.44***	0.53***
	(0.13)	(0.14)
Obs.	100	100

Notes: Standard errors clustered at the country-level in parentheses. *** p<0.01

compute wages by skill level we resort once again to the WIOD Socio-Economic Accounts: The high-skilled wage is computed by applying the high-skilled share of labor compensation and the high-skilled share of total hours; we convert hours into persons by assuming that the number of hours per person does not vary with skills.

Table (D.1) reports the second stage IV estimates for $1/\nu$ for $\beta = 0.97$ for the baseline case and for the extension with public good described below. The estimates for alternative values of $\beta = \{0.90, 0.95\}$ are the same up to the second decimal digit.

C.4.1 Estimation with Public Goods

In section 3.5.2 of the main text we extended our model to account for additional congestion effects coming from the provision of public goods. It turns out that this extension only slightly modifies the methodology for the estimation of the international migration elasticity outlined above. The first stage, based on the migration share equation, is unchanged. The second stage relies on a modified Bellman equation that includes the per capita provision of public goods $\left(G^i/L^i_{t+1}\right)$, weighted by the fraction of public goods in total consumption (α_i), as well as wages net of labor income taxes,

$$\frac{\beta}{\nu} E_t V^i_{t+1,s} = \frac{\beta}{\nu} \left\{ \begin{array}{c} \alpha_i \log \left(G^i / L^i_{t+1} \right) + (1-\alpha_i) \log \left[\left(1-\tau^i_{t+1}\right) \frac{w^i_{t+1,s}}{P^i_{t+1}} \right] \\ + \beta E_t V^i_{t+2,s} + \Omega^i_{t+1,s} \end{array} \right\}.$$

Following the same steps outlined above for the case without public good, it is easy to obtain the estimating equation

$$\phi^i_{t,s} = \xi_{t,s} + \kappa^i + \frac{\beta}{\nu} \left\{ -\alpha_i \log L^i_{t+1} + (1-\alpha_i) \log \left[\left(1-\tau^i_{t+1}\right) \frac{w^i_{t+1,s}}{P^i_{t+1}} \right] \right\} + \epsilon^i_{t,s}, \tag{C.10}$$

where the country fixed effect is now defined as
$\kappa^i = (\beta/\nu)\, \alpha_i \log G^i - (\beta/\nu) \left(m^{i,1} - m^{1,i}\right)$. In terms of data, we need to compute the fraction of public goods in total consumption α_i, which we construct using the WIOD World Input-Output Database, and we need information on labor income taxes. In order to compute net real wages we resort to the OECD Tax Database, which provides data on combined central and sub-central government income tax plus employee social security contribution, as a percentage of gross wage earnings, for people whose income is 100 percent of the average wage ((OECD, 2016)). In the OECD Tax Database the average wage is defined as the average annual gross wage earnings of adult, full-time, manual and non-manual workers. Data are available for each year for 14 countries in our sample, all except Lithuania, Latvia and Cyprus. For these three countries we compute the tax rate as the average of the tax rate for all the other NMS countries, by year.

C.5 Elasticity of Substitution Between Low- and High-Skilled Workers

In Section 3.4.3 we provided an estimate of the elasticity of substitution between low and high-skilled workers. To construct the data, we consider all industries in the economy except for agriculture and fishing, international organizations, and government and justice. We consider all single-job workers between 18 and 65 years old, working no more than 480 hours per month, earning at least the minimum wage, excluding apprentices and workers for which no information on education is available. We trim the top and bottom 1 percent of workers according to the distribution of hourly wages in each year. We end up with 25.7 millions observations that we aggregate into skill-year groups to construct hours. To construct the average wage in each cell we use a more selective sample that includes only employees with a permanent contract, working at least 35 hours per week. The average weekly wage in a skill-year cell is constructed by using only the base wage, and then taking the weighted average over workers where the weights are the regular hours worked by the individual. Wages are deflated to 2005 using Statistics Portugal monthly consumer price index by special aggregates that we convert to annual. In order to classify workers as "displaced" we partly follow (Carneiro and Portugal, 2006) and define a firm as shutting down after year t when the firm is observed in the *Quadros de Pessoal* data in year t but is not observed in the dataset in any of the three subsequent years. If a firm is last active in t we record the total regular hours worked by its low- and high-skilled workers in t and use these hours to construct the instrument for $t+1$.[19]

Table E.1 reports the estimates, which are all significant at 1 percent. Employing the IV methodology and data outlined above, we obtain an elasticity of 4,

[19] We construct the lead because the information reported in *Quadros de Pessoal* is collected in October of every year from 1994 on (before that it was collected in March).

which is the number we use in our quantitative analysis. Our estimate is slightly above those commonly found for the U.S. ((Katz and Murphy, 1992), (Johnson, 1997), (Krusell et al., 2000b), (Ottaviano and Peri, 2012a), (Ciccone and Peri, 2005)) which range between 1.5 and 2.5, but below the elasticity of substitution of 5 between low- and medium-skilled workers found for Germany ((Dustmann et al., 2009)). Since the set of European countries we consider in the quantitative analysis is pretty diverse in terms of labor market institutions and workforce characteristics we consider our benchmark estimate of 4 as a good compromise.

The estimate of the elasticity of substitution turns out to be pretty robust to alternative different specifications, methodologies, and levels of data aggregation. Table E.1 reports an alternative set of estimates using OLS with linear or spline (with break in 1993) trends, at the industry-region and country-level. It also reports a set of estimates based on an alternative way to construct the data series for hours and wages based on (Autor et al., 2008). In this case we construct a fix-weighted ratio of high-skill to low-skill wages for a composition-constant set of sex-education-experience groups. To do that, we regress monthly deflated wages, for each sex and year, on five education categories (3 years or less, between 4 and 6 years, between 7 and 9 years, between 10 and 12 years, and 13 years and above), a quartic in experience (defined as age minus 6 minus the number of education years), and all the interactions between the education dummies and the quartic in experience. The predicted wages for each sex-education-experience-year group are then aggregated at the skill-year level with a constant set of weights based on the aggregate hours shares of each group. The series for hours is constructed by aggregating at the skill-year level the series for total regular hours worked by sex, five education groups and experience. The aggregation employs a series of weights to turn hours into efficiency units. Weights are constructed by normalizing the predicted wages described above by the top wage across cells. Estimates

TABLE E.1: Elasticity of substitution between low- and high-skill workers, Portuguese matched employer-employee data

	Ind.-region-level			Country-level			Country-level (compos.-adjusted)		
	Elasticity	R^2	Obs.	Elasticity	R^2	Obs.	Elasticity	R^2	Obs.
IV	4.0	0.84	180						
Linear trend	5.2	0.94	210	4.2	0.97	14	3.6	0.97	14
Spline	3.7	0.92	210	3.1	0.98	14	3.0	0.99	14

Notes: All estimates are significant at 1 percent. All industry-region-level estimates include industry-region fixed effects. Industry-region-level OLS estimates include industry-region-specific trends.

for the elasticity of substitution, using different types of trends turn out to be slightly smaller, but overall pretty similar to all the others.

C.6 Equilibrium Conditions of the Temporary Equilibrium in Changes

In this appendix, we describe the equilibrium conditions of the production structure in relative time differences. As in the main text, let $\dot{y}_{t+1} \equiv y_{t+1}/y_t$ denote the relative time change of a variable and by $\hat{y}_{t+1} \equiv \dot{y}'_{t+1}/\dot{y}_{t+1}$ the relative time difference of the variable under a sequence of policies $\{\Upsilon'_t\}_{t=0}^{\infty}$ relative to the sequence of policies $\{\Upsilon_t\}_{t=0}^{\infty}$. Also, let's define $\omega_{s,t} = w_{s,t}\,(r_t)^{\gamma^i/(1-\gamma^i)}$.

The cost of the bundle of inputs and the price index in relative time differences are

$$\hat{x}_t^i = \left(\frac{\xi'^i_{h,t-1}\left(\dot{\omega}'^i_{h,t}\right)^{1-\rho} + \xi'^i_{l,t-1}\left(\dot{\omega}'^i_{l,t}\right)^{1-\rho}}{\xi^i_{h,t-1}\left(\dot{\omega}^i_{h,t}\right)^{1-\rho} + \xi^i_{l,t-1}\left(\dot{\omega}^i_{l,t}\right)^{1-\rho}} \right)^{\frac{(1-\gamma^i)}{1-\rho}},$$

$$\hat{P}_t^i = \left(\sum_{j=1}^{N} \pi'^{ij}_{t-1} \dot{\pi}^{ij}_t \hat{A}^j_t (\hat{\kappa}^{ij}_t \hat{x}^j_t)^{-\theta} \right)^{-\frac{1}{\theta}},$$

while the bilateral expenditure shares in relative time differences are

$$\hat{\pi}_t^{ij} = \left(\frac{\hat{\kappa}_t^{ij} \hat{x}_t^j}{\hat{P}_t^i} \right)^{-\theta} \hat{A}_t^j.$$

The share of high-skilled labor in the counterfactual equilibrium is given by

$$\xi_{s,t}^{i'} = \xi_{s,t-1}^i \frac{\left(\dot{\omega}_{s,t}^{\prime i} \right)^{1-\rho}}{\left(\dot{x}_t^{\prime i} \right)^{\frac{1-\rho}{1-\gamma^i}}}.$$

Total expenditure in the counterfactual equilibrium is given by

$$X_t^{\prime i} = \Xi \left(\dot{\omega}_{h,t}^{\prime} \right)^{1-\gamma^i} \left(\dot{\xi}_{h,t}^{\prime i} \right)^{\gamma^i} \left(\dot{L}_{h,t}^{\prime i} \right)^{1-\gamma^i} w_{h,t-1}^{\prime i} L_{h,t-1}^{\prime i} +$$

$$\left(\dot{\omega}_{l,t}^{\prime} \right)^{1-\gamma^i} \left(\dot{\xi}_{l,t}^{\prime i} \right)^{\gamma^i} \left(\dot{L}_{l,t}^{\prime i} \right)^{1-\gamma^i} w_{l,t-1}^{\prime i} L_{l,t-1}^{\prime i} + \iota^i \chi_t^{\prime},$$

with $\Xi = \frac{1}{\sum_{j=1}^N \frac{\pi_t^{\prime ij}}{(1+\tau_t^{\prime ij})}}$ and $\chi_t^{\prime} = \sum_{i=1}^N \left(\dot{\omega}_{h,t}^{\prime i} \right) \left(\frac{\dot{L}_{h,t}^{\prime i}}{\dot{\xi}_{h,t}^{\prime i}} \right)^{1-\gamma} r_{t-1}^i H^i.$

Finally, the labor market condition of high-skilled labor is

$$\dot{\omega}_{s,t}^{\prime i} = \left(\frac{1}{\left(\dot{\xi}_{s,t}^{\prime i} \right)^{\gamma^i} \left(\dot{L}_{s,t}^{\prime i} \right)^{1-\gamma^i}} \left(\frac{(1-\gamma^i) \xi_{s,t}^{\prime i}}{w_{s,t-1}^{\prime i} L_{s,t-1}^{\prime i}} \sum_{j=1}^N \frac{\pi_t^{\prime ji} X_t^{\prime j}}{\tau_t^{\prime ji}} \right) \right)^{\frac{1}{1-\gamma^i}}.$$

Appendix D

Appendix to chapter 4

D.1 Spatial Autoregressive Model

The decision of not using a Spatial error model has a theoretical foundation that lies in the economic theory behind our analysis.

The use of a Spatial "y" model ("spatially lagged dependent variable", (Anselin, 2002)), such as a spatial autoregressive model (SAR) or a spatial lags model (SL) would have been inconsistent because very difficult to justify with theory: it is obscure how the electoral outcome in a certain municipality influences simultaneously the electoral outcome in other municipalities net of a number of controls. Effectively, it can happen that a general factor (i.e. the regional governance) influences the votes of people living in neighboring municipalities, but this effect should be captured by the introduction of regional fixed effects.

Secondly, a spatial "x" model (SLX) implies the existence of cross regressive terms that affect the outcomes of neighboring places. This in turn implies that the turnout in a certain municipality which is instrumented with weather in that municipality has an effect on the turnout of neighboring municipalities. While it is easy to claim that weather conditions can be similar across municipalities, showing a common pattern in certain areas, it is puzzling that turnout rates in a certain place simultaneously affects turnout of neighbors. Moreover, this effect should be relevant net of the introduction of regional fixed effects and the usual set of controls.

Lastly, we discuss the spatial error model (SE). The use of this model is slightly controversial because in principle it would suit perfectly our case by completely eliminating any concern about the existence of a spatial pattern in the error term of our specification (residuals of IV). Spatially autocorrelated error terms would lead to inconsistent and inefficient estimates, hence the use of SE model would account for this nuisance. The decision on whether to use the SE model has been mainly based on the results of the spatial statistics computed, i.e. Moran's I and LISA; where, the analysis of the spatial dependence of the residuals show that at the Regional level there is no significant spatial pattern that is worth noting, while at Province level we have values of Moran's I from a high 0.2 to a low 0.07. The introduction of the first stage regression residuals of the neighboring places - lagged residuals - in our IV model on the one hand would reduce the spatial autocorrelation problem by reducing the standard errors, on the other would not cause any significant change in the regression coefficients (because in the case it has a significant impact, it would affect only consistency and efficiency, but not unbiasedness). Since the robust standard errors in our IV specification are not too big and given the Moran's I values, we decide to stick to the normal IV model without the superimposition of any structure (even one of spatial autocorrelation) to the error term.

However, to be completely certain of our choice, we perform a SE model in STATA using Provinces as weights; specifically, we firstly compute the residual of the first stage regression in STATA, and subsequently we use this information together with the weight files created (that weight the residuals of the first stage of neighboring municipalities) to implement IV estimation. Results of the SE model shown in Table 4 do not highlight any striking difference with respect

TABLE E.1: Spatial Error Model

VARIABLES	(1) First Turnout	(2) IV PD	(3) IV PDL	(4) First Turnout	(5) IV M5S	(6) IV SC
Rainfalls	-0.00595***			-0.0139***		
	(0.00145)			(0.00188)		
Turnout		-1.559***	0.352		0.924***	-0.814***
		(0.415)	(0.256)		(0.162)	(0.151)
Social Capital	YES	YES	YES	YES	YES	YES
Altitude	YES	YES	YES	YES	YES	YES
FE	YES	YES	YES	YES	YES	YES
Observations	7,106	7,106	7,106	7,131	7,131	7,131
F test	.	16.82	20.67	.	54.74	35.42
R2	0.708	0.360	0.887	0.996	0.942	0.755

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

to the benchmark specification.

D.2 Complete tables

TABLE E.2: IV Complete

VARIABLES	(1) Turnout	(2) PD	(3) PDL	(4) UDC	(5) LN	(6) SEL	(7) Turnout	(8) M5S	(9) SC
Rainfalls	-0.00681***						-0.0147***		
	(0.00150)						(0.00197)		
Turnout		-1.295***	-0.105	0.316*	-0.0592	0.164		0.788***	-0.345***
		(0.334)	(0.261)	(0.191)	(0.159)	(0.105)		(0.170)	(0.0970)
Social Capital	YES	YES	YES	YES	YES	YES	YES	YES	YES
Altitude	YES	YES	YES	YES	YES	YES	YES	YES	YES
FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	7,106	7,106	7,106	7,106	7,106	7,111	7,131	7,131	7,131
R-squared	0.205	-0.242	0.379	-0.012	0.745	0.214	0.544	0.147	0.160
F test	.	20.72	20.72	20.72	20.72	20.84	.	55.30	55.30
R2	0.692	0.462	0.882	0.534	0.854	0.647	0.995	0.930	0.836

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

TABLE E.3: IV Complete Females

VARIABLES	(1) Turnout	(2) PD	(3) PDL	(4) UDC	(5) LN	(6) SEL	(7) Turnout	(8) M5S	(9) SC
Rainfalls	-0.00671***						-0.0150***		
	(0.00168)						(0.00223)		
Turnout		-1.313***	-0.107	0.321	-0.0600	0.166		0.771***	-0.338***
		(0.371)	(0.266)	(0.197)	(0.161)	(0.108)		(0.173)	(0.0972)
Social Capital	YES	YES	YES	YES	YES	YES	YES	YES	YES
Altitude	YES	YES	YES	YES	YES	YES	YES	YES	YES
FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	7,106	7,106	7,106	7,106	7,106	7,111	7,131	7,131	7,131
F test	.	15.98	15.98	15.98	15.98	16.10	.	45.26	45.26
R2	0.695	0.359	0.882	0.516	0.854	0.637	0.994	0.924	0.825

YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

TABLE E.4: IV Complete Males

VARIABLES	(1) Turnout	(2) PD	(3) PDL	(4) UDC	(5) LN	(6) SEL	(7) Turnout	(8) M5S	(9) SC
Rainfalls	-0.00685***						-0.0142***		
	(0.00152)						(0.00190)		
Turnout		-1.286***	-0.104	0.314*	-0.0588	0.163		0.814***	-0.356***
		(0.336)	(0.259)	(0.190)	(0.158)	(0.105)		(0.176)	(0.100)
Social Capital	YES	YES	YES	YES	YES	YES	YES	YES	YES
Altitude	YES	YES	YES	YES	YES	YES	YES	YES	YES
FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	7,106	7,106	7,106	7,106	7,106	7,111	7,131	7,131	7,131
F test	.	20.31	20.31	20.31	20.31	20.40	.	56.11	56.11
R2	0.622	0.442	0.883	0.532	0.853	0.645	0.996	0.928	0.837

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Bibliography

Abowd, J., Kramarz, F., and Margolis, D. (1999). High wage workers and high wage firms. *Econometrica*, 67(2):251–333.

Addison, J. T., Portugal, P., and Vilares, H. (2015). Sources of the Union Wage Gap: Results from High-Dimensional Fixed Effects Regression Models. IZA Discussion Papers 9221, Institute for the Study of Labor (IZA).

Ahlfeldt, G. M., Redding, S. J., Sturm, D. M., and Wolf, N. (2015). The economics of density: Evidence from the berlin wall. *Econometrica*, 83(6):2127–2189.

Allen, T. and Arkolakis, C. (2014). Trade and the topography of the spatial economy. *The Quarterly Journal of Economics*, 129(3):1085–1140.

Amador, J. and Opromolla, L. D. (2012). Product and destination mix in export markets. *Review of World Economics*, forthcoming.

Amiti, M. and Weinstein, D. E. (2011). Exports and financial shocks. *The Quarterly Journal of Economics*, 126(4):1841–1877.

Angrist, J. and Pischke., J. (2009). *Mostly Harmless Econometrics; an Empiricists Companion*. Princeton.

Angrist, J. D. (1995). The economic returns to schooling in the west bank and gaza strip. *The American Economic Review*, 85:1065–1087.

Anselin, L. (1995). *Geographical Analysis*, 27(2):93–115.

Anselin, L. (2002). Under the hood : Issues in the specification and interpretation of spatial regression models. *Agricultural Economics*, 27(3):247–267.

Antras, P., Garicano, L., and Rossi-Hansberg, E. (2006). Offshoring in a knowledge economy. *Quarterly Journal of Economics*, 121(1):31–77.

Argote, L. and Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. *Organizational behavior and human decision processes*, 82(1):150–169.

Arkolakis, K. (2010). Market penetration costs and the new consumers margin in international trade. *Journal of Political Economy*, 118(6):1151–1199.

Artopoulos, A., Friel, D., and Hallak, J. C. (2013). Export emergence of differentiated goods from developing countries: Export pioneers and business practices in argentina. *Journal of Development Economics*, 105:19–35.

Artuç, E., Chaudhuri, S., and McLaren, J. (2010). Trade shocks and labor adjustment: A structural empirical approach. *The American Economic Review*, 100(3):1008–1045.

Artuç, E. and McLaren, J. (2015). Trade policy and wage inequality: A structural analysis with occupational and sectoral mobility. *Journal of International Economics*, 97(2):278–294.

Atkin, D., Khandelwal, A. K., and Osman, A. (2016). Exporting and firm performance: Evidence from a randomized experiment. *Quarterly Journal Economics*, Forthcoming.

Autor, D. H., Dorn, D., and Hanson, G. H. (2013a). The china syndrome: Local labor market effects of import competition in the united states. *American Economic Review*, 103(6):2121–68.

Autor, D. H., Dorn, D., and Hanson, G. H. (2013b). The Geography of Trade and Technology Shocks in the United States. *American Economic Review*, 103(3):220–225.

Autor, D. H., Dorn, D., Hanson, G. H., and Song, J. (2014a). Trade adjustment: Worker-level evidence. *The Quarterly Journal of Economics*, 129(4):1799–1860.

Autor, D. H., Dorn, D., Hanson, G. H., and Song, J. (2014b). Trade adjustment: Worker level evidence. *The Quarterly Journal of Economics*, 129(4):1799–1860.

Autor, D. H., Katz, L. F., and Kearney, M. S. (2008). Trends in us wage inequality: Revising the revisionists. *The Review of Economics and Statistics*, 90(2):300–323.

Baldwin, R. (1995). The eastern enlargement of the european union. *European Economic Review*, 39(3-4):474–481.

Baldwin, R., Francois, J., and Portes, R. (1997). The costs and benefits of eastern enlargement: the impact on the eu and central europe. *Economic Policy*, 12(24):125–176.

Balsvik, R. (2011). Is labor mobility a channel for spillovers from multinationals? evidence from norwegian manufacturing. *Review of Economics and Statistics*, 93(1):285–297.

Bassi, A. (2013). The indian rain dance of the incumbent: The effect of weather beyond turnout. *Not published*.

Békés, G. and Muraközy, B. (2012). Temporary trade and heterogeneous firms. *Journal of International Economics*, 87(2):232–246.

Bernard, A., Jensen, B., Redding, S., and Schott, P. (2012). The empirics of firm heterogeneity and international trade. *Annual Review of Economics*, 4:283–313.

Bernard, A. B., Jensen, J. B., and Schott, P. K. (2006). Survival of the best fit: Exposure to low-wage countries and the (uneven) growth of us manufacturing plants. *Journal of international Economics*, 68(1):219–237.

Berton, F., Mocetti, S., Presbitero, A., and Richiardi, M. G. (2017). Banks, firms, and jobs. *IMF working paper No. 17/38*.

Black, S. E. and Lynch, L. M. (1997). How to Compete: The Impact of Workplace Practices and Information Technology on Productivity. NBER Working Papers 6120, National Bureau of Economic Research, Inc.

Blanchard, O. and Portugal, P. (2001). What hides behind an unemployment rate: Comparing portuguese and u.s. labor markets. *American Economic Review*, 91(1):187–207.

Blinder, A. S. (2006). Offshoring: The next industrial revolution? *Foreign Affairs*, 85(2):113–128.

Bloom, N., Draca, M., and Reenen, J. V. (2011a). Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity. CEP Discussion Papers dp1000, Centre for Economic Performance, LSE.

Bloom, N., Draca, M., and Reenen, J. V. (2011b). Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity. CEP Discussion Papers dp1000, Centre for Economic Performance, LSE.

Bloom, N., Eifert, B., Mahajan, A., McKenzie, D., and Roberts, J. (2013). Does management matter? evidence from india. *The Quarterly Journal of Economics*, 128(1):1–51.

Bloom, N., Sadun, R., and Reenen, J. V. (2016). Managment as a technology? NBER Working Papers 22327, National Bureau of Economic Research.

Bloom, N., Sadun, R., and Van Reenen, J. (2012). The organization of firms across countries*. *The Quarterly Journal of Economics*, 127(4):1663–1705.

Bloom, N. and Van-Reenen, J. (2010). Why do management practices differ across firms and countries? *Journal of Economic Perspectives*, 24(1):203–224.

Bonfim, D. and Dai, Q. (2012). Bank size and lending specialization. *Working Papers*.

Borjas, G. (1987). Self-selection and the earnings of immigrants. NBER Working Papers 2248, National Bureau of Economic Research, Inc.

Borjas, G. J., Grogger, J., and Hanson, G. H. (2012). Comment: On estimating elasticities of substition. *Journal of the European Economic Association*, 10(1):198–210.

Brandt, L., Biesebroeck, J. V., and Zhang, Y. (2012). Creative accounting or creative destruction? firm-level productivity growth in chinese manufacturing. *Journal of Development Economics*, 97(2):339 – 351.

Broocks, A. and Van Biesebroeck, J. (2017). The impact of export promotion on export market entry. *Journal of International Economics*, 107:19–33.

Bryan, G. and Morten, M. (2017). The aggregate productivity effects of internal migration: Evidence from indonesia.

Burstein, A., Hanson, G., Tian, L., and Vogel, J. (2017). Tradability and the labor-market impact of immigration: Theory and evidence from the u.s. Working Paper 23330, National Bureau of Economic Research.

Cabral, L. and Mata, J. (2003). On the evolution of the firm size distribution: Facts and theory. *American Economic Review*, 93(4):1075–1090.

Cahuc, P., Postel-Vinay, F., and Robin, J. (2006). Wage bargaining with on-the-job search: Theory and evidence. *Econometrica*, 74(2):323–364.

Caliendo, L., Dvorkin, M., and Parro, F. (2017a). Trade and labor market dynamics: General equilibrium analysis of the china trade shock. *mimeo, Yale University*.

Caliendo, L., Mion, G., Opromolla, L. D., and Rossi-Hansberg, E. (2015a). Productivity and organization in portuguese firms. Working Paper 21811, National Bureau of Economic Research.

Caliendo, L., Monte, F., and Rossi-Hansberg, E. (2015b). The Anatomy of French Production Hierarchies. *Journal of Political Economy*, 123(4):809–852.

Caliendo, L. and Parro, F. (2015). Estimates of the trade and welfare effects of nafta. *The Review of Economic Studies*, 82(1):1–44.

Caliendo, L., Parro, F., Rossi-Hansberg, E., and Sarte, P. (2017b). The impact of regional and sectoral productivity changes on the u.s. economy. *mimeo, Yale University*.

Caliendo, L. and Rossi-Hansberg, E. (2012). The impact of trade on organization and productivity. *Quarterly Journal of Economics*, 127(3):1393–1467.

Cardoso, A. and Portugal, P. (2005). Contractual wages and the wage cushion under different bargaining settings. *Journal of Labor Economics*, 23(4):875–902.

Carneiro, A., aes, P. G., and Portugal, P. (2012). Real wages and the business cycle: Accounting for worker, firm and job-title heterogeneity. *American Economic Journal: Macroeconomics*, 4(2):133–152.

Carneiro, A. J. M. and Portugal, P. (2006). Earnings losses of displaced workers: Evidence from a matched employer-employee dataset. *IZA DP No. 2289*.

Chang, Y.-Y., Gong, Y., and Peng, M. W. (2012). Expatriate knowledge transfer, subsidiary absorptive capacity, and subsidiary performance. *Academy of Management Journal*, 55(4):927–948.

Chodorow-Reich, G. (2014). <p>the employment effects of credit market disruptions: Firm-level evidence from the 2008-09 financial crisis</p>. *Quarterly Journal of Economics*, 129:1–59. <p>Lead article</p>.

Chor, D. and Manova, K. (2012). Off the cliff and back? credit conditions and international trade during the global financial crisis. *Journal of International Economics*, 87(1):117 – 133. Symposium on the Global Dimensions of the Financial Crisis.

Ciccone, A. and Peri, G. (2005). Long-run substitutability between more and less educated workers: Evidence from us states, 1950–1990. *The Review of Economics and Statistics*, 87(4):652–663.

Citrin, J., Schickler, E., and Sides, J. (2003). What if every- one voted? simulating the impact of increased turnout in senate elections. *American Journal of Political Science 47 (January): 75- 90*.

Cosar, A. K. (2013). Adjusting to trade liberalization: Reallocation and labor market policies. *University of Chicago Booth School of Business, unpublished manuscript*.

Coşar, A. K., Guner, N., and Tybout, J. (2016). Firm dynamics, job turnover, and wage distributions in an open economy. *The American Economic Review*, 106(3):625–663.

Costinot, A. and Rodriguez-Clare, A. (2014). Trade theory with numbers: Quantifying the consequences of globalization. *Handbook of International Economics*, pages 197–261.

Council of the European Union (2012). Consolidated versions of the treaty on european union and the treaty on the functioning of the european union. *Official Journal of the European Union*, 55.

Das, M., Roberts, M., and Tybout, J. (2007). Market entry costs, producer heterogeneity and export dynamics. *Econometrica*, 75(3):837–873.

Davis, D. R. and Weinstein, D. E. (2002). Technological superiority and the losses from migration. Technical report, National Bureau of Economic Research.

DeNardo, J. (1980). Turnout and the vote: The joke's on the democrats. *The American Political Science Review*, 74(2):pp. 406–420.

DeNardo, J. (1986). Does heavy turnout help democrats in presidential elections? *American Political Science Review 80*.

Desmet, K., Nagy, D. K., and Rossi-Hansberg, E. (2016). The geography of development. *In Press, Journal of Political Economy*.

Desmet, K. and Rossi-Hansberg, E. (2014). Spatial development. *The American Economic Review*, 104(4):1211–1243.

di Giovanni, J., Levchenko, A. A., and Ortega, F. (2015). A global view of cross-border migration. *Journal of the European Economic Association*, 13(1):168–202.

Diamond, R. (2016). The determinants and welfare implications of us workers' diverging location choices by skill: 1980-2000. *American Economic Review*, 106(3):479–524.

Dix-Carneiro, R. (2014). Trade liberalization and labor market dynamics. *Econometrica*, 82(3):825–885.

Dix Carneiro, R. and Kovak, B. K. (2017). Trade liberalization and regional dynamics. *American Economic Review*, page forthcoming.

Downs, A. (1957). *An Economic Theory of Democracy*. New York: Harper & Row.

Dustmann, C. and Frattini, T. (2011). Immigration: the european experience.

Dustmann, C., Frattini, T., and Rosso, A. (2015). The effect of emigration from poland on polish wages. *The Scandinavian Journal of Economics*, 117(2):522–564.

Dustmann, C., Ludsteck, J., and Schönberg, U. (2009). Revisiting the german wage structure. *The Quarterly Journal of Economics*, 124(2):843–881.

Dustmann, C. and Meghir, C. (2005). Wages, experience and seniority. *The Review of Economic Studies*, 72(1):77–108.

Eaton, J., Eslava, M., Krizan, C., Jinkins, D., and Tybout, J. (2012). A search and learning model of export dynamics. (mimeo).

Eaton, J., Eslava, M., Kugler, M., and Tybout, J. (2008). *The Organization of Firms in a Global Economy*, chapter The Margins of Entry into Export Markets: Evidence from Colombia. Harvard University Press.

Eaton, J. and Kortum, S. (2001). Technology, trade, and growth: A unified framework. *European Economic Review*, 45(4-6):742–755.

Eaton, J. and Kortum, S. (2002). Technology, geography, and trade. *Econometrica*, 70:1741–1779.

Eisinga, R., Grotenhuis, M. T., and Pelzer, B. (2012). Weather conditions and voter turnout in dutch national parliament elections, 1971-2010. *International Journal Biometeorology*, 56(4):736–86.

Erikson, R. S. (1995). State turnout and presidential voting: A closer look. *American Politics Quarterly 23 (October): 387-96*.

European Union (2003). Documents concerning the accession of the czech republic, the republic of estonia, the republic of cyprus, the republic of latvia, the republic of lithuania, the republic of hungary, the republic of malta, the republic of poland, the republic of slovenia and the slovak republic to the european union. *Official Journal of the European Union*, 46.

Fajgelbaum, P. D., Morales, E., Serrato, J. C. S., and Zidar, O. M. (2015). State taxes and spatial misallocation. NBER Working Papers 21760, National Bureau of Economic Research.

Fallick, B., Fleischman, C. A., and Rebitzer, J. B. (2006). Job-hopping in silicon valley: some evidence concerning the microfoundations of a high-technology cluster. *The Review of Economics and Statistics*, 88(3):472–481.

Feenstra, R. C., Inklaar, R., and Timmer, M. P. (2015). The next generation of the penn world table. *The American Economic Review*, 105(10):3150–3182.

Foley, C. F. and Manova, K. (2015). International trade, multinational activity, and corporate finance. *Annual Review of Economics*, 7(1):119–146.

Frias, J. A., Kaplanz, D. S., and Verhoogen, E. A. (2009). Exports and wage premia: Evidence from Mexican employer-employee data. Columbia University mimeo.

Friedrich, B. (2015). Trade Shocks, Firm Hierarchies and Wage Inequality. Economics Working Papers 2015-26, Department of Economics and Business Economics, Aarhus University.

Gabaix, X. and Landier, A. (2008). Why has ceo pay increased so much? *The Quarterly Journal of Economics*, 123(1):49–100.

Galle, S., Rodriguez-Clare, A., and Yi, M. (2017). Slicing the pie: Quantifying the aggregate and distributional effects of trade. *Unpublished manuscript, Univ. Calif., Berkeley*.

Garicano, L. (2000). Hierarchies and the organization of knowledge in production. *Journal of Political Economy*, 108(5).

Garicano, L. and Rossi-Hansberg, E. (2004). Inequality and the organization of knowledge. *American Economic Review*, 94(2):197–202.

Gibbons, R. and Katz, L. (1992). Does unmeasured ability explain inter-industry wage differentials? *The Review of Economic Studies*, 59(3):515–535.

Gomez, B. T., Hansford, T. G., and Krause, G. A. (2007). The republicans should pray for rain: Weather, turnout, and voting in u.s. presidential elections. *Journal of Politics*, 69(3):649–663.

Greenstone, M., Mas, A., and Nguyen, H.-L. (2014). Do credit market shocks affect the real economy? quasi-experimental evidence from the great recession and 'normal' economic times. Working Paper 20704, National Bureau of Economic Research.

Grofman, B., Owen, G., and Collet., C. (1999). Rethinking the partisan effects of higher turnout: So what's the question? *Public Choice 99 (June): 357-76.*

Grossman, G. M. and Rossi-Hansberg, E. (2008). Trading tasks: A simple theory of offshoring. *American Economic Review*, 98(5):1978–1997.

Guadalupe, M. and Wulf, J. (2008). The flattening firm and product market competition: The effect of trade liberalization. *NBER Working Paper*, 14491.

Guidolin, M. and La Ferrara, E. (2007). Diamonds are forever, wars are not: Is conflict bad for private firms? *The American Economic Review*, 97(5):1978–1993.

Guimarães, P. and Portugal, P. (2010). A simple feasible procedure to estimate models with high-dimensional fixed effects. *Stata Journal*, 10(4):628–649.

Guiso, L. and Rustichini, A. (2011). Understanding the size and profitability of firms: the role of a biological factor. CEPR Discussion Papers 8205, Centre for Economic Policy Research.

Handley, K. and Limao, N. (2015). Trade and investment under policy uncertainty: Theory and firm evidence. *American Economic Journal: Economic Policy*, 7(4):189–222.

Hansford, T. G. and Gomez, B. T. (2010). Estimating the electoral effects of voter turnout. *American Political Science Review*, 104:268–288.

Hanson, G. H. and Slaughter, M. J. (2002). Labor-market adjustment in open economies: Evidence from us states. *Journal of international Economics*, 57(1):3–29.

Hanson, G. H. and Slaughter, M. J. (2016). High-skilled immigration and the rise of stem occupations in u.s. employment. Working Paper 22623, National Bureau of Economic Research.

Helpman, E., Itskhoki, O., Muendler, M., and Redding, S. (2012). Trade and inequality: From theory to estimation. NBER Working Papers 17991.

Helpman, E., Itskhoki, O., and Redding, S. (2010). Inequality and unemployment in a global economy. *Econometrica*, 78(4):1239–1283.

Hong, G. and Mclaren, J. (2016). Are immigrants a shot in the arm for the local economy? *mimeo, University of Virginia*.

Hsieh, C.-T. and Klenow, P. (2009). Misallocation and manufacturing tfp in china and india. *The Quarterly Journal of Economics*, 124(4):1403–1448.

Hubbard, T. and Garicano, L. (2007). The Return to Knowledge Hierarchies. Working Papers 07-01, Center for Economic Studies, U.S. Census Bureau.

Hummels, D., Minor, P., Reisman, M., and Endean, E. (2007). Calculating tariff equivalents for time in trade. *USAID Report, March*.

Hummels, D. L. and Schaur, G. (2013). Time as a trade barrier. *The American Economic Review*, 103(7):2935–2959.

Iacovone, L. and Javorcik, B. S. (2012). Getting ready: Preparation for exporting. University of Oxford mimeo.

Ichniowski, C., Shaw, K., and Prennushi, G. (1997). The effects of human resource management practices on productivity: A study of steel finishing lines. *The American Economic Review*, 87(3):291–313.

Iyer, R., Peydró, J.-L., da Rocha-Lopes, S., and Schoar, A. (2014). Interbank liquidity crunch and the firm credit crunch: Evidence from the 2007–2009 crisis. *Review of Financial Studies*, 27(1):347–372.

Jiménez, G., Atif, M. M., Peydro, J.-L., and Saurina Salas, J. (2011). Local versus aggregate lending channels: The effects of securitization on corporate credit supply. *Available at SSRN: https://ssrn.com/abstract=1939774 or http://dx.doi.org/10.2139/ssrn.1939774*.

Jiménez, G., Ongena, S., Peydró, J.-L., and Saurina, J. (2014). Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking? *Econometrica*, 82(2):463–505.

Johnson, G. E. (1997). Changes in earnings inequality: the role of demand shifts. *The Journal of Economic Perspectives*, 11(2):41–54.

Jones, C. (1995). R&d-based models of economic growth. *Journal of Political Economy*, 103(4):759–84.

Katz, L. F. and Murphy, K. M. (1992). Changes in relative wages, 1963–1987: Supply and demand factors. *The Quarterly Journal of Economics*, 107(1):35–78.

Kennan, J. (2017). Open borders in the european union and beyond: Migration flows and labor market implications. Working Paper 23048, National Bureau of Economic Research.

Kerr, P. S. and Kerr, W. R. (2011). Economic impacts of immigration: A survey. *Finnish Economic Papers*, 24(1):1–32.

Khwaja, A. I. and Mian, A. (2008). Tracing the impact of bank liquidity shocks: Evidence from an emerging market. *American Economic Review*, 98(4):1413–42.

Klein, P. and Ventura, G. (2009). Productivity differences and the dynamic effects of labor movements. *Journal of Monetary Economics*, 56(8):1059–1073.

Kondo, I. (2013). Trade reforms, foreign competition, and labor market adjustments in the us. *mimeo, Federal Reserve Board*.

Kortum, S. S. (1997). Research, patenting, and technological change. *Econometrica: Journal of the Econometric Society*, pages 1389–1419.

Krugman, P. (1980). Scale economies, product differentiation, and the pattern of trade. *The American Economic Review*, 70(5):950–959.

Krusell, P., Ohanian, L. E., Ríos-Rull, J.-V., and Violante, G. L. (2000a). Capital-skill complementarity and inequality: A macroeconomic analysis. *Econometrica*, 68(5):1029–1053.

Krusell, P., Ohanian, L. E., Ríos-Rull, J.-V., and Violante, G. L. (2000b). Capital-skill complementarity and inequality: A macroeconomic analysis. *Econometrica*, 68(5):1029–1053.

Kucheryavyy, K., Lyn, G., and Rodríguez-Clare, A. (2016). Grounded by gravity: A well-behaved trade model with industry-level economies of scale. NBER Working Papers 22484, National Bureau of Economic Research.

Lagakos, D. and Waugh, M. E. (2013). Selection, agriculture, and cross-country productivity differences. *American Economic Review*, 103(2):948–80.

Liberti, J. M. (2017). Initiative, incentives, and soft information. *Management Science*, 0(0):null.

Lind, J. T. (2013). Rainy day politics: An instrumental variables approach to the effect of parties on political outcomes. *Working paper*.

Lourenço, R. and Rodrigues, P. M. (2015). House prices: bubbles, exuberance or something else? evidence from euro area countries. *Working Papers*.

Manova, K., Wei, S.-J., and Zhang, Z. (2015). Firm exports and multinational activity under credit constraints. *Review of Economics and Statistics*, 97(3):574–588.

Martincus, C. V., Carballo, J., and Graziano, A. (2015). Customs. *Journal of International Economics*, 96(1):119–137.

Martinez, M. D. and Gill., J. (2005). The effects of turnout on partisan outcomes in u.s. presidential elections 1960-2000. *Journal of Politics 67 (November): 1248-74*.

Martins, P. S. (2009). Dismissals for cause: The difference that just eight paragraphs can make. *Journal of Labor Economics*, 27(2):257–279.

Martins, P. S. and Opromolla, L. D. (2012). Why ex(im)porters pay more: Evidence from matched firm-worker panels. Mimeo.

McLaren, J. (2017). Globalization and labor market dynamics. *Annual Review of Economics*, 9(1):177–200.

McLaren, J. and Hakobyan, S. (2015). Looking for local labor market effects of nafta. *mimeo, University of Virginia*.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, 71(6):1695–1725.

Menezes-Filho, N. A. and Muendler, M.-A. (2011). Labor reallocation in response to trade reform. Working Paper 17372, National Bureau of Economic Research.

Mion, G. and Muûls, M. (2015). The impact of ukti trade services on value of goods exported by supported firms.

Mion, G. and Opromolla, L. D. (2014). Managers' mobility, trade performance, and wages. *Journal of International Economics*, 94(1):85–101.

Mion, G., Opromolla, L. D., and Sforza, A. (2016). The diffusion of knowledge via managers' mobility. *CEPR working paper*.

Mion, G. and Zhu, L. (2013). Import competition from and offshoring to china: A curse or blessing for firms? *Journal of International Economics*, 89(1):202–215.

Monte, F., Redding, S. J., and Rossi-Hansberg, E. (2015). Commuting, migration and local employment elasticities. Working Paper 21706, National Bureau of Economic Research.

Morales, E., Sheu, G., and Zahler, A. (2012). Gravity and extended gravity: Estimating a structural model of export entry. Columbia University mimeo.

Moxnes, A. (2010). Are sunk costs in exporting country specific? *Canadian Journal of Economics*, 43(2):467–493.

Munch, J. R. and Skaksen, J. R. (2008). Human capital and wages in exporting firms. *Journal of International Economics*, 75(2):363–372.

Nagel, J. H. and McNulty, J. E. (1996). Partisan effects of voter turnout in senatorial and gubernatorial elections. *The American Political Science Review*, 90(4):pp. 780–793.

OECD (2016). Taxing wages 2016.

Ossa, R. (2014). Trade wars and trade talks with data. *The American Economic Review*, 104(12):4104–4146.

Ottaviano, G. I. and Peri, G. (2012a). Rethinking the effect of immigration on wages. *Journal of the European Economic Association*, 10(1):152–197.

Ottaviano, G. I. P. and Peri, G. (2012b). Rethinking the effect of immigration on wages. *Journal of the European Economic Association*, 10(1):152–197.

Ottaviano, G. I. P., Peri, G., and Wright, G. C. (2013). Immigration, offshoring, and american jobs. *American Economic Review*, 103(5):1925–59.

Paravisini, D. (2008). Local bank financial constraints and firm access to external finance. *The Journal of Finance*, 63(5):2161–2193.

Paravisini, D., Rappoport, V., and Schnabl, P. (2015a). Specialization in bank lending: Evidence from exporting firms. Working Paper 21800, National Bureau of Economic Research.

Paravisini, D., Rappoport, V., Schnabl, P., and Wolfenzon, D. (2015b). Dissecting the effect of credit supply on trade: Evidence from matched credit-export data. *The Review of Economic Studies*, 82(1):333–359.

Parrotta, P. and Pozzoli, D. (2012). The effect of learning by hiring on productivity. *RAND Journal of Economics*, 43(1):167–185.

Persson, M., Sundell, A., and ʹOhrvall Richard (2013). Does election day weather affect voter turnout? evidence from swedish elections. *Electoral studies*, (forthcoming on).

Radcliff, B. (1994). Turnout and the democratic vote. *American Politics Quarterly 22 (July): 259-76.*

Ramondo, N., Rodríguez-Clare, A., and Saborío-Rodríguez, M. (2016). Trade, domestic frictions, and scale effects. *The American Economic Review*, 106(10):3159–3184.

Rauch, J. E. (1999). Networks versus markets in international trade. *Journal of international Economics*, 48(1):7–35.

Redding, S. J. (2016). Goods trade, factor mobility and welfare. *Journal of International Economics*, 101:148–167.

Redding, S. J. and Rossi-Hansberg, E. (2016). Quantitative spatial economics. Working Paper 22655, National Bureau of Economic Research.

Redding, S. J. and Sturm, D. M. (2008). The costs of remoteness: Evidence from german division and reunification. *The American Economic Review*, 98(5):1766–1797.

Richards, G. S. and Duxbury, L. (2015). Work-group knowledge acquisition in knowledge intensive public-sector organizations: An exploratory study. *Journal of Public Administration Research and Theory*, 25(4):1247–1277.

Schank, T., Schnabel, C., and Wagner, J. (2007). Do exporters really pay higher wages? First evidence from German linked employer-employee data. *Journal of International Economics*, 72(1):52–74.

Schnabl, P. (2012). The international transmission of bank liquidity shocks: Evidence from an emerging market. *The Journal of Finance*, 67(3):897–932.

Silva, J. S. and Tenreyro, S. (2006). The log of gravity. *The Review of Economics and statistics*, 88(4):641–658.

Song, J., Almeida, P., and Wu, G. (2003). Learning–by–hiring: When is mobility more likely to facilitate interfirm knowledge transfer? *Management science*, 49(4):351–365.

Syverson, C. (2010). What determines productivity? NBER Working Papers 15712, National Bureau of Economic Research.

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R., and de Vries, G. J. (2015a). An illustrated user guide to the world input–output database: the case of global automotive production. *Review of International Economics*, 23(3):575–605.

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R., and Vries, G. J. (2015b). An illustrated user guide to the world input–output database: the case of global automotive production. *Review of International Economics*, 23(3):575–605.

Tombe, T. and Zhu, X. (2015). Trade, migration and productivity: A quantitative analysis of china. *Manuscript, University of Toronto*.

Tsai, W. (2001). Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *Academy of management journal*, 44(5):996–1004.

Verba, S. and Nie, N. H. (1972). *Participation in America: Political Democracy and Social Equality*. New York: Harper & Row.

Wooldridge, J. M. (2009). On estimating firm-level production functions using proxy variables to control for unobservables. *Economics Letters*, 104(3):112 – 114.

Young, A. (2013). Inequality, the urban-rural gap, and migration. *The Quarterly Journal of Economics*, 128(4):1727–1785.