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Three Essays on International Trade

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Pinar Kaynak

M.Sc. in International Economics

Université de Lausanne

born on March 9, 1987

citizen of Turkey

accepted on the recommendation of

Professor Peter H. Egger, ETH Zürich, examiner

Professor Joseph Francois, University of Bern, co-examiner

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Abstract

This dissertation is a collection of three papers studying the effects of international trade on total welfare and labor markets. Collectively, these papers present three different assessments of trade policy from both theoretical and empirical points of view. The first paper focuses on welfare effects of trade policy, while the remaining two are concerned with labor market effects of international trade.

The paper in Chapter 2 quantifies trade effects of changes in trade costs exploiting a multi-country, multi-sector framework. In this paper, I use a panel of 32 OECD countries and 20 manufacturing sectors covering the years from 1996 to 2009 to estimate sectoral trade elasticities in the short run and the long run separately, and find a large degree of variation across sectors, with the estimates ranging from 1.4% to 15.5% in the short run and 6.2% to 25% in the long run. Leather products turned out to be the sector with the largest difference between short-term and long-term elasticities, whereas Office equipments sector displayed the smallest gap between these elasticities. Then, I conduct two counterfactual experiments in the short run and the long run, using the corresponding sectoral trade elasticities to see how consumer welfare would have been affected under two different scenarios. Under the first scenario, tariffs remain unchanged at their 1996 level, whereas the second scenario considers, the effects of a 10% reduction in trade costs worldwide. I find that an average country would suffer an almost 7% loss in real income in the short run and 3.8% loss in the long run, had the tariffs remained at their (higher) 1996 level. On the other hand, an average country would enjoy a 3.6% improvement in real income in the case of a 10% homogeneous reduction in trade costs in the short run and 3.8% improvement in real income in the long run. My results indicate that if the tariff levels remained at 1996 levels, Eastern European countries would have suffered the largest losses both in the short run and in the long run. In the case of a 10% reduction in all trade costs, on the other hand, all countries would have been better off except for Mexico in the short run, and there would be no losers in the long run.

The second paper in Chapter 3, co-authored with Peter Egger and Benedikt Rydzek-Zoller, studies the direct and indirect general equilibrium effects of export exposure and import competition on

labor markets. There we consider the impact of export and import competition on local labor-market outcomes in an emerging economy, namely Turkey. We find that notable adjustments to changes in exports mainly happen at the extensive, per-capita-employment margin, and to a much smaller extent at the intensive margins such as hours worked. These changes are mainly driven by direct export exposure of regions (direct effect). We only find very limited and small labor-market effects through import competition. In an emerging economy such as Turkey, import-competing channel seems less effective and most of the labor-market effects are driven by increased export exposure.

Shifting the focus to the firm side, the third paper in the last chapter, again co-authored with Peter Egger and Benedikt Rydzek-Zoller, explores how the global market entry status affects wage premia, when firms are classified into three categories: domestic exporters, non-exporting multinational enterprises, and exporting multinational enterprises (MNEs). Using French firm-level panel data for the years from 2006 to 2012 and a multivariate endogenous treatment model relying on the approach of Wooldridge (1995), we find that both domestic exporters and exporting MNEs pay, on average, higher wages than non-exporting firms, whereas non-exporting MNEs tend to pay lower wages than non-exporting domestic firms.

Zusammenfassung

Diese Dissertation umfasst eine Zusammenstellung von Papieren über die Auswirkungen der Handelspolitik auf die allgemeine Wohlfahrt und die Arbeitsmärkte. Die einzelnen Kapitel stellen drei verschiedene Einschätzungen der Handelspolitik aus theoretischer sowie aus empirischer Sicht dar. Das erste Papier konzentriert sich auf die Wohlfahrtseffekte der Handelspolitik, während die beiden anderen sich mit den Arbeitsmarkteffekten des Welthandels befassen.

Das dritte Kapitel beziffert die Auswirkungen auf den Handel aufgrund von Veränderungen der Kosten des Handels mit Hilfe eines länder- und sektorübergreifenden Ansatzes. Unter Verwendung eines Panels von 32 OECD-Ländern und 20 Sektoren des verarbeitenden Gewerbes, das die Jahre 1996 bis 2009 umfasst, werden sektorale Handelselastizitäten auf kurze und lange Sicht getrennt geschätzt und ein grosses Mass an Heterogenität zwischen den Sektoren festgestellt, wobei die Schätzungen zwischen 1,4% bis 15,5% auf kurze Sicht und 6,2% bis 25% auf lange Sicht liegen. Der grösste Unterschied hinsichtlich der Grössenordnung findet sich bei Lederprodukten, während der Sektor Büroausrüstung den geringsten Unterschied zwischen kurz- und langfristigen Elastizitäten aufweist. Anhand der geschätzten Handelselastizitäten führe ich anschliessend zwei kontrafaktische Experimente auf kurze Sicht sowie auf lange Sicht mit den entsprechenden sektoralen Handelselastizitäten durch, um zu ermitteln, wie gut oder schlecht es den Verbrauchern ergangen wäre, wenn die Zölle unverändert auf dem Niveau von 1996 geblieben wären bzw. wenn die Handelskosten weltweit um 10% gesenkt worden wären. Auf kurze Sicht stelle ich fest, dass ein durchschnittliches Land dank der Zollsenkungen eine Verbesserung des Realeinkommens um fast 7% erfahren hat, während ein durchschnittliches Land im Falle einer homogenen Senkung der Handelskosten um 10% 3,6% an Realeinkommen gewonnen hat. Langfristig gesehen hat ein durchschnittliches Land eine Verbesserung von fast 3,8% des Realeinkommens sowohl durch Zollsenkungen als auch durch eine gleichmässige Senkung der Handelskosten um 10% erfahren. Wären die Zölle auf dem (höheren) Niveau von 1996 geblieben, hätten die osteuropäischen Länder kurzfristig und langfristig am meisten verloren. Im Falle einer 10%-igen Senkung aller Handelskosten wären alle Länder mit Ausnahme Mexikos kurzfristig besser dran gewesen und es gäbe auf lange Frist keine Verlierer.

Das vierte Kapitel, das die direkten und indirekten allgemeinen Gleichgewichtseffekte von Exportexponierung und Importkonkurrenz auf den Arbeitsmärkten analysiert, wurde gemeinsam mit Peter Egger und Benedikt Rydzek-Zoller verfasst. Wir analysieren die Auswirkungen des Export- und Importwettbewerbs auf die Entwicklung des lokalen Arbeitsmarktes in einer aufstrebenden Wirtschaft, der Türkei. Wir finden auffällige Anpassungen an die Veränderungen der Exporte der extensiven Pro-Kopf-Arbeitsangebot und in viel geringerem Masse am intensiven Arbeitsangebot wie den Arbeitsstunden. Diese Veränderungen werden vorwiegend durch die direkte Exportexposition der Regionen (direkter Effekt) angetrieben.

Das letzte Kapitel, das gemeinsam mit Peter Egger und Benedikt Rydzek-Zoller verfasst wurde, verlagert den Schwerpunkt auf die Firmenseite und befasst sich mit der Frage, wie sich der Zustand des globalen Markteintritts auf die Lohnprämien auswirkt, wobei die Unternehmen in drei Kategorien eingeteilt werden: inländische Exporteure, nicht exportierende multinationale Unternehmen und Export multinationaler Unternehmen. Anhand von französischen Paneldaten auf Unternehmensebene der Jahre 2006 bis 2012 und unter Verwendung eines multivariaten endogenen Treatmentmodells gemäss Wooldridge (1995) stellen wir fest, dass inlöndische Exporteure und exportierende multinationale Unternehmen im Durchschnitt höhere Löhne zahlen als nicht-exportierende Unternehmen (sowohl inländische als auch multinationale Unternehmen), wobei nicht-exportierende multinationale Unternehmen tendenziell niedrigere Löhne zahlen als nicht-exportierende inlöndische Unternehmen.

Chapter 1

Introduction

Trade patterns that affect many actors in the economy have a big role in an era of globalization. In today's world, all countries engage in trade, and hence trade policies are of crucial importance. Every country is affected up to a certain extent due to a change in trade policy design even in one country. This dissertation takes up the challenge of improving the estimation of trade effects on welfare and labor markets in countries.

This thesis consists of three chapters that assess the effects of different trade policy instruments. While the first paper is concerned about quantifying welfare effects of trade in a dynamic framework, the remaining two chapters will focus on labor-market and firm-level effects of international trade.

The subsequent chapter quantifies trade effects of changes in trade costs exploiting a multi-country, multi-sector framework in the same spirit as Caliendo and Parro (2014). Using a panel of 32 OECD countries and 20 manufacturing sectors covering the years from 1996 to 2009, it proposes a new methodology to estimate sectoral trade elasticities employing the Arellano and Bond (1988) estimator, taking into account the dynamic nature of the variables, while differentiating short-run and long-run trade elasticities. Empirical findings suggest a large degree of heterogeneity across sectors with the short-run estimates ranging from 1.4% to 15.5% , and long-run estimates ranging from 6.2% to 25%. Then, the estimated elasticities are used to identify the impact of different trade policy scenerios. As in Dekle et al. (2007), the counterfactual outcomes are calculated expressing the model in relative changes, which gives the advantage of few data and parameter requirements which are bilateral trade flows, production, tariffs and estimates of sectoral trade elasticities. Distinguishing short-run and long-run impacts, I find that welfare would be less by 7% on average in the short run and by 3.8% in the long run had the tariffs remained at (higher) 1996 level. In this case, Eastern European countries would have lost the most in the short run *and* in the long run as they are the ones experience most reductions due to joining the European Union. In case of a 10% reduction in all trade costs, an average country would gain 3.6% and 3.8% in the short run and long run, respectively. The results suggest that, all countries would have been better off except for Mexico in the short run and in the long run there are no losers.

Shifting the focus to labor-market effects of trade, the third chapter (which is co-authored with Peter Egger and Benedikt Rydzek-Zoller) analyzes the direct and indirect effects of export exposure and import competition on local labor markets in an emerging economy, namely Turkey. Less developed and transition countries compete with each other for demand in developed economies, they tend to produce at much higher labor intensity than developed economies do, and they are less capable of absorbing adverse shocks than developed countries due to weaker social security systems, less accumulated wealth, lower savings rates, and more flexible and less formal labor markets; see Rodrik (2006) and Nordman and Pasquier-Doumer (2015). Hence, export competition effects on local labor markets in less developed and transition economies may be quantitatively quite important. The extent to which these trade shocks (in developed countries) have spillovers to countries that export to the developed markets is not clear and did not receive much attention in earlier academic work. We aim at filling this gap by allowing for both export competition and import competition in Turkey as a response to overall trade liberalization. By considering multilateral export shocks, two effects on Turkish labor markets are of interest. First, an export shock for Turkey vis-a-vis another country may generate employment effects in Turkish labor markets. We refer to this as the *direct* effect. Second, trade shocks in countries competing with Turkey in the same export markets might negatively impact Turkish labor markets. We refer to the latter as the *indirect* effect. In this sense our analysis is an extended flip-side of Autor et al. (2013, 2016): export shocks might increase employment in the exporting country and third-country (indirect) competition effects can cushion these outcomes. We find that, in a transition economy such as Turkey, it seems that the import-competing channel is much more limited and most of the labor-market effects are driven by increased export exposure. Competition effects from third countries on Turkish export markets have a cushioning effect on the country's labor-market outcomes in accordance with theoretical expectations.

The final chapter (co-authored with Peter Egger and Benedikt Rydzek-Zoller) assesses the link between firms' international activities and wage inequality which has been the center of attention for a long time. Wage inequality may be the outcome of two alternative mechanisms at work: specialization forces and comparative advantage on the one hand, whereby workers in some (firms and) sectors win while others lose in labor markets with some frictions; and premia paid to workers of firms which gain from globalization relative to others even within sectors. With an interest in the three firm-status-related wage premia (relative to non-exporting domestic firms) we classify firms as: exporting domestic firms (E), non-exporting multinational enterprises (M), exporting multinational enterprises (ME), and the remainder reference category (non-exporting domestic firms). Relying on French firm-level data we build on the self-selection approach for panel data by Wooldridge (1995) and modify it to a setting with three mutually exclusive endogenous treatments as regressors of interest in a regression with log firm-level average wages per worker as the dependent variable. We find that while workers of exporting-only firms and exporting-multinational enterprises (MNEs) enjoy a significant wage premium, employees of MNE-only firms face a negative effect. Our results indicate that the wage premium of MNEs is based less on the MNE-status and much more on the exporting-status of the firm. Our results suggest that non-MNE exporters pay premia over comparable non-exporters of $100\exp(0.929) - 100 \approx 153\%$ for their average worker. MNE exporters pay a smaller premium of $100\exp(0.275) - 100 \approx 32\%$, and non-exporting MNEs pay an average wage which is $100\exp(-0.283) - 100 \approx 33\%$ lower than that of comparable non-exporting domestic firms.

Chapter 2

Estimating Trade Elasticities for Manufacturing Industry in the OECD Countries: A Dynamic Gravity Application

2.1 Introduction

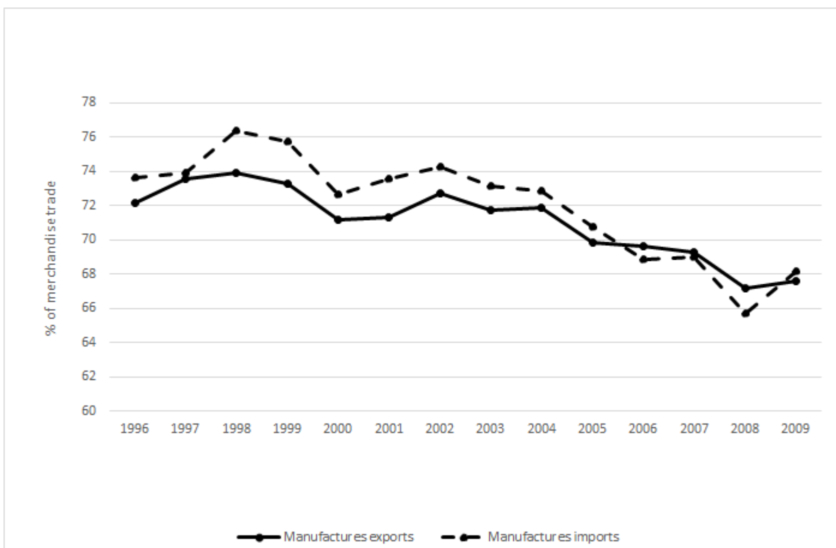
Since the introduction to the literature by the early work of Tinbergen (1962), the gravity model of trade has been one of the main instruments to explain the volume and geographical structure of trade (see Anderson (1979), Anderson and Van Wincoop (2003), Baltagi et al. (2014), Head and Mayer (2014), Egger and Staub (2016) for a select list of studies of that model). Pioneered by Eaton and Kortum (2002), the multi-country version of Ricardian trade model has become the dominant tool to explain trade mechanism and study the impact of trade costs (e.g. tariffs) for trade, prices and consumer welfare, in a gravity framework (see Alvarez and Lucas Jr. (2007), Dekle et al. (2007), Costinot et al. (2011), Fieler (2011), Shikher (2012), Caliendo and Parro (2014), Egger and Nigai (2015), Levchenko and Zhang (2016)).

The versions of the gravity equation such as the one by Eaton and Kortum (2002) supports structural estimation where all parameters of the model are estimated within the same data that the model is estimated on and calibrated to. However, with such an approach often – if not typically – quantitative trade models do not distinguish short-run and long-run effects of trade shocks, implicitly assuming that they are identical. Hence, the accumulation of responses over time is unclear.

In this study, the aim is to fill this gap and develop a model by extending the Eaton and Kortum (2002) framework into a multi-country multi-sector setup while incorporating the dynamic nature of responses.

In this study, I focus on trade flows in final goods in manufacturing sectors as trade in manufactures constitute the vast majority of world trade (see Figure 2.1). I specifically consider trade within the OECD countries between 1996 and 2009. I assume that markets are perfectly competitive, labor is the only factor of production which is perfectly mobile across sectors, but immobile across countries. Productivity and the dispersion of productivity are different among sectors. Productivity differences are introduced along the same lines as Eaton and Kortum (2002). Bilateral trade shares combined with the dispersion of productivities discipline the impact of a change in trade costs.

Figure 2.1: Share of manufactures in world merchandise trade



Source: World Bank. Years 1996 to 2009.

Trade elasticities are estimated employing the Arellano and Bond (1988) estimator. Then, using the estimated values counterfactual outcomes are calculated in the same spirit as in Dekle et al. (2007) by expressing the model in relative changes. This is an important trait of the model as there are limited data and parameter requirements which are bilateral trade flows, production, tariffs and estimates of sectoral trade elasticities.

I find significant heterogeneity *both in short run and long run* sectoral trade elasticities. The short-run trade elasticities lie between 1.4% to 15.5%, which fall fairly within the range of estimates in the literature, while the long-run trade elasticities vary between 6.2% and 25%. Regarding wealth effects, the empirical analysis largely confirms theoretical predictions. Briefly, the majority of countries benefit from a reduction in trade costs.

This work relates to several strands of the literature. First, it relates to a large body of work on new general equilibrium models of trade such as Eaton and Kortum (2002), Anderson and Van Wincoop (2003), Alvarez and Lucas Jr. (2007), Costinot et al. (2011), Arkolakis et al. (2012), Egger et al. (2012), Eaton and Kortum (2012), Eaton et al. (2016), Hsieh and Ossa (2016) where they quantify welfare effects of trade due to technology or trade cost changes. It also relates to multi-sector versions of such models, e.g., Dekle et al. (2007), Costinot et al. (2011), Fieler (2011), Shikher (2012), Caliendo and Parro (2014), Simonovska and Waugh (2014), Egger and Nigai (2015). Beyond these, it relates to studies on the estimation of trade costs and elasticities. Anderson and Van Wincoop (2003), Imbs et al. (2010), Bergstrand et al. (2013), Marquez (2013), Caliendo and Parro (2014), Simonovska and Waugh (2014), Egger and Nigai (2015), Egger, Francois and Nigai (forthcoming) report estimates of trade elasticities using different techniques. Lastly, it relates to the dynamic panel estimation literature applied to trade (see Greenaway et al. (2002), Faustino and Leitão (2007), Desmet et al. (2018)).

This paper contributes to the mentioned strands of literature in two ways: (i) it estimates trade elasticities inspired by the approach of Arellano and Bond (1988) which had been designed for few time periods and many cross-sectional units, and for independent variables that are not strictly exogenous (see Roodman (2009)) and it casts this design in the context of gravity model of trade; (ii) it distinguishes short-run and long-run trade effects on welfare.

The paper is structured as follows. The subsequent section outlines the model. Section 2.3 presents the data and estimation strategy. Section 2.4 shows the estimation results. Section 2.5 presents the counterfactual analysis. Finally, the last section concludes with a summary of the main findings.

2.2 The quantitative model

In this section, I sketch out a multi-country multi-sector general equilibrium version of trade as in Caliendo and Parro (2014). The model mainly builds on Eaton and Kortum (2002)'s model of Ricardian trade with a continuum of goods $\omega \in [0, 1]$. There are N countries and S sectors. I denote countries by i and j and sectors by s. Unless otherwise indicated country i is the exporter and country j is the importing country. There are only manufacturing sectors and all markets are perfectly competitive. Labor is the only factor of production and it is fully mobile across sectors and immobile across countries.

2.2.1 Households

Each country i is endowed with L_i representative households who maximize their utility by consuming goods from sector s C_i^s. The preferences of households are given by

$$u(C_i) = \prod_{s=1}^{S} C_i^{s\alpha_i^s} \quad \text{where} \quad \sum_{s=1}^{S} \alpha_i^s = 1. \tag{2.1}$$

As labor is the only source of income and supplied inelastically, the utility function is maximized subject to total income, Y_i, which we will see in a moment.

As it is standard in the literature, prior to consumption individual varieties are assumed to be combined according to a sector-specific constant-elasticity-of-substitution (CES) aggregator

$$Q_i^s = \left[\int q_i^s(\omega^s)^{1-\frac{1}{\sigma^s}} d\omega^s \right]^{\sigma^s/(\sigma^s-1)}, \tag{2.2}$$

where $\sigma^s \geq 0$ is the elasticity of substitution across goods within sector s and $q_i^s(\omega^s)$ is the demand for good ω^s. This maximization is subject to a budget constraint that aggregates buyers in country i to X_i, country i's total spending, where $X_i = \sum_1^S X_i^s$ and $X_i^s = \int_0^1 q_i^s(\omega) p_i^s(\omega)$.

The solution to the problem of the consumer gives the following demand for good ω^s in country i

$$q_i^s(\omega^s) = \left(\frac{p_i^s(\omega^s)}{P_i^s} \right)^{-\sigma^s} Q_i^s. \tag{2.3}$$

CES preferences yield a Dixit-Stiglitz price index

$$P_i^s = \left[\int p_i^s(\omega^s)^{1-\sigma^s} d\omega^s \right]^{1/(1-\sigma^s)}, \tag{2.4}$$

where $p_i^s(\omega^s)$ denotes the lowest price of good ω^s across all locations i.

2.2.2 Goods

A continuum of goods $\omega^s \in [0, 1]$ is produced in each sector s. Productivity of producers of goods differs across sectors and countries. The efficiency of producing good ω^s in country i is denoted by $z_i^s(\omega^s)$. The distribution of productivities among goods are independent across countries and sectors. The production technology of a good ω^s is given by

$$q_i^s(\omega^s) = z_i^s(\omega^s) l_i^s(\omega^s), \tag{2.5}$$

where $l_i^s(\omega^s)$ is the amount of labor employed within the production process. I assume that there is perfect competition and production with constant returns to scale. So, firms price at unit cost

$$p_i^s(\omega^s) = c_i / z_i^s(\omega^s), \tag{2.6}$$

where c_i denotes the unit cost which is simply given by

$$c_i = w_i, \tag{2.7}$$

and w_i is the country-specific wage. As I assume labor is fully mobile across sectors, therefore wages do not vary across sectors.

2.2.3 International trade costs and prices

I assume that there are two types of trade costs: iceberg trade costs and ad-valorem flat-rate tariffs. Iceberg costs are defined in physical units as in Samuelson (1954), one unit of a tradable good in sector s shipped from country i to country j requires producing $d_{ij}^s \geq 1$ units in i, with $d_{jj}^s = 1$. Country j has to pay an ad-volerem flat-rate tariff τ_{ij}^s over the goods that are imported from country i. Combining both trade costs we obtain

$$\kappa_{ij}^s = \tilde{\tau}_{ij}^s d_{ij}^s, \tag{2.8}$$

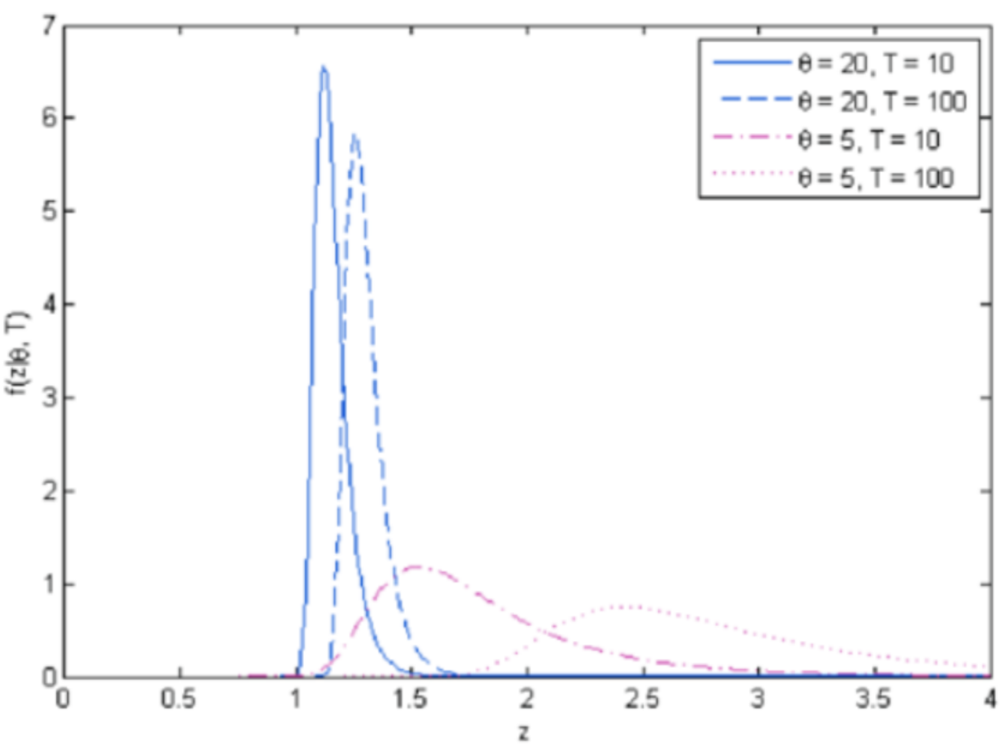
where $\tilde{\tau}_{ij}^s = (1 + \tau_{ij}^s)$. Additionally, to avoid any type of arbitrage I assume that the triangular inequality $\kappa_{jh}^s \kappa_{hi}^s \geq \kappa_{ji}^s$ holds for all j, h, i.

A unit of a good ω^s produced in country i will be available in country j at unit prices $\frac{c_i \kappa_{ij}^s}{z_i^s(\omega^s)}$. I assume that all countries buy from the lowest cost supplier, hence, the price of the good ω^s in country i is given by

$$p_i^s(\omega^s) = \min_j \left\{ \frac{c_j \kappa_{ji}^s}{z_j^s(\omega^s)} \right\}. \tag{2.9}$$

As already mentioned, I assume that the efficiency of producing a good ω^s in any country i varies by country and sector and follows a Fréchet distribution with a location parameter, $T_i^s \geq 0$, that varies by country and sector, and shape parameter, θ^s, that varies by sector. These distributions are independent across countries and sectors. In the context of this model, a higher T_i^s implies a higher average productivity in a given country-sector pair, and a lower θ^s means a higher dispersion of productivity across goods. Translating these parameters into trade terminology, T_i^s can be interpreted in two ways. First, it can be interpreted as an indicator of comparative advantage across industries. For example, if $T_i^s/T_j^s/ > T_i^m/T_j^m$, then country i has comparative advantage in industry s. Second, it can also be interpreted as the absolute advantage of a country for a given sector. For instance, if $T_i^s > /T_j^s$ then country i has an absolute advantage over country j in sector s. On the other hand, parameter θ^s identifies the comparative advantage across goods within a specific industry. A lower value of θ^s indicates more dispersion of productivities among producers, meaning a higher comparative advantage within the industry. Figure 2.2 depicts examples of Fréchet distribution with different values of θ^s and T_i^s.

Figure 2.2: Fréchet distribution depiction



Source: Fieler (2011)

In the context of this paper, two factors determine the cost of production in country i in comparison to country j in any sector s: (i) the relative effective wages $\left(\frac{\kappa_{ij}^s w_i}{w_j}\right)$; (ii) relative technology parameters.[1] As θ^s increases $\left(\frac{T_i^s}{T_j^s}\right)^{-1/\theta^s}$ coverges to 1 and effective wages overtake technology in determining costs. That is why lower-income countries tend to specialize in sectors where θ^s is high, because their cost advantage comes from low wages while higher-income countries tend to specialize in sectors with a low θ^s as their cost advantage comes from efficient production.

Following the properties of the Fréchet distribution, the sector-specific price index can be expressed as

$$P_i^s = \Upsilon^s \big[\sum_{h=1}^{N} T_h^s (c_h \kappa_{hi}^s)^{-\theta^s} \big]^{-1/\theta^s}, \tag{2.10}$$

for all sectors s and countries i where $\Upsilon^s = \left[\Gamma\left(\frac{\theta^s+1-\sigma^s}{\theta^s}\right)\right]^{1/(1-\sigma^s)}$ is a constant and Γ represents the Gamma function. [2]

I assume that consumers buy the goods at prices P_i^s. Assuming Cobb-Douglas preferences (see Equation (2.1)), the consumption price index in country i becomes

$$P_i = \prod_{s=1}^{S} (P_i^s / \alpha_i^s)^{\alpha_i^s}. \tag{2.11}$$

2.2.4 Expenditure shares

Total expenditure on goods in sector s in country j is equal to $X_j^s = P_j^s Q_j^s$. X_{ij}^s denotes the expenditure of country j on sector s goods from country i. Country j's share of expenditure on goods from i are denoted by $\pi_{ij}^s = X_{ij}^s / X_j^s$. Using the properties of Fréchet distribution the expenditure share is derived as follows

$$\pi_{ij}^s = \frac{T_i^s [c_i \kappa_{ij}^s]^{-\theta^s}}{\sum_{h=1}^{N} T_h^s [c_h \kappa_{hj}^s]^{-\theta^s}}. \tag{2.12}$$

From the above equation we can see that bilateral trade shares π_{ij}^s takes the form of a multi-sector

[1] If we take the expectation of the cost of delivering one unit of good ω^s from country i to country j over ω^s we obtain: $\frac{E(p_{ij}^s(\omega^s))}{E(p_{jj}^s(\omega^s))} = \left(\frac{T_i^s}{T_j^s}\right)^{-1/\theta^s} \frac{\kappa_{ij}^s w_i}{w_j}$ (see Fieler (2011)).

[2] While this framework allows demand being inelastic, $\sigma^s \leq 1$, the restriction $\sigma^s < \theta^s + 1$ must hold to guarantee having a well defined price index (see Dekle et al. (2007)).

version of a gravity equation. Changes in tariffs have a direct effect in the shares via κ_{ij}^s. As θ^s goes up, the elasticity of bilateral trade share with respect to relative price and trade barriers increases. The intuition behind this is as follows: a higher θ^s implies lower heterogeneity of production efficiencies across goods in any sector s, depressing the comparative advantage within that sector. Therefore, fewer efficiency outliers will be able to resist against shocks in relative prices or trade barriers, and hence will be more affected (see Eaton and Kortum (2002)).

2.2.5 Total expenditure and trade balance

Total expenditure on sector s goods in country i is equal to

$$X_i^s = \alpha_i^s Y_i, \tag{2.13}$$

where Y_i is the total income in country i and is given by

$$Y_i = w_i L_i + R_i + D_i, \tag{2.14}$$

which is the sum of labor income, trade deficit D_i and tariff revenues R_i. Specifically,

$$R_i = \sum_{s=1}^{S} \sum_{j=1}^{N} \tau_{ij}^s M_{ij}^s \quad \text{where} \quad M_{ij}^s = X_i^s \frac{\pi_{ji}^s}{1 + \tau_{ji}^s},$$

and M_{ij}^s are country i's imports of sector s goods from country j. National deficits are the summation of sectoral trade deficits, $D_i = \sum_{s=1}^{S} D_i^s$ and sectoral deficits are defined as

$$D_i^s = \sum_{j=1}^{N} M_{ij}^s - \sum_{j=1}^{N} X_{ij}^s \quad \text{where} \quad X_{ij}^s = X_j^s \frac{\pi_{ij}^s}{1 + \tau_{ij}^s},$$

where X_{ij}^s are country i's exports to country j in sector s. Then, using the definition of expenditure and trade deficit we have

$$\sum_{s=1}^{S} \sum_{j=1}^{N} X_i^s \frac{\pi_{ji}^s}{1 + \tau_{ji}^s} - D_i = \sum_{s=1}^{S} \sum_{i=1}^{N} X_j^s \frac{\pi_{ij}^s}{1 + \tau_{ij}^s}. \tag{2.15}$$

2.3 Data and methodology

The model comes in handy as it requires only a few number of parameters and variables for the estimations and calculation of the counterfactuals. Similar to Caliendo and Parro (2014), we only need the vector of θ^s, α^s and bilataral trade shares to (i) calculate the evolution in trade costs and (ii) perform counterfactual analysis. In this section, data sources as well as the methodology used in the analysis are discussed.

2.3.1 Data description

This study employs data from various sources. Bilateral export flows are obtained from Organization for Economic Co-operation and Development (OECD) Structural Analysis (STAN) database. Quantity of exports are obtained from World Integrated Trade Solution (WITS) database. Finally, tariffs are sourced from United Nations Statistical Division-Trade Analysis and Information System (UNCTAD-TRAINS) database. In the end, due to data limitations 20 sectors are left. Table 2.1 shows the list of sectors included in the analysis.

Table 2.1: Industry classification

Number	Industry	ISIC Rev. 3
1	Food product and beverages	15
2	Tobacco products	16
3	Textiles	17
4	Wearing apparel,dressing and dyeing of fur	18
5	Leather, leather products and footwear	19
6	Wood and products of wood and cork	20
7	Pulp, paper and paper products	21
8	Printing and publishing	22
9	Coke, refined petroleum products and nuclear fuel	23
10	Chemicals and chemical products	24
11	Rubber and plastic products	25
12	Other non-metallic mineral products	26
13	Basic metals	27
14	Fabricated metal products, except machinery and equipment	28
15	Machinery and equipment, n.e.c.	29
16	Office, accounting and computing machinery	30
17	Electrical machinery and apparatus, n.e.c.	31
18	Radio, television and communication equipment	32
19	Medical, precision and optical instruments	33
20	Motor vehicles, trailer and semi-trailers	34

Bilateral Exports I use bilateral exports for the 20 manufacturing sectors shown in Table 2.1 of all 32 OECD countries covering years between 1996 to 2009. Bilateral exports data come from OECD STAN Bilateral Trade Database in goods. Values are reported in thousands of U.S. dollars at current prices. Sectors are defined using 2-digit ISIC Revision (Rev.) 3.

Tariffs Bilateral tariffs data at the sectoral level for the years between 1996 and 2009 are obtained from the UNCTAD-TRAINS. Simple average tariff rates are used. Since the European Union member countries do not impose any tariffs to each other, tariff rates among them are missing in the raw data. The tariff rates between these countries are set to 0% and included in the current data.

Prices (Unit Value of Exports) Prices are calculated as the value of exports divided by the quantity of exports. Value of exports is obtained from OECD STAN database and reported in thousands of national currency at current prices. Quantity of exports is obtained from WITS database. Commodities are defined using the Harmonized Commodity Description and Coding System (HS) 1988/1992 at the 6-digit level of aggregation and are concorded to 2-digit ISIC Rev. 3 using the United Nations concordance table.

Combining the aforementioned data, an unbalanced panel of 20 sectors for the years 1996-2009 covering 32 OECD countries[3] are constructed. Table 2.2 shows summary statistics of the variables.

Table 2.2: Descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Tariff	3.960	9.000	0	350	244,574
log(1+tariff)	0.969	1.037	0	5.861	244,574
Exports	189,405	1,062,094	0.001	6.60e+07	276,716
log(Exports)	8.591	3.414	-6.908	18.006	276,716
Price	0.063	1.737	4.49e-08	160.728	9,704
log(Price)	-5.373	1.927	-9.940	5.079	9,704

Notes: 32 OECD countries, 20 ISIC Rev. 3 sectors, and years between 1996-2009. Exports and tariffs are reporter-partner-sector-time ($ijst$) specific and prices are reporter-sector-time (ist) specific.

2.3.2 Informing the model from the data

In a large quantitative literature in economics, aggregate bilateral exports of country i to country j at time t, X_{ijt}, are derived to be determined by a multiplicative function which includes three components: exporter-time specific factors, A_{it}; importer-time specific factors, B_{jt}; and exporter-importer-time specific factors, K_{ijt} (see Egger and Nigai (2015)). Following this, a generic gravity model including these components may be formalized as

$$X_{ijt} = A_{it} B_{jt} K_{ijt} U_{ijt}. \tag{2.16}$$

where U_{ijt} denotes a random measurement error about bilateral exports. This relationship can be extended to the sectoral level, where all of the aforementioned components vary across sectors,

[3]OECD countries include: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, United Kingdom (UK) and United States of America (USA).

$X^s_{ijt} = A^s_{it}B^s_{jt}K^s_{ijt}U^s_{ijt}$. As a first step, I express the deterministic part of Equation (2.16) in logarithmic form and estimate the following equation for each and every sector seperately

$$x^s_{ijt} = a^s_{it} + b^s_{jt} + \kappa^s_{ijt}. \tag{2.17}$$

Here, x^s_{ijt} is the log of exports from country i to country j in sector s at time t. a_{it} and b_{jt} are exporter-time and importer-time fixed effects, respectively. From now on, I use the convention of referring the log variables in small letters, and using capital letters otherwise. After decomposing bilateral trade flows as shown in Equation (2.17), I obtain the residual, κ^s_{ijt} which corresponds to trade costs.

Different than studies so far in trade literature (e.g. Eaton and Kortum (2002), Caliendo and Parro (2014) Novy (2013)), I take into account the dynamic structure of the prices and trade costs assuming both are path-dependent and a function of their previous values, and estimate the following equation for each and every sector seperately using Arellano-Bond estimator (see Arellano and Bond (1988)) [4]:

$$\kappa^s_{ijt} = \varphi^s \kappa^s_{ijt-1} + \theta^s \log(\tilde{\tau}^s_{ijt}) + \mu^s_{ij} + \upsilon^s_{ijt}, \tag{2.18}$$

where μ_{ij} are exporter-importer fixed effects and υ^s_{ijt} is the error term. I assume that trade costs only vary via variable trade costs in the short run, and therefore the coefficient of θ^s gives the trade elasticity in the short run. In the long-run, the past value of trade costs will have an impact on the trade elasticity as well, therefore the long-run trade elasticity will be different from the short run. I calculate the long-run elasticities using the conventional method where the sectoral long-run trade elasticity, θ^s_L is defined as

$$\theta^s_L = \frac{\theta^s}{1-\varphi^s}. \tag{2.19}$$

As a next step, I decompose the unit value of exports, again by employing Arellano-Bond estimator:

$$p^s_{it} = \xi^s p^s_{it-1} + \eta^s_i + \varepsilon^s_{it}, \tag{2.20}$$

where p^s_{it} is the log of prices, η^s_i is a country fixed-effect and ε^s_{it} is the error term.

[4] Arellano-Bond estimator is basically a "difference" GMM dynamic panel estimation technique and is designed for dynamic "small T, large N" panels (see Roodman (2006) and Roodman (2009) for more detailed explanation).

2.4 Empirical findings

Table 2.3 presents the estimates and heteroskedasticity-robust standard errors regarding Equation (2.18). As shown below, the magnitudes of the shape parameter θ^s vary significantly across sectors ranging from 1.4% to 15.5% in the short run, with an average of 7.48% and a variance of 0.001. Communication equipments sector has the lowest value of θ^s, followed by Office equipments and Food products. This implies that productivities of goods within these sectors are more dispersed, reinforcing the comparative advantage. On the other hand, Clothing, Tobacco products, and Fabricated metals display the highest values of θ^s. This means that the productivities are rather concentrated in these sectors.

Table 2.3: Determinants of trade costs

Sector	κ_{ijt-1}	$\log(\tilde{\tau}_{ijt})$	N	Hansen stat.	AR(2)
Food products	0.764^{***}	-0.036^{**}	11,094	0.156	0.983
	(0.109)	(0.016)			
Tobacco products	0.394^{***}	-0.139^{***}	4,999	0.150	0.181
	(0.061)	(0.036)			
Textiles	0.665^{***}	-0.061^{**}	10,831	0.178	0.125
	(0.117)	(0.025)			
Clothing	0.380	-0.155^{*}	10,294	0.350	0.390
	(0.306)	(0.081)			
Leather products	0.634^{***}	-0.077^{***}	9,929	0.179	0.252
	(0.072)	(0.025)			
Wood products	0.489^{***}	-0.106^{**}	10,137	0.352	0.049
	(0.171)	(0.045)			
Paper products	0.662^{***}	-0.051	10,277	0.482	0.163
	(0.086)	(0.032)			
Printing and publishing	0.628^{**}	-0.038	10,889	0.745	0.140
	(0.312)	(0.049)			
Coke and refined products	0.521	-0.078	8,188	0.170	0.278
	(0.465)	(0.116)			
Chemicals	0.574^{**}	-0.078	11,210	0.504	0.156
	(0.272)	(0.053)			
Plastics	0.581^{***}	-0.076^{***}	11,038	0.299	0.496
	(0.080)	(0.024)			
Non-metal products	0.634^{*}	-0.062	10,713	0.157	0.235
	(0.363)	(0.068)			
Basic metals	0.438^{***}	-0.120^{***}	10,529	0.150	0.121
	(0.043)	(0.038)			
Fabricated metal products	0.321	-0.117^{**}	10,726	0.205	0.216
	(0.262)	(0.056)			
Machinery	0.557	-0.041	11,198	0.072	0.194
	(0.390)	(0.054)			
Office equipments	0.485^{***}	-0.032	10,546	0.113	0.065
	(0.120)	(0.049)			
Electrical equipments	0.327	-0.106^{*}	11,024	0.201	0.392
	(0.282)	(0.056)			
Communication equipments	0.760^{***}	-0.014	10,760	0.130	0.374
	(0.107)	(0.020)			
Medical equipments	0.339^{***}	-0.070^{***}	11,058	0.150	0.088
	(0.040)	(0.034)			
Motor vehicles	0.736^{***}	-0.039^{*}	10,441	0.383	0.127
	(0.081)	(0.021)			

Notes: Standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively.

The estimates presented above are in the range of the ones in the literature. Figure 2.3 shows the comparison between the corresponding estimates in Caliendo and Parro (2014), Egger et. al (forthcoming) and my estimates. The estimates are fairly close to each other in some of the sectors, e.g., Electrical equipments, Textiles; and extremely close to one of the papers in several sectors, e.g., Chemicals, Paper products and Wood products. However, there is a significant difference in: Petroleum and Communications sectors. For the Petroleum sector, it is not very far from Egger et. al.'s estimate but quite different from that of Caliendo and Parro (2014). The reason might be that, as it depends on natural resources, the unit cost and tariff data might not be perfect. Regarding the Communications sector, the scope might differ depending on different sources of data, so the notable difference might be related to that. Overall, as my estimates fall within the range of estimates in the literature, I can confidently use them in the subsequent analysis.

Figure 2.3: Comparing estimates of θ^s

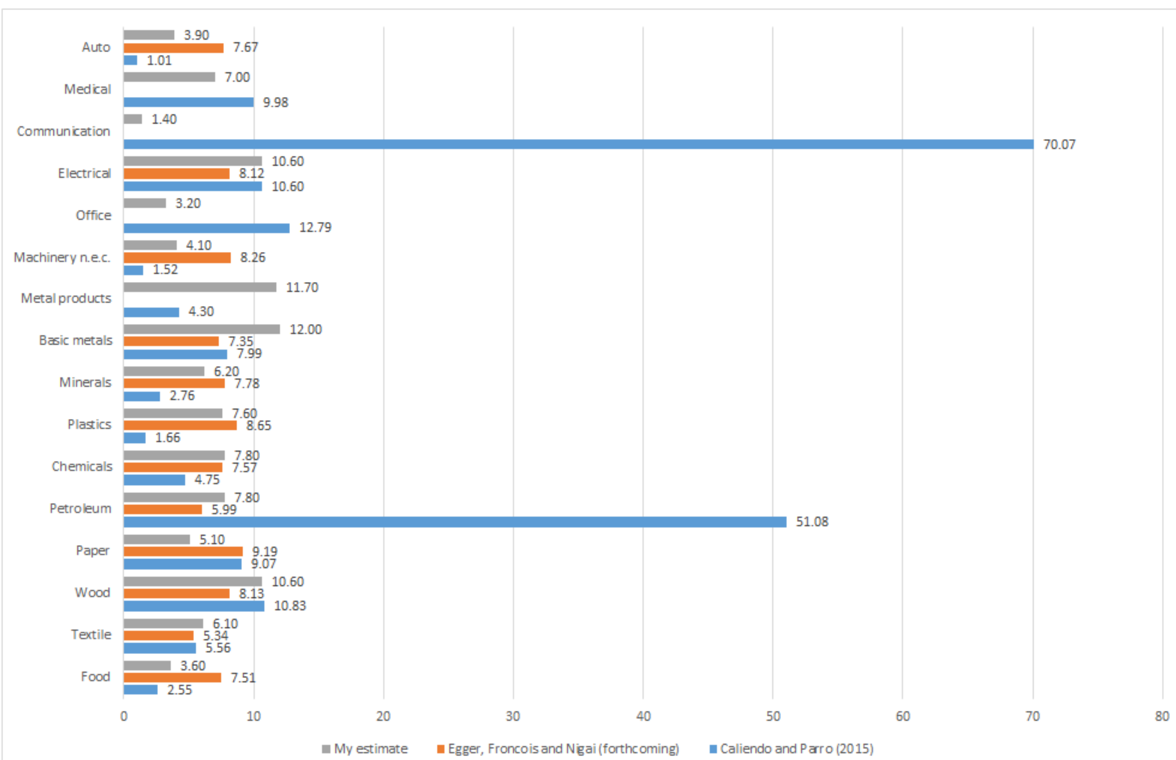


Table 2.4 shows the long-run trade elasticities, ranging from 6.2% to 25%. The average elasticity of trade is equal to 16%, which is more than double that of the short run. The variance is 0.002 which doubles the variance among short-run trade elasticities. In all sectors long-run trade elasticity is higher than short-run trade elasticity.

Similar to the short-run productivity dispesion parameter, we see significant variation among the sectors considering the long-run productivity dispesion parameter. The long-run dispersion parameter is related to the short-run dispersion parameter and the lagged values of trade costs (see Equation (2.19)). In the long run, the Clothing sector which has the highest short-run trade elasticity has also the biggest long-run trade elasticity, while the Communication equipments sector has the lowest long-run trade elasticity and also the lowest short-run trade elasticity.

Table 2.4: Productivity dispersion parameter: Long-run

Sector	θ_L^s	Sector	θ_L^s
Food products	0.153	Plastics	0.181
Tobacco products	0.229	Non-metal products	0.169
Textiles	0.182	Basic metals	0.214
Clothing	0.250	Fabricated metal products	0.172
Leather products	0.210	Machinery	0.093
Wood products	0.207	Office equipments	0.062
Paper products	0.151	Electrical equipments	0.158
Printing and publishing	0.102	Communication equipments	0.058
Coke and refined products	0.163	Medical equipments	0.106
Chemicals	0.183	Motor vehicles	0.148

Figure 2.4 shows the comparison of short-run and long-run trade elasticities in each sector. The biggest difference in terms of magnitudes is found for Leather products, while the Office equipments sector has the least gap between short-run and long-run elasticities.

Figure 2.4: Short-run vs. long-run trade elasticities

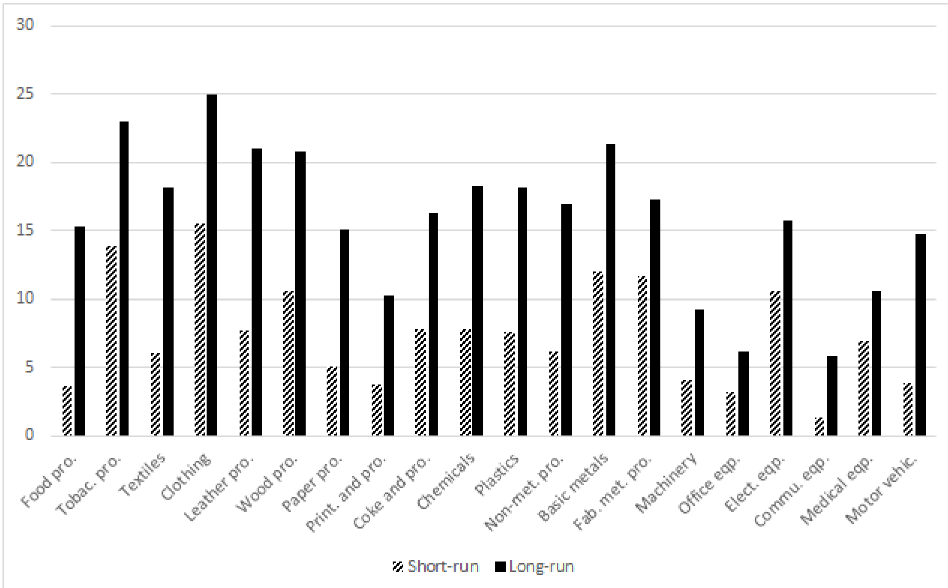


Table 2.5 shows the estimation results for Equation (2.20). The coefficients on the lagged value of prices vary notably. Coke and refined products sector have the lowest magnitude with 0.083 (which is not statistically significant) and Medical equipments sector have the highest magnitude with 0.894, which is statistically significant at the 1% level. One can see that prices in the majority of sectors are heavily dependent on past values. The sectors which are the most path-dependent after Medical equipments are Motor vehicles and Basic metals. Non-metal products and Machinery have also fairly large values.

Table 2.5: Decomposition of unit value of exports

Sector	$\log p_{it-1}$	Hansen stat.	AR(2)	N
Food products	0.392	0.224	0.559	429
	(0.248)			
Tobacco products	0.687***	0.116	0.946	398
	(0.168)			
Textiles	0.661***	0.176	0.802	429
	(0.171)			
Clothing	0.661***	0.243	0.271	429
	(0.084)			
Leather products	0.558***	0.385	0.688	429
	(0.100)			
Wood products	0.467*	0.312	0.522	426
	(0.268)			
Paper products	0.653***	0.553	0.587	429
	(0.179)			
Printing and publishing	0.583***	0.235	0.484	425
	(0.149)			
Coke and refined products	0.083	0.120	0.319	425
	(0.191)			
Chemicals	0.613***	0.181	0.264	429
	(0.048)			
Plastics	0.301**	0.109	0.236	429
	(0.157)			
Non-metal products	0.725***	0.275	0.825	427
	(0.158)			
Basic metals	0.802***	0.461	0.640	429
	(0.111)			
Fabricated metal products	0.716***	0.380	0.116	429
	(0.129)			
Machinery	0.758***	0.234	0.625	425
	(0.106)			
Office equipments	0.389***	0.127	0.453	425
	(0.130)			
Electrical equipmenst	0.303**	0.166	0.118	425
	(0.124)			
Communication equipments	0.582***	0.076	0.408	425
	(0.189)			
Medical equipments	0.894***	0.100	0.152	426
	(0.142)			
Motor vehicles	0.804**	0.162	0.269	425
	(0.083)			

Notes: Standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively.

Table 2.6 shows the determinants of exporter-fixed effects. Sectors which have the biggest coefficients on lagged values of exporter-fixed effects are Motor vehicles, Medical equipments and Machinery. These are also the sectors with high(est) adjustment costs. This implies that sectors in which exporter-fixed effects are heavily dependent on past prices are also the sectors in which prices conditional on fixed effects are heavily path-dependent.

Table 2.6: Determinants of exporter-fixed effects

Sector	a_{it-1}	N	Hansen stat.	AR(2)
Food products	0.832***	425	0.157	0.941
	(0.078)			
Tobacco products	0.528	392	0.184	0.322
	(0.529)			
Textiles	0.862***	425	0.230	0.442
	(0.107)			
Clothing	0.951***	425	0.198	0.238
	(0.044)			
Leather products	0.819***	425	0.276	0.155
	(0.085)			
Wood products	0.503	425	.	0.284
	(0.692)			
Paper products	0.508**	425	0.173	0.136
	(0.237)			
Printing and pub.	0.608**	425	0.122	0.261
	(0.257)			
Coke, refined products	0.665***	425	0.105	0.534
	(0.141)			
Chemicals	0.794***	425	0.095	0.780
	(0.236)			
Plastics	0.991***	425	0.229	0.644
	(0.005)			
Non-met. products	0.683***	425	0.093	0.180
	(0.202)			
Basic metals	0.420**	425	0.124	0.160
	(0.185)			
Fabricated metal products	0.887***	425	0.193	0.316
	(0.089)			
Machinery	0.963***	425	0.064	0.155
	(0.035)			
Office equipments	0.724***	425	0.707	0.246
	(0.200)			
Electrical equipments	0.790***	425	0.217	0.160
	(0.168)			
Communication equipments	0.919***	425	0.427	0.183
	(0.071)			
Medical equipments	0.996***	425	0.150	0.688
	(0.112)			
Motor vehicles	0.996***	425	0.323	0.298
	(0.296)			

Notes: Standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively.

2.5 Measuring the gains from changes in trade costs

Trade costs have been declining worldwide, but what would have happened had it remained unchanged? In this section, I tackle this issue by questioning how the welfare of consumers in each country would change if there were no change in tariffs between 1996 and 2009. Then, I take one step further, and ask how much the consumers would have gained or lost if there was a homegenous reduction of 10% in trade costs. In both cases I consider a reduction in trade costs, one stemming purely from a change in tariffs and one from a total reduction of 10% worldwide. I conduct the experiments for short-run and long-run responses within the proposed multi-country multi-sector model.

I adopt the approach proposed by Dekle et al. (2007) as applied by Caliendo and Parro (2014) in a multi-country multi-sector framework. Instead of solving for an equilibrium under alternative trade policies seperately, I make use of the notion of relative changes. Within this framework, one can identify the effects on equilibrium outcomes without being having to solve each and every equation one-by-one and without estimating parameters such as T_i^s and iceberg trade costs d_{ij}^s which are difficult to identify from the data.

Definition 1 *Let ($\mathbf{w}$, P) be an equilibrium under tariff structure τ and let ($\mathbf{w}$', P') be an equilibrium under tariff structure τ'. Suppose that there is a hypothetical change of tariff structure from τ to τ'. Define ($\hat{\omega}$, $\hat{P}$) as an equilibrium under the τ' relative to τ , where a variable with a hat $\hat{x}$ represents the relative change of that variable, namely $\hat{x} = x'/x$. Using* (2.7)*,* (2.10)*, and* (2.12) *changes in equilibrium conditions can be expressed as follows*:

$$\hat{c}_i = \hat{w}_i. \tag{2.21}$$

Then, changes in the price indices are calculated as

$$\hat{P}_i^s = \Big[\sum_{i=1}^{N} \pi_{ji}^s [\hat{\kappa}_{ji}^s \hat{c}_j]^{-\theta^s}\Big]^{-1/\theta^s}. \tag{2.22}$$

Changes in bilateral trade shares can be specified as [5]

$$\hat{\pi}_{ji}^{s} = \left[\frac{\hat{c}_j \hat{\kappa}_{ji}^{s}}{\hat{P}_i^{s}}\right]^{-\theta^s}. \tag{2.23}$$

Similarly, change in real wages can be given as

$$\log \frac{\hat{w}_i}{\hat{P}_i} = -\sum_{s=1}^{S} \frac{\alpha_i^s}{\theta^s} \log \hat{\pi}_{ii}^{s}. \tag{2.24}$$

Counterfactual total expenditure is defined as

$$X_i^{s'} = \alpha_i^s Y_i^{'}. \tag{2.25}$$

I assume trade deficits are exogenous, then, the counterfactual trade balance can be calculated as

$$\sum_{s=1}^{S}\sum_{j=1}^{N} \frac{\pi_{ji}^{s'}}{1+\tau_{ji}^{s'}} X_i^{s'} - D_i = \sum_{s=1}^{S}\sum_{j=1}^{N} \frac{\pi_{ij}^{s'}}{1+\tau_{ij}^{s'}} X_j^{s'}, \tag{2.26}$$

where $\hat{\kappa}_{ij}^{s} = (1+\tau_{ij}^{s'})/(1+\tau_{ij}^{s})$ and

$$Y_i^{'} = \hat{w}_i w i L_i + \sum_{s=1}^{S}\sum_{j=1}^{N} \tau_{ji}^{s'} \frac{\pi_{ji}^{s'}}{1+\tau_{ij}^{s'}} X_i^{s'} + D_i. \tag{2.27}$$

Finally, totally differentiating welfare, $Wel_i = Y_i/P_i$, after using the equilibrium conditions of the model, the change in welfare is given by

$$d\log Wel_i = \frac{1}{Y_i}\sum_{s=1}^{S}\sum_{i=1}^{N} \underbrace{(X_{ij}^{s} d\log c_i - M_{ij}^{s} d\log c_j)}_{\text{Terms of trade}} + \frac{1}{Y_i}\sum_{s=1}^{S}\sum_{j=1}^{N} \underbrace{\tau_{ij}^{s} M_{ij}^{s} (d\log M_{ij}^{s} - d\log c_j)}_{\text{Volume of trade}} \tag{2.28}$$

As we see from the set of equations above, I start by first solving the changes in wages, or in other words, cost of production. This system of equations provides an $N \times 1$ vector of wage changes. I use US wages as the numeraire.

[5] It is important to underline that in this model the elasticity of trade with respect to trade costs is the dispersion of productivity, which is not the same as the elasticity of substitution in Armington models. In this Ricardian-type model of trade bilateral trade flows do not depend on elasticity of substitution between goods, but only on the shape parameter governing the productivity dispersion, and the elasticity of trade with respect to trade costs is equal to θ^s.

2.5.1 Counterfactuals: Short run

I conduct two counterfactual experiments in the short run. In both experiments, I treat data from 2009 as a benchmark and see whether the consumers in each country would be better or worse off due to changes in tariffs and trade costs. In the first experiment, I investigate how much consumers would have gained or lost if there had been no change in tariffs relative to 1996. In the second experiment, I ask how much consumers would gain or lose if trade costs had been reduced by 10% globally. I choose to reduce trade costs by 10% as Anderson and Van Wincoop (2004) estimate about 10% of trade costs are policy-related trade barriers.

Experiment 1: Eliminating changes in tariffs

In the first experiment, I use the calculated trade cost changes from 1996 to 2009 and define the counterfactual change in tariffs as follows:

$$\hat{\tau}_{ij}^{s} = \frac{\tau_{ij,1996}^{s}}{\tau_{ij,2009}^{s}} \quad \text{for all} \quad i \neq j \quad \text{and} \quad s \in S. \tag{2.29}$$

The results are reported for every country in the sample in Table 2.7. I report (percentage) changes in real income, ΔW_i, nominal wages, Δw_i, and prices, ΔP_i. Δ indicates the percentage change of a variable with respect to the initial level of the variable, e.g. $\Delta W_i = (W_{i,2009} - W_{i,1996})/W_{i,1996} \times 100$. An average country would experience a loss of almost 7% in real income had the tariff levels remained at (higher) 1996 levels. Five top countries that would lose the most in that case are Estonia, Poland, Slovenia, Hungary, and Czech Republic that lost 19%, 16.1%, 16%, 13.5% and 14.8%, respectively. In other words, these are the countries which benefit (lower) 2009 tariff levels the most. This is expected as Eastern European countries are the ones which experienced the most considerable reduction in trade costs by joining the European Union (EU) in year 2004. Old members of the EU, such as Germany, France and Spain would lose from tariff increase as well but to a lesser extent. New Zealand, Korea and Japan which are far away from Europe would lose the least. In this sense, Mexico and Canada are outliers as they significantly lose from tariff rise. This might be due to common languages with EU countries and the colonial background. The results suggest that there are no winners.

Table 2.7: Counterfactual changes in welfare in Experiment 1: Short run

iso	ΔW_i	Δw_i	ΔP_i	iso	ΔW_i	Δw_i	ΔP_i
AUS	-4.857	-6.050	-1.192	ITA	-3.815	-3.333	0.482
AUT	-1.553	2.468	4.020	JPN	-3.283	-0.112	3.171
BEL	-4.367	-3.902	0.464	KOR	-1.191	0.105	1.296
CAN	-7.609	2.080	9.689	LUX	-3.839	-3.703	0.136
CHL	-5.332	0.322	5.654	MEX	-8.530	1.798	10.328
CHZ	-11.517	-3.098	8.419	NLD	-4.226	-3.729	0.497
DNK	-5.094	-3.903	1.191	NZL	-0.604	1.066	1.668
EST	-17.436	-5.567	11.869	NOR	-8.177	-5.336	2.841
FIN	-5.228	-4.319	0.909	POL	-14.608	-2.902	11.706
FRA	-3.409	-2.925	0.484	PRT	-2.466	-2.233	0.233
DEU	-4.057	-3.216	0.840	SLN	-14.275	-2.940	11.335
GRC	-4.537	-4.513	0.022	ESP	-3.316	-2.961	0.355
HUN	-12.904	-2.732	10.172	SWE	-6.698	-4.988	1.710
ISL	-9.401	-6.581	2.819	CHE	-7.077	-2.872	4.206
IRL	-3.620	-2.696	0.924	GBR	-4.499	-3.522	0.977
ISR	-5.176	1.563	6.740	USA	-3.642	0.000	3.642

Experiment 2: Reduction in trade costs

In this experiment, I examine the extent of potential gains or losses from a homogeneous reduction in trade costs. Here, I assume a marginal reduction of 10% across all international trade flows such that

$$\hat{\kappa}_{ij}^{s} = 0.9 \quad \text{for all} \quad i \neq j \quad \text{and} \quad s \in S. \tag{2.30}$$

Table 2.8 presents the results. An average country would gain 3.6% in terms of real income. Countries which would benefit the most are Norway, Japan, Switzerland, Australia and Iceland which gain 11.7%, 9.9%, 9.5%, 9%, and 8.6%, respectively. We see that the list and order of countries being affected the most (in absolute terms) from a 10% marginal reduction are quiet different than that of the previous experiment. In the second experiment, rather wealthier countries are affected the most– they gain the lion's share; while in the first experiment it is the Eastern European countries which suffer the most. This is because in the previous experiment the trade costs do not change proportionally, and, naturally, the Eastern European countries facing the highest increase in tariffs lose the most. However, in the case of a homogenous reduction, non-EU countries gain the most which did not face low trade barrier previleges previously. Also, in the second experiment, we see that how far countries are located from each other does not matter as much as before. The major losers of the previous example, Eastern European countries and Canada, gain the least in the second experiment. Mexico is the only country which is slightly worse off (due to trade diversion).

Table 2.8: Counterfactual changes in welfare in Experiment 2: Short run

iso	ΔW_i	Δw_i	ΔP_i	iso	ΔW_i	Δw_i	ΔP_i
AUS	8.909	3.038	-5.871	ITA	2.573	2.452	-0.121
AUT	5.960	-0.218	-6.177	JPN	9.867	0.785	-9.082
BEL	2.496	2.718	0.221	KOR	6.573	0.876	-5.697
CAN	0.413	-0.170	-0.583	LUX	1.962	2.596	0.633
CHL	3.083	0.249	-2.834	MEX	-0.161	-0.140	0.021
CHZ	1.718	2.303	0.585	NLD	2.393	2.598	0.205
DNK	2.559	2.684	0.124	NZL	2.787	0.297	-2.490
EST	3.016	3.458	0.442	NOR	11.433	3.241	-8.192
FIN	3.091	2.940	-0.151	POL	1.585	2.165	0.580
FRA	2.227	2.251	- 0.024	PRT	1.544	1.942	0.398
DEU	2.564	2.473	-0.092	SLN	1.567	2.215	0.648
GRC	2.879	2.976	0.097	ESP	2.225	2.251	0.026
HUN	1.573	2.146	0.573	SWE	3.380	3.306	-0.074
ISL	8.386	3.955	-4.430	CHE	9.133	2.180	-6.953
IRL	2.207	2.152	-0.055	GBR	3.171	2.645	-0.527
ISR	3.149	-0.002	-3.151	USA	4.837	0.000	-4.837

2.5.2 Counterfactuals: Long run

As mentioned earlier, I distinguish short-run and long-run welfare effects of trade policy. In this section, I investigate whether the welfare effects change by taking into account long-run trade elasticities. I conduct precisely the same experiments. The only difference is I use long-term trade elasticities instead of the short-term. In both experiments, I treat data from 2009 as benchmark and see how much each country would have gained or lost due to the changes in tariffs and trade costs in the long-run.

Experiment 1: Eliminating changes in tariffs

In this experiment, I investigate how much consumers would have gained if there had no change in tariffs been relative to 1996 and define tariff changes as shown in Equation (2.29).

The results are reported in Table 2.9 for every country in the sample. I report (percentage) changes in real income, ΔW_i, nominal wages, Δw_i, and prices, ΔP_i. An average country would experience a deterioration of almost 3.8% in real income thanks to increase in tariffs. The welfare effect for an average country is smaller (in absolute terms) than in the short run. This is expected as trade elasticities are higher in the long-run. In the overall picture, all countries lose less (in absolute terms) than they do in the short run. The top five losers are again the Eastern European countries and the order of the major losers do not change: Estonia, Poland, Slovenia, Hungary, and Czech Republic (in descending order) lose 12.7%, 10.9%, 10.5%, 8.8% and 8%, respectively. As underlined earlier, this is (mostly) because they would no longer enjoy tariff reductions (as they normally do due to the integration with the EU) in such a scenerio. Different than the short-run results, New Zealand, Korea and Australia gain.

Table 2.9: Counterfactual changes in welfare in Experiment 1: Long-run

iso	ΔW_i	Δw_i	ΔP_i	iso	ΔW_i	Δw_i	ΔP_i
AUS	-1.370	-4.518	-3.148	ITA	-1.633	-1.507	0.126
AUT	0.805	4.825	4.020	JPN	-1.516	1.365	2.882
BEL	-2.422	-2.144	0.278	KOR	1.155	1.826	0.670
CAN	-6.147	2.673	8.821	LUX	-1.893	-1.953	-0.060
CHL	-3.879	1.118	4.997	MEX	-7.429	2.014	9.443
CHZ	-8.033	-1.772	6.261	NLD	-2.266	-1.960	0.306
DNK	-2.926	-2.130	0.798	NZL	2.235	3.433	1.198
EST	-12.709	-3.613	9.097	NOR	-6.526	-3.862	2.663
FIN	-3.094	-2.562	0.532	POL	-10.909	-2.097	8.811
FRA	-1.273	-1.089	0.184	PRT	-0.397	-0.267	0.129
DEU	-1.965	-1.435	0.530	SLN	-10.545	-1.693	8.852
GRC	-2.088	-2.881	-0.793	ESP	-1.223	-1.199	0.024
HUN	-8.767	-1.083	7.684	SWE	-4.389	-3.408	0.982
ISL	-7.374	-5.029	2.347	CHE	-4.699	-1.082	3.617
IRL	-1.331	-0.778	0.553	GBR	-2.559	-1.866	0.694
ISR	-3.018	2.900	5.918	USA	-2.961	0.000	2.961

Experiment 2: Reduction in trade costs

In the last experiment, I examine the extent of potential gains from a homogeneous reduction in trade costs using the long-run trade elasticities. Similar to the second experiment, I assume a reduction of 10% as shown in Equation (2.30).

Table 2.10 presents the results. An average country would experience an improvement of 3.8% in its real income. In contrast to Experiment 1, an average country would gain almost equally both in the short run and the long run from such a policy change, although the distrubution of the gains is quite different. The top five winners remain the same in the long run (compared to the short run), however the order of the winners change: Norway, Japan, Switzerland, Iceland, Australia gain 10.8%, 9.7%, 9.1%, 8.1%, and 7.1%, respectively. Mexico and Canada gain slightly. In contrast to the short-run consequences, there are no losers in the long run.

Table 2.10: Counterfactual changes in welfare in Experiment 2: Long run

iso	ΔW_i	Δw_i	ΔP_i	iso	ΔW_i	Δw_i	ΔP_i
AUS	7.138	2.433	-4.705	ITA	2.896	3.046	0.150
AUT	6.684	0.507	-6.177	JPN	9.753	1.459	-8.295
BEL	2.912	3.296	0.382	KOR	7.121	1.983	-5.139
CAN	0.888	0.519	-0.370	LUX	2.458	3.135	0.677
CHL	2.401	0.564	-1.837	MEX	0.260	0.507	0.247
CHZ	2.212	2.861	0.649	NLD	2.779	3.144	0.365
DNK	2.931	3.232	0.3014	NZL	2.437	0.819	-1.618
EST	3.413	3.945	0.532	NOR	10.818	3.657	-7.161
FIN	3.439	3.567	0.128	POL	2.082	2.732	0.649
FRA	2.580	2.830	0.250	PRT	2.005	2.525	0.521
DEU	3.035	3.191	0.156	SLN	2.090	2.782	0.692
GRC	3.220	3.549	0.329	ESP	2.560	2.816	0.256
HUN	2.078	2.720	0.642	SWE	3.871	4.027	0.156
ISL	8.151	4.757	-3.394	CHE	9.051	2.739	-6.312
IRL	2.553	2.731	0.178	GBR	3.611	3.418	-0.193
ISR	2.908	0.581	-2.326	USA	3.393	0	-3.393

2.6 Conclusion

This study develops a general equilibrium model that quantifies short-run and long-run welfare effects of changes in trade costs. The model is very parsimonious with only a small number of parameter requirements. Using the model, first I show the channels in which trade policy impacts bilateral trade, prices and welfare. Second, I decompose trade cost into its components at the sector-exporter-importer-year level. Following this, I estimate short-run and long-run trade elasticities at the sectoral level. Finally, I quantify welfare effects of tariff changes.

I find that both long-run and short-run trade elasticities vary quite a lot across sectors. The average sectoral short-run elasticity is 7.48% lying between 1.4% to 15.5%, while the average long-run elasticity is 16% ranging between 6.2% to 25%. The heterogeneity in long-run elasticities across sectors is larger than the heterogeneity in the short run.

The results suggest that had the trade costs remained at the (higher) 1996 level, countries would have lost except for New Zealand, Korea and Japan relative to what actually happened. In this case, Eastern European countries would have lost the most in the short run *and* in the long run. In the case of a 10% reduction in all trade costs, all countries would have been better off except for Mexico. The top winners in this case would have been non-EU countries such as Norway, Japan and Australia. Overall, for all countries, the welfare effects are smaller in absolute terms in the long run than in the short run due to higher long-run than short-run trade elasticities. However, the list of top winners and losers from such a policy would be unchanged.

Nevertheless, the proposed analysis has some limitations: (i) this paper only focuses on the manufacturing sectors in 32 OECD countries ignoring manufactures trade in the rest of the world; and (ii) it imposes a common expenditure share for any sector across countries as is conventional in the literature. Interesting extensions in the future might relax these limitations -considering more countries, integrating services, allowing for some heterogeneity of consumer preferences across countries- and, eventually, even consider non-homothetic preferences.

2.7 Appendix

Without loss of generality, for the sake of simplicity in the derivations I drop superscript s which indicates sector-specific variables.

2.7.1 Supply side

The basic idea behind Eaton and Kortum (2002) is that a country $j \in N$ purchases a good $\omega \in \Omega$ from country $i \in N$ if: (i) it has a lower unit cost c_i^s; (ii) it has higher productivity $z_i(\omega^s)$; and or (iii) it has lower trade cost τ_{ij}^s.

Following their idea, productivity of goods are assumed to be random variables drawn independently and identically for each ω^s. For practical purposes I drop sector index s. Define F_i to be the cumulative distribution function of the productivity in country $i \in S$:

$$F_i \equiv \Pr\{z_i(\omega) \leq z\}. \tag{2.31}$$

Following Eaton and Kortum (2002), I assume that $F_i(z)$ is a Fréchet distribution, meaning that $z \geq 0$ for all z.

$$F_i(z) = \exp\{T_i z^{-\theta}\}, \tag{2.32}$$

where $T_i > 0$ is a measure of aggregate productivity of country i. A larger value of T_i decreases the value of z, meaning that it increases the probability of larger values of z, and θ which is only sector-specific and assumed to be constant across countries governs the distribution of productivities across goods within countries.

2.7.2 Prices

In perfect competition only the lowest cost producer of a good will supply that particular good. Thus, we want to derive the distribution of the minimum price over a set of prices offered by producers

$$p_i = \min\{p_{1i}, p_{2i}, ..., p_{Ni}\}. \tag{2.33}$$

For finding out the distribution of this distribution, I utilize the advantage of the extreme value distribution. Let us consider the probability of country $i \in N$ offering good $\omega \in \Omega$ to country $j \in N$ for a price less than p. As the technology is i.i.d. across goods, this probability will be the same for all goods. Define:

$$G_{ij}(p) = \Pr\{p_{ij}(\omega) \leq p\}. \tag{2.34}$$

Using Equation (2.9) and a Fréchet distribution

$$\begin{aligned} G_{ij}(p) &= \Pr\{p_{ij}(\omega) \leq p\} \\ &= \Pr\left\{\frac{c_i\tau_{ij}}{z_i(\omega)} \leq p\right\} \\ &= \Pr\left\{\frac{c_i\tau_{ij}}{p} \leq z_i(\omega)\right\} \\ &= 1 - \Pr\left\{z_i(\omega) \leq \frac{c_i\tau_{ij}}{p}\right\} \\ &= 1 - F_i\left(\frac{c_i\tau_{ij}}{p}\right) \\ &= 1 - \exp\left\{-T_i\left(\frac{c_i\tau_{ij}}{p}\right)^{-\theta}\right\}. \end{aligned} \tag{2.35}$$

Now, let us consider the probability that country $j \in N$ pays a price less than p for good $\omega \in \Omega$. Define

$$G_j(p) \equiv \Pr\{p_j(\omega) \leq p\}. \tag{2.36}$$

As country j buys from the least cost provider using Equation (2.9), we have

$$\begin{aligned} G_j(p) &= \Pr\{\min_{i \in N} p_{ij}(\omega) \leq p\} \\ &= 1 - \Pr\{\min_{i \in N} p_{ij}(\omega) \geq p\} \\ &= 1 - \Pr\{\cap_{i \in N}(p_{ij}(\omega) \geq p)\} \\ &= 1 - \prod_{i \in N}(1 - G_{ij}(p)). \end{aligned} \tag{2.37}$$

Substituting Equation (2.35) into (2.37) we get

$$\begin{aligned} G_j(p) &= 1 - \prod_{i \in N} (1 - G_{ij}(p)) \\ &= 1 - \prod_{i \in N} \exp\left\{ -T_i \left(\frac{c_i \tau_{ij}}{p} \right)^{-\theta} \right\} \\ &= 1 - \exp\left\{ -p^{\theta} \sum_{i \in N} T_i (c_i \tau_{ij})^{-\theta} \right\}. \end{aligned}$$

$$G_j(p) = 1 - \exp\{-p^{\theta} \Phi_j\}, \tag{2.38}$$

where $\Phi_j \equiv \sum_{i \in N} T_i (c_i \tau_{ij})^{-\theta}$. Equation (2.38) shows the distribution of prices across goods for country j. Using the definition of the price index given in Equation(2.4), we have

$$\begin{aligned} P_j &= \Big[\int p_i(\omega)^{1-\sigma} d\omega \Big]^{1/(1-\sigma)} \\ P_j^{1-\sigma} &= \int_0^{\infty} p^{1-\sigma} dG_j(p) \\ P_j^{1-\sigma} &= \int_0^{\infty} p^{1-\sigma} \left(\frac{d}{dp} \Big(1 - \exp\{-p^{\theta} \Phi_j\} \Big) \right) dp \\ P_j^{1-\sigma} &= \theta \Phi_j \int_0^{\infty} p^{\theta - \sigma} \exp\{-p\theta \Phi_j\} dp. \end{aligned}$$

Define $x \equiv p^{\theta} \Phi_j$, then we have

$$\begin{aligned} P_j^{1-\sigma} &= \int_0^{\infty} \left(\frac{x}{\Phi_j} \exp\{-x\} \right) dx \\ P_j^{1-\sigma} &= \Phi_j^{-\frac{1-\sigma}{\theta}} \int_0^{\infty} x^{\frac{1-\sigma}{\theta}} \exp\{-x\} dx \\ P_j^{1-\sigma} &= \Phi_j^{-\frac{1-\sigma}{\theta}} \Gamma\left(\frac{\theta + 1 - \sigma}{\theta} \right) \\ P_j &= \Phi_j^{-\frac{1}{\theta}} \Gamma\left(\frac{\theta + 1 - \sigma}{\theta} \right)^{\frac{1}{1-\sigma}} \end{aligned}$$

where $\Gamma(t) \equiv \int_0^\infty x^{t-1}e^x dx$ represents the Gamma function. Consequently, the equilibrium price index in country $j \in N$ can be written as

$$P_j = \Upsilon\big[\sum_{h=1}^{N} T_h(c_h\kappa_{hj})^{-\theta}\big]^{-1/\theta} \tag{2.39}$$

where $\Upsilon \equiv \Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{1-\sigma}}$.

2.7.3 Gravity

As already mentioned, any country $j \in N$ purchases the goods only from the least cost provider and buys the good ω from $i \in N$ only if country i satisfies this condition. Then, the probability of country j of buying good ω from country i equals the probability of country i being the least cost supplier. As all goods receive i.i.d. draws and there are a continuum of varieties, then following law of large numbers, this probability will be equal to the fraction of goods i sells to j

$$\begin{aligned}
\pi_{ij} &\equiv \Pr\left\{p_{ij}(\omega) \leq \min_{k\in N\backslash j} p_{kj}(\omega)\right\} \\
\Rightarrow &= \int_0^\infty \Pr\left\{\min_{k\in N\backslash j} p_{kj} \geq p\right\} dG_{ij}(p) \\
&= \int_0^\infty \Pr\left\{\cap_{k\in N\backslash j}(p_{kj} \geq p)\right\} dG_{ij}(p) \\
&= \prod_{k\in N\backslash j} (1 - G_{kj}(p))dG_{ij}(p).
\end{aligned} \tag{2.40}$$

Substituting Equation (2.35) we obtain

$$
\begin{aligned}
\pi_{ij} &= \prod_{k \in N\ j} (1 - G_{kj}(p)) dG_{ij}(p) \\
&= \prod_{k \in N\ j} \left(\exp\left\{ -T_i \left(\frac{c_i \tau_{ij}}{p} \right)^{-\theta} \right\} \right) \left(\frac{d}{dp} \left(1 - \exp\left\{ -T_i \left(\frac{c_i \tau_{ij}}{p} \right)^{-\theta} \right\} \right) \right) dp \\
&= \frac{T_i (c_i \tau_{ij})^{\theta}}{\Phi_j} \Big(-\exp\{-p^{\theta} \Phi_j\}|_0^{\infty} \Big) \\
&= \frac{T_i (c_i \tau_{ij})^{\theta}}{\Phi_j}.
\end{aligned} \tag{2.41}
$$

The fraction of goods exported from i to j depends on i's share in j's Φ_j. More productive countries with lower costs and countries with lower bilateral trade costs will compose a larger share of goods sold to j.

Also, it is important to emphasize that π_{ij} is the share of goods that country $i \in N$ sells to country $j \in N$, meaning that it may not be the same as the fraction of j's income spent on goods shipped from i. However, given the Fréchet distribution, the distribution of the prices of goods will be exactly the same as the distribution of goods bought from country i. Note that the probability that country $i \in N$ can offer good $\omega \in \Omega$ for a price lower than $\tilde{p}$ conditional on i having the lowest price is the product of inverse of the probability that i has the lowest cost good and the probability that j receives a price offer lower than $\tilde{p}$:

$$
\begin{aligned}
\Pr\left\{ p_{ij}(\omega) \leq \tilde{p} | p_{ij}(\omega) \leq \min_{k \in N \setminus i} p_{kj}(\omega) \right\} &= \frac{1}{\pi_{ij}} \int_0^{\tilde{p}} \Pr\left\{ p_{ij}(\omega) \leq \min_{k \in N \setminus i} p_{kj}(\omega) \right\} dG_{ij}(p) \\
&= \frac{1}{\pi_{ij}} \int_0^{\tilde{p}} \prod_{k \in N \setminus i} (1 - G_{kj}(p)) dG_{ij}(p) \\
&= \frac{1}{\pi_{ij}} \frac{T_i (c_i \tau_{ij})^{-\theta}}{\Phi_j} \Big(-\exp\{-p^{\theta} \Phi_j\}|_0^{\tilde{p}} \Big) \\
&= \frac{1}{\pi_{ij}} \frac{T_i (c_i \tau_{ij})^{-\theta}}{\Phi_j} \Big(1 - \exp\{-p^{\theta} \Phi_j\} \Big) \\
&= G_j(\tilde{p}).
\end{aligned} \tag{2.42}
$$

This implies that countries with higher comparative advantage (higher productivity or lower trade costs, etc.), will exploit their advantages by selling a greater number of goods to country j until the point where the distribution of prices they offer to j become the same as j's overall price distribution.

As a result, the fraction of goods purchased from a particular origin is equal to the fraction of j's income spent on goods from country i

$$\frac{X_{ji}}{Y_j} = \frac{T_i(c_i\tau_{ij})^{-\theta}}{\Phi_j}. \tag{2.43}$$

This implies that the total expenditure of j on goods purchased from i equals to

$$X_{ji} = \pi_{ij}X_j. \tag{2.44}$$

Therefore,

$$X_{ji} = \frac{T_i(c_i\tau_{ij})^{-\theta}}{\Phi_j}X_j. \tag{2.45}$$

Assuming that $c_i = w_i$,

$$X_{ji} = \Upsilon^{-\theta}T_i w_i^{-\theta}\tau_{ij}^{-\theta}P_j^{\theta}X_j. \tag{2.46}$$

As in general equilibrium the total income of a country is equal to its total sales

$$Y_i = \sum_{j=1}^{N} X_{ij}. \tag{2.47}$$

Substituting Equation (2.46) into Equation (2.47) yields

$$\begin{aligned} Y_i &= \sum_{j=1}^{N} \Upsilon^{-\theta}T_i w_i^{-\theta}\tau_{ij}^{-\theta}P_j^{\theta}X_j \\ Y_i &= \Upsilon^{-\theta}T_i w_i^{-\theta}\sum_{j=1}^{N} \tau_{ij}^{-\theta}P_j^{\theta}X_j \\ \Upsilon^{-\theta}T_i w_i^{-\theta} &= \frac{Y_i}{\sum_{j=1}^{N}\tau_{ij}^{-\theta}P_j^{\theta}X_j}. \end{aligned} \tag{2.48}$$

If we substitute Equation (2.48) back into Equation (2.46) we get

$$X_{ji} = \Upsilon^{-\theta} T_i w_i^{-\theta} \tau_{ij}^{-\theta} P_j^{\theta} X_j$$
$$X_{ji} = \tau_{ij}^{-\theta} \times \frac{Y_i}{\Pi_i^{-\theta}} \times \frac{X_j}{P_j^{-\theta}}, \tag{2.49}$$

where $\Pi_i \equiv \left(\sum_{k \in N} \tau_{ik}^{-\theta} \frac{X_k}{P_k^{-\theta}} \right)$.

2.7.4 Welfare

Following CES prefrences, the welfare of a worker in country $i \in N$ can be written as

$$W_i \equiv \frac{w_i}{P_i}. \tag{2.50}$$

Given $X_{ji} = \pi_{ij} X_j$, from Equation (2.46) we obtain

$$\pi_{ij} = \Upsilon^{-\theta} T_i w_i^{-\theta} \tau_{ij}^{-\theta} P_j^{\theta},$$

and given $\tau_{ii} = 1$, we have

$$\pi_{ii} = \Upsilon^{-\theta} T_i W_i^{-\theta} \iff$$
$$W_i = \Upsilon^{-1} T_i^{\frac{1}{\theta}} \pi_{ii}^{-\frac{1}{\theta}}. \tag{2.51}$$

2.7.5 Counterfactuals

Benchmark trade shares are defined as

$$\pi_{ji}^{s} = \frac{T_j^s [c_j^s \kappa_{ji}^s]^{-\theta^s}}{\sum_{h=1}^{N} T_h^s [c_h^s \kappa_{hi}^s]^{-\theta^s}}, \tag{2.52}$$

and counterfactual trade shares are

$$\pi_{ji}^{s'} = \frac{T_j^{s'} [c_j^{s'} \kappa_{ji}^{s'}]^{-\theta^s}}{\sum_{h=1}^{N} T_h^{s'} [c_h^{s'} \kappa_{hi}^{s'}]^{-\theta^s}}. \tag{2.53}$$

Defining $\hat{x} = x'/x$, we have

$$\hat{\pi}^s_{ji} = \frac{\hat{T}^s_j [\hat{c}^s_j \hat{\kappa}^s_{ji}]^{-\theta^s}}{\sum_{h=1}^N T^{s'}_h [c^{s'}_h \kappa^{s'}_{hi}]^{-\theta^s} / \sum_{k=1}^N T^s_k [c^s_k \kappa^s_{hi}]^{-\theta^s}} \tag{2.54}$$

$$= \frac{\hat{T}^s_j [\hat{c}^s_j \hat{\kappa}^s_{ji}]^{-\theta^s}}{\sum_{h=1}^N \hat{T}^s_h [\hat{c}^s_h \hat{\kappa}^s_{hi}]^{-\theta^s} T_h [c_h \kappa^s_{hi}]^{\theta^s} / \sum_{k=1}^N T^s_k [c^s_k \kappa^s_{ki}]^{-\theta^s}} \tag{2.55}$$

$$= \frac{\hat{T}^s_j [\hat{c}^s_j \hat{\kappa}^s_{ji}]^{-\theta^s}}{\sum_{h=1}^N \pi_{hi} \hat{T}^s_h [\hat{c}^s_h \hat{\kappa}^s_{hi}]^{-\theta^s}} \tag{2.56}$$

2.7.6 Solving the model

This section presents a detailed description on how to solve the model. Consider a change in policy from τ to τ', given by $\hat{\kappa}^s_{ji}$ or a change in D_i to D_i'.

1. Guess a vector of wages $\hat{\mathbf{w}} = (\hat{w}_1, \hat{w}_2, ..., \hat{w}_N)$.

2. Use equilibrium conditions (2.21) and (2.22) to solve for prices in each sector and country, $\hat{p}^s_i(\hat{\mathbf{w}})$, and costs, $\hat{c}^s_i(\hat{\mathbf{w}})$.

3. Use the information on π^s_{ji} and θ^s with the solutions for $\hat{p}^s_i$ and $\hat{c}^s_i$ from the second step and solve for $\pi^{s'}_{ji}(\hat{\mathbf{w}})$ using Equation (2.23).

4. Given $\pi^{s'}_{ji}$ from the previous step, the new tariff vector τ' and the data for α^s_i, solve for total expenditure in each sector s and country i, $X^{s'}_i(\hat{\mathbf{w}})$ consistent with vector of wages $\hat{\mathbf{w}}$ as follows

$$X^{s'}_i = \alpha^s_i \left(\hat{w}_i w i L_i + \sum_{s=1}^S \sum_{j=1}^N \tau^{s'}_{ji} M^{s'}_{ji} + D^{'}_i \right). \tag{2.57}$$

Equation (2.57) above presents a system of $S \times N$ equations in $S \times N$ total expenditures. If we write the system of equations in matrix form, then

$$\Omega(\hat{\mathbf{w}}) \mathbf{X}(\hat{\mathbf{w}}) = \mathbf{\Delta}(\hat{\mathbf{w}}),$$

where $\mathbf{X}$ is a vector of sector-country-specific expenditures and $\mathbf{\Delta}(\hat{\mathbf{w}})$ is a vector of total shares of each sector and country in the final demand, value added and trade deficits in each country. Specifically, Matrix $\mathbf{\Omega}(\hat{\mathbf{w}})$ is a square matrix of dimensions $SN \times SN$, and it captures the general equilibrium effects of tariffs.

5. Following step 4, substitute $\pi^{s}_{ji}(\hat{\mathbf{w}}), \mathbf{X}(\hat{\mathbf{w}}), \tau', D'_i$ in Equation (2.26) we get

$$\sum_{s=1}^{S}\sum_{j=1}^{N}\frac{\pi^{s'}_{ji}(\hat{\mathbf{w}})}{1+\tau^{s'}_{ji}}X^{s'}_{i}(\hat{\mathbf{w}}) - D'_i = \sum_{s=1}^{S}\sum_{j=1}^{N}\frac{\pi^{s'}_{ij}(\hat{\mathbf{w}})}{1+\tau^{s'}_{ij}}X^{s'}_{j}(\hat{\mathbf{w}}). \tag{2.58}$$

6. Iterate until the equilibrium condition in Equation (2.58) is satisfied (up to a tiny deviation).

Chapter 3

Effects of Trade Shocks on Turkish Local Labor Markets

Since the seminal work of Autor et al. (2013, 2016) the effect of major trade shocks on local labor markets has been put into the limelight of the public debate. In particular, related work has centered around a quantification of the direct effect of imports from less developed countries on developed countries' labor markets, see Bernard et al. (2006), Auer and Fischer (2008), and Dauth et al. (2017).[1]

Autor et al. (2013) analyzed how the increased import competition due to China's accession to the World Trade Organization (WTO) in 2001 affected local labor markets in the United States (US). Their key finding was that in sector-regions that were more exposed to higher import competition from China, the unemployment, (early) retirement, and disability take-up rates increased, while wages declined. This effect was persistent and lasting at least for a decade, see Autor et al. (2016). For the German manufacturing sector Dauth et al. (2017) examined the labor-market effects of increased trade exposure (imports and exports) on individual workers with regard to China and Eastern European countries. They found that workers in import-competing sectors moved out of the labor force or became unemployed at a greater likelihood than in other sectors. Moreover, young workers were more likely to move into export-intensive sectors. Thus, the negative labor-market impact of trade shocks was much stronger for older workers in import-competing industries than for younger workers in export-intensive sectors. All three studies largely focused on the growth of imports from less developed or transition countries, China or Eastern Europe, in a developed, high-income country, the US or Germany.

[1] Pavcnik (2017) provides an overview of the literature on import competition around the world and evaluates policies to reduce negative distributional consequences of trade.

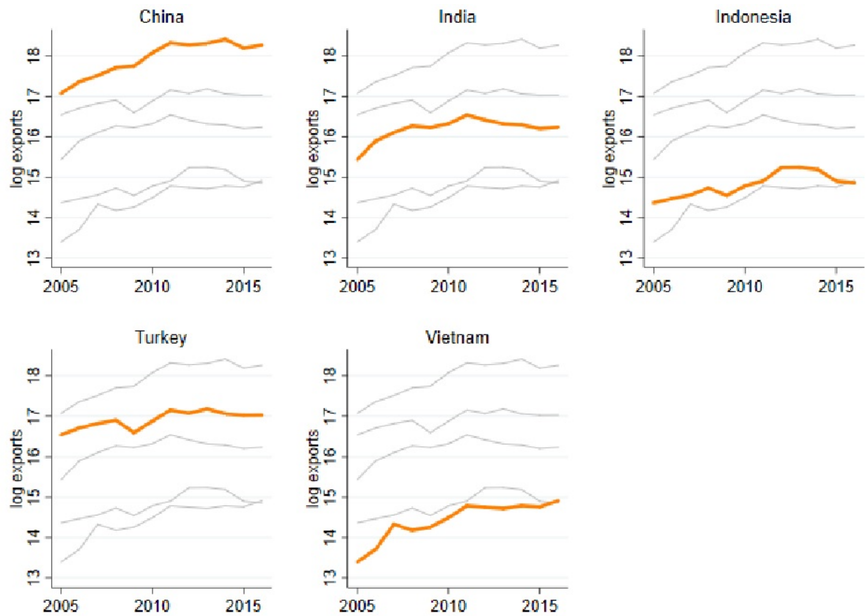
The impact of trade shocks might be very different for developing or transitional countries themselves. First of all, many transition countries grow mostly because of their exports rather than their strong domestic demand, so that employment and wage growth are tightly connected with trade. China is a good example of this export-led growth phenomenon. However, less developed and transition countries compete with each other for demand in developed economies, they tend to produce at much higher labor intensity than developed economies do, and they are less capable of absorbing adverse shocks than developed countries due to weaker social security systems, less accumulated wealth, lower savings rates, and more flexible and less formal labor markets; see Rodrik (2006) and Nordman and Pasquier-Doumer (2015). Hence, export competition effects on local labor markets in less developed and transition economies may be quantitatively quite important, but those effects receive relatively little attention in comparison to the import competition effects on local labor markets in developed countries.[2]

In the present paper, we aim at contributing to this debate by focusing on a middle-income country, which is a competitor of other major developing exporting countries such as China in various sectors at least in the European Union, namely Turkey. Autor et al. (2013, 2016), and Dauth et al. (2017) find that the local labor markets in developed countries – namely, the United States and Germany, respectively – are affected adversely by major (for those developed countries) import-competing foreign trade shocks. The extent to which these trade shocks (in developed countries) have spillovers to countries that export to the mentioned developed markets is not clear and did not receive much attention in earlier academic work. We aim at filling in this gap by allowing for both export-competition and import-competition in Turkey as a response to overall trade liberalization. We do not focus on one specific shock such as the increase of China's exports after its WTO accession, but consider the change in overall trade flows. After all, workers do not care which competitor exactly is responsible for them loosing their job, but what counts is the overall displacement effect. Isolating just one source of competition bears the danger of misattributing effects to it, when those effects accrue to other shocks. Figures 3.1 and 3.2 depict the export growth of major Turkish competitors in Germany and the United States between 2007 and 2017. These figures document that not only China increased its exports to the US and Germany, but also a wide range of developing countries did at the same time. Hence, ignoring just one of these economies as a source of labor-market effects

[2] Another important difference between developed countries and less developed or transition economies is that manufacturing has declined in importance and become increasingly capital intensive and employ a relatively smaller share of the workforce for almost a century (see Boppart 2014; Dauth et al. 2017), while this is not or at least much less the case for less developed and transition countries. E.g., in Turkey the employment share of workers in the manufacturing sector rose from 22.5% in 2005 to over 27% in 2015. This means that the potential labor-market exposure to adverse shocks at foreign markets of countries such as Turkey may be comparably high and even have increased at the same time as employment in developed countries' manufacturing had declined anyway.

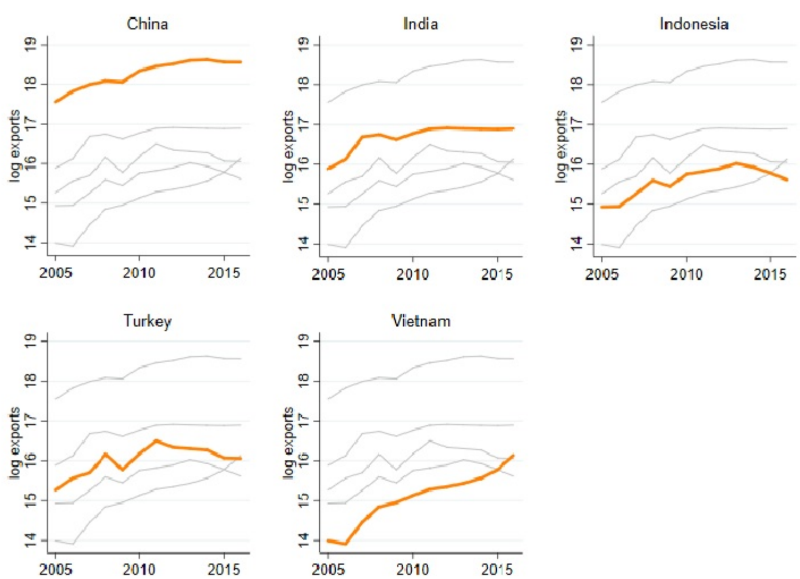
may be problematic. This implies that looking at a particular exporting and importing country in isolation is likely to mis-specify the associated labor-market effects.

Figure 3.1: Evolution of log total exports (in 1,000 USD) of selected countries to Germany



Source: Comtrade. Years 2005 to 2017.

Figure 3.2: Evolution of log total exports (in 1,000 USD) of selected countries to the USA.



Source: Comtrade. Years 2005 to 2017.

By considering multilateral export shocks, two effects on Turkish labor markets are of interest. First, an export shock for Turkey vis-a-vis another country may generate employment effects in Turkish labor markets. We refer to this as the *direct* effect. Second, trade shocks in countries competing with Turkey in the same export markets might negatively impact Turkish labor markets. We refer to the latter as the *indirect* effect. In this sense our analysis is an extended flip-side of Autor et al. (2013, 2016): export shocks might be increasing employment in the exporting country and third country (indirect) competition effects can cushion these outcomes.

We utilize trade and labor-market data at the level of Nomenclature of Territorial Units for Statistics (NUTS) 2 regions in Turkey (the size which roughly corresponds to labor-market zones in the United States) to empirically investigate the aforementioned relationships.[3] We document that local labor markets in Turkey as a transition economy are affected through export competition. Moreover, the results of our empirical analysis suggest that for exports the direct effect as well as the aforementioned cushioning indirect effect are present. Empirically we find that the direct and indirect effects can explain a significant part of the changes in export patterns of Turkish regions. Specifically, an increase of the direct trade openness (direct effect) by one standard deviation raises Turkish region-sector export growth between 0.06 and 0.17 percentage points. On the contrary, increasing the indirect export exposure (indirect effect) by one standard deviation lowers Turkish region-sector export growth up to 0.08 percentage points. In terms of local labor-market effects, an (exogenous) increase of export growth by one percentage point raises employment growth between 0.19 and 0.80 percentage points. Furthermore, we investigate the import-competing trade-shock effects on local labor markets as Autor et al. (2013, 2016) do for the US with respect to China and Dauth et al. (2017) do for Germany with respect to China and Eastern Europe. We find only limited evidence that Turkish local labor markets are adversely affected by direct import competition, only hours worked decline significantly after an import-competing trade shock and (negative) wage effects are only marginally significant. Hence, trade shocks may likely have very different effects on local labor markets in middle-income economies, and spillovers or cushion effects might be very limited, squaring with the results of Feenstra and Sasahara (2018) and Fischer and Sauré (2018).

This paper relates to the several strands of the current literature. First, it contributes to the literature on the labor-market effects of trade, see Slaughter (1998), Matusz (1998), Krugman (2000), Autor et al. (2013, 2016), Balsvik et al. (2015), Caliendo et al. (2015), Feenstra et al. (2017), and Wang et al. (2018). Earlier work primarily focused on labor-market effects of direct

[3]Autor et al. (2013, 2016) distinguish between 722 labor-market zones in the United States. With a population of about 300 million of the United States in their sample period, the average number of inhabitants per labor-market zone is about 417 thousand. With 26 zones at hand for Turkey, the number of inhabitants per average considered zone in our sample period is almost 3 million.

competition between two trading countries or regions. However, in (multi-country and) multi-region equilibrium, the competition between two (countries or) regions is not determined by the characteristics of these regions alone, but also indirectly by other (countries and) regions. The relative importance of direct and indirect effects in developing and transition economies as opposed to developed countries is largely unknown.

A second contribution is the construction of instruments to address the endogeneity of foreign demand for and supply of output to any region and its labor market. Urban, regional, and international trade economists widely acknowledge the endogenous determination of prices for outputs and inputs in general equilibrium, see Ahlfeldt et al. (2012) for an example of a one-city equilibrium with many micro regions, Desmet and Rossi-Hansberg (2010) for an example of a global regional equilibrium with many macro regions, and Eaton and Kortum (2002) for an example of a global multi-country equilibrium. In those models prices – and, hence, supply and demand – are generally endogenous. The multi-regional equilibrium structure implies that prices or quantities demanded in third places, regions, or countries can fundamentally not be exogenous drivers of the prices in or demand between any pair of regions or countries, as everything endogenous in the "world" is jointly determined by the exogenous, fundamental factors of all regions and countries in the world. What these fundamental factors are, depends on the model assumptions, but (immobile-factor) endowments, technology, and "frictions" to transport and factor mobility are key candidates thereof. The instrumentation strategy used in the work by Autor et al. (2013, 2016), Balsvik et al. (2015) or Dauth et al. (2017) do not pay full attention to this issue. We propose constructing instruments based on exogenous bilateral trade costs which adhere to a global general-equilibrium-theory-consistent argument.

Third, we are able to measure the actual rather than the "imputed" or "expected" exposure of a region's labor market by sector to foreign trade (exports and imports). Earlier work assumed that this exposure could be predicted or imputed by multiplying the sector share in total sales or expenditures of imports (or exports) of a country with a region's importance share of that sector in the country, see Autor et al. (2013, 2016) and Dauth et al. (2017). This approach is commonly referred to as a shift-share approach, see Adao et al. (2018). The main reason for this shift-share approach was that the actual trade exposure of a region and sector's labor market was not readily measurable in the data at the time of these studies. However, such an approach may suffer from measurement error. In this study, we use actually measured trade exposure at the Turkish regional level rather than imputing it.

Lastly, we utilize regional data on regional labor markets and international trade of a transitional economy while the literature has mostly focused on labor-market outcomes as a response to trade shocks in developed countries, see Autor et al. (2013, 2016), Balsvik et al. (2015), Dauth et al. (2017), and Taniguchi (2019).[4]

The remainder of the paper is structured as follows. The subsequent section outlines a stylized trade model to measure export- and import-competing trade shocks and their potential consequences on labor markets. The model is also used to motivate the instrumental-variable (IV) strategy. Section 3.2 presents the proposed estimation methodology and the associated instruments. Section 4.1 describes the data used in the empirical analysis. Section 3.4 summarizes the key empirical findings. The last section concludes with a summary of the main findings.

3.1 A generic multi-region model of trade

In the first part of this section we derive a stylized general-equilibrium trade model to motivate our instrumental variable approach. In the second part we relate labor market outcomes to trade patterns.

3.1.1 Product-market outcomes

The empirical analysis of trade effects on local labor markets in this paper will exploit the variation of trade costs as an instrumental variable (IV) for endogenous trade flows to establish a causal relationship between import and export competition and local-labor-market outcomes. The proposed IV differs from the commonly used IVs in the related literature, see Autor et al. (2013, 2016). These rely on observed trade flows between a destination market and a third country as an IV for trade between the country of interest and the destination market. E.g., Autor et al. (2013, 2016) take trade flows between China and Germany as an IV for trade flows between China and the US. In standard general-equilibrium trade models, all multilateral trade flows are endogenous and hence cannot be used as an IV. Depending on the foundations the fundamental (exogenous) parameters, in such general-equilibrium models are usually the endowments with inter-regionally immobile factors, technology, or frictions to goods trade or factor flows. Using exogenous bilateral trade costs as an IV for bilateral trade flows can be rationalized from a host of such trade models. Instead, using third-country trade flows would violate the assumption of exogenous IVs in customary trade models. The following stylized regional trade model will clarify these points.

To motivate the use of our IV strategy it is sufficient to focus on a single-sector multi-region model designed for a cross section of data, variants of which had been used by Eaton and Kortum (2002)

[4] Some notable exceptions are Artuc and McLaren (2010), Cosar (2013), Dix-Carneiro and Kovak (2017), and Demir and Javorcik (2018).

for countries, by Desmet and Rossi-Hansberg (2010) for macro regions and by Ahlfeldt et al. (2012) for micro regions within a city.[5]

For simplicity, we will assume that the model world consists of N regions, countries or, more generally, markets which are indexed by i and n. Let us use D_n to denote aggregate expenditures in market n, C_n to denote the (scaled) consumer price index in country n, and A_i to capture a multiplicative conglomerate of endogenous variables and fundamental drivers of supply potential in region i. Specifically, in Ricardian models as typically employed in regional and urban economics, A_i is a positive function of exogenous productivity, and in other models it may be proportional to labor endowments, etc. A_i depends inversely on the endogenous output prices in the model and, hence, on factor-market outcomes such as wages or unemployment rates. $B_{in} > 0$ is an inverse function of the frictions to trade and transactions for selling output of i to customers in n, i.e., higher values of B_{in} indicate less trade frictions or less trade costs. Specifically, the sales (exports when crossing country borders) from region i to market n are determined by

$$X_{in} = \frac{A_i B_{in} D_n}{C_n}, \tag{3.1}$$

$$C_n = \sum_{j=1}^{N} A_j B_{jn}, \tag{3.2}$$

$$D_n = \sum_{j=1}^{N} X_{jn}. \tag{3.3}$$

Assuming that aggregate sales equal aggregate expenditures in each market, as is customary in urban and regional models of this kind, see, e.g., Desmet and Rossi-Hansberg (2010) or Ahlfeldt et al. (2012), we can re-write Equation (3.3) as:

$$D_i = \sum_{n=1}^{N} X_{in} = A_i \sum_{n=1}^{N} \frac{D_n}{C_n} B_{in}. \tag{3.4}$$

When defining

$$E_i = \sum_{j=1}^{N} (D_j B_{ij} / C_j) \tag{3.5}$$

as a variable which is the scaled seller-price index of i (as opposed to the consumer-price index, there, C_i), we could write $A_i = D_i/E_i$. Substituting this back into Equation (3.1) yields a structural

[5] Although the price indices are different in Ahlfeldt et al. (2012), the overall intuition of the stylized general-equilibrium model prevails.

gravity equation of interregional trade:

$$X_{in} = \frac{D_n D_i}{C_n E_i} B_{in}. \tag{3.6}$$

The terms C_n and E_i are called multilateral resistance terms in the literature (see Anderson and van Wincoop, 2003). As mentioned above, they are related to the seller- and customer-price indices in i and n, respectively, which themselves are inversely related to the frictions to the sales from and to, respectively, these markets from anywhere in the world. For all regions and countries in the world, price indices, C_n and E_i, are endogenously determined through output-market clearing in Equation (3.3). The above system of equations can be seen as a generic version of the Eaton and Kortum (2002) gravity framework of international trade, which is the most widely used framework to explain the sales between regions; see Desmet and Rossi-Hansberg (2010) and Ahlfeldt et al. (2012).[6]

Equation (3.6) is a stylized gravity equation of inter-place, inter-regional, or inter-country trade that is consistent with many standard general-equilibrium trade models. Intuitively, the sales from region i to country n rise with the economic size of i and n, D_i and D_n, respectively. Increasing total expenditures in market n ceteris paribus will directly imply more consumption from anywhere in the world, while higher income in i will ceteris paribus imply larger sales and production to anywhere in the world. Larger trade frictions between i and n (smaller B_{in}), e.g., due to larger distances or higher policy barriers, will ceteris paribus diminish the demand of n for output in i.

In Equation (3.6) the bilateral sales from i to n are affected by two kinds of sales frictions: the trade or transaction costs between a region i and partner country n, captured by B_{in}, which we refer to as the *direct effect* of transport or transaction costs; and all other trade or transaction costs in the world, captured by B_{jm} where either $j = i$ but $m \neq n$ or $j \neq i$ but $m = n$ or even $j \neq i$ and $m \neq n$, which we refer to as the *indirect effect* of transport or transaction costs. The case, where $j \neq i$ but $m = n$ reflects how trade of a third party (not i) to destination market n would increase competition for exports from region i to the same destination market. However, in this set-up, while trade of j to n is endogenous to trade of i to n, the frictions B_{jn} are not.

[6] The only difference between applications of that framework between models of international trade versus inter-regional or inter-place trade is that the latter kinds of models always also allow labor to be mobile between regions and places, whereas many (but not all) trade models assume labor to be immobile between countries. With labor mobility, an additional set of equations is required, but we can abstain from extending the framework here, as this extension is irrelevant for the arguments given here. Moreover, micro-regional models tend to abstract from transport costs for goods, as such transport costs do not vary much, e.g., within cities.

In terms of the stylized model the *direct effect* of B_{in} on X_{in} is given by:

$$\frac{\partial X_{in}}{\partial B_{in}} = \underbrace{\frac{D_n D_i}{C_n E_n}}_{\text{First Order Effect}} - \underbrace{\left(\frac{D_n D_i}{C_n^2 E_n} B_{in} \frac{\partial C_n}{\partial B_{in}} + \frac{D_n D_i}{C_n E_n^2} B_{in} \frac{\partial E_i}{\partial B_{in}}\right)}_{\text{Conditional General Equilibrium Effect}} + \underbrace{\left(\frac{D_i}{C_n E_n} B_{in} \frac{\partial D_n}{\partial B_{in}} + \frac{D_n}{C_n E_n} B_{in} \frac{\partial D_i}{\partial B_{in}}\right)}_{\text{Full General Equilibrium Effect}} \quad (3.7)$$

The *direct effect* of sales frictions refers to the impact of changes of transaction costs between i and n on sales from i to n. Note that this direct effect itself consists, when using the terminology of Larch and Yotov (2016), of a first-order effect, a conditional general equilibrium effect, and a full general equilibrium effect. Hence, while a change of trade costs between a Turkish region i and a foreign country n directly affects the consumer price for i's products in n, it also affects the consumer-price index in n (the price of all goods consumed there), and it eventually affects factor prices and incomes in n and everywhere else due to the connectedness of all regions in the world through trade.

The *indirect effect* of a change in trade costs B_{jm} with $\{jm\} \neq \{in\}$ on X_{in} emerges through conditional and full general-equilibrium effects only:

$$\frac{\partial X_{in}}{\partial B_{jm}} = \underbrace{-\left(\frac{D_n D_i}{C_n^2 E_n} B_{in} \frac{\partial C_n}{\partial B_{jm}} + \frac{D_n D_i}{C_n E_n^2} B_{jn} \frac{\partial E_i}{\partial B_{im}}\right)}_{\text{Conditional General Equilibrium Effect}} + \underbrace{\left(\frac{D_i}{C_n E_n} B_{in} \frac{\partial D_n}{\partial B_{jm}} + \frac{D_n}{C_n E_n} B_{in} \frac{\partial D_i}{\partial B_{jm}}\right)}_{\text{Full General Equilibrium Effect}}. \quad (3.8)$$

I.e., changes of any other trade costs than the ones between i and n also affect the trade between i and n due to consumer-price and factor-price effects in both i and n (and everywhere else).

3.1.2 Labor-market outcomes

Using output-market clearing in Equation (3.3) allows us to relate labor-market outcomes to trade flows. Total expenditures in region i have to be equal to total sales of the region, which in turn have to be equal to total income in that region by assumption. Using L_i, H_i, and W_i for the number of workers and employees, the hours worked per capita, and the average hourly wages in region i, respectively, we can write:

$$D_i = \sum_{n=1}^{N} X_{in} = L_i H_i W_i, \quad (3.9)$$

which in equilibrium of the above model is equal to total regional income. Intuitively, all income is generated by the sales and, hence, total income is directly related to total sales (exports).

Changes in employment, average hours worked, and wages relate directly to changes in bilateral trade between region i and all countries this region sells to. But through the equilibrium structure and the definition of income in Equation (3.4) and consumer- and producer-price indices in Equations (3.2) and (3.5), respectively, the income components are indirectly determined, through trade, by world-wide trade costs (i.e., the trade costs between trading partners directly as well as indirectly). As income depends on trade through Equation (3.4) and trade depends on income through equation (3.6) there is a two-way relationship which implies endogeneity in an empirical framework.

In what follows, we empirically relate changes in bilateral trade flows to the three labor-market outcomes of interest. We use an instrumental variable strategy based on exogenous bilateral trade costs to eliminate the endogeneity of trade as a determinant of labor-market outcomes and to establish a causal relationship.

3.2 Estimation strategy

In this section we introduce the estimation strategy of our analysis. It consists of three parts. First, we estimate the impact of Turkish regional exports on its respective local labor markets. Second, as exports are endogenous as indicated by our stylized general-equilibrium framework, we use changes in bilateral trade costs to construct two IVs: (i) changes of bilateral trade costs between a Turkish region and all possible destination markets; (ii) changes of bilateral trade costs between all foreign countries (excluding Turkey) and all possible destination market of Turkish exports. We use these instrumental variables to establish a causal relationship between exports and labor-market outcomes in Turkey. Lastly, we consider the effect of import competition by including Turkish regional imports in the estimation. As labor-market outcomes we consider employment, average hours worked, and real hourly wages at the sector-region-year level.[7]

3.2.1 Export effect on labor markets

The stylized general-equilibrium trade model in Section 3.1 suggests that changes in sectoral wages, average hours worked, and employment should be positively related to the changes in sectoral exports of region i to all other countries in the rest of the world. To test this prediction, we estimate the effect of changes of exports on local (regional) labor markets using the following estimation equation:

[7]Note that W_i above indicated nominal wages. In general-equilibrium models, changes in nominal quantities depend on the choice of the numéraire good. This is not the case with real quantities, as they are deflated by a price index so that the dependency on the numéraire good is avoided.

$$\Delta q_{ikt} = \beta_1 \Delta \log \sum_{n \in N_{-TUR}} X_{inkt} + Z_{ikt}\eta_1 + \Gamma_{ik} + \Gamma_{it} + u_{ikt}, \tag{3.10}$$

where q_{ikt} is either the logarithm (log) of total employment (l_{ikt}), the log real hourly wage (w_{ikt}), or the log average hours worked (h_{ikt}) in region i and industry k at time t. X_{inkt} are sector k exports from region i to foreign market n at time t. We aggregate exports by summing region i exports to all countries in the world excluding Turkey itself, i.e., $n \in N_{-TUR}$. Z_{ikt} captures the region-sector-time specific control variables, i.e., the ratio of female employees to male employees denoted as variable "female", the ratio of high-educated employees to low-educated employees denoted as variable "skilled", and the ratio of youth employment to elder employment denoted as variable "youth". Γ_{ik} and Γ_{it} denote region-sector and region-time fixed effects respectively, and u_{ikt} is an error term. Δ indicates the first difference of a variable with respect to time, e.g., $\Delta q_{ikt} = q_{ikt} - q_{ikt-1}$.

3.2.2 Export competition: IV approach

As described in the stylized general-equilibrium model in Section 3.1 all trade flows are interdependent and hence prone to endogeneity. As trade flows depend on fundamentals and all bilateral trade costs, we propose two instrumental variables: (i) changes of weighted exogenous trade costs between a Turkish region i and all possible destination markets as an IV for the direct export exposure; (ii) changes of weighted exogenous trade costs between a country j and all possible Turkish export destination market n as an IV for indirect export exposure.

To be able to estimate exogenous bilateral trade costs at the year-sector level, all variables in the structural gravity equation in Equation (3.6) have to be indexed additionally by k for sectors and t for years. Taking logs to obtain $x_{inkt} = \log(X_{inkt})$ and $b_{inkt} = \log(B_{inkt})$ and subsuming the log of all ikt and nkt terms in $\Lambda_{ikt} = \ln(D_{ikt}/E_{ikt})$ and $\Lambda_{nkt} = \ln(D_{nkt}/C_{nkt})$, respectively, where $\{D_{ikt}, E_{ikt}, D_{nkt}, C_{nkt}\}$ are simply the sector counterparts to $\{D_{it}, E_{it}, D_{nt}, C_{nt}\}$ in the model of Section 3.1, we obtain

$$x_{inkt} = \Lambda_{ikt} + \Lambda_{nkt} + b_{inkt}. \tag{3.11}$$

The latter is an empirical model, which can be estimated for each sector and year with region/country-fixed effects Λ_{ikt} and Λ_{nkt}, obtaining an estimate of b_{inkt} as a residual; see Harrigan (1996), Eaton and Kortum (2002), Baier and Bergstrand (2009), and Egger and Nigai (2015). We denote the estimates of b_{inkt} by $\check{b}_{inkt}$.

Based on the latter, we define the IV for the direct export exposure of Turkish region i in sector k

and year t as:

$$\tilde{b}_{ikt} = \sum_{n \in \Omega - TUR} \zeta_{ink0} \check{b}_{inkt}, \tag{3.12}$$

where ζ_{ink0} is the share of country n in all exports of Turkish region i in sector k at time 0 ($t = 0$ corresponds to 2007) and $\check{b}_{inkt}$ are the above estimated exogenous sectoral trade costs of Turkey with a destination country n at time t.

The IV for the indirect export exposure is given by

$$\tilde{b}^{*}_{ikt} = \sum_{j \in \Omega_{-TUR}} \sum_{n \in \Omega_{-TUR}} \zeta_{ink0} \kappa_{jnk0} \check{b}_{jnkt}, \tag{3.13}$$

where κ_{jnk0} is defined as the share of exporter country j in country n's total imports (except for Turkey) in sector k at time 0 ($t = 0$ corresponds to 2007). These weighted trade costs in logs can be interpreted as the average trade costs of all foreign countries to all possible export destinations of Turkey. The two weights ensure that trade costs to main Turkish export destinations are more important and as well consider the importance of the third country in the respective Turkish export destination.

We use $\tilde{b}_{ikt}$ and $\tilde{b}^{*}_{ikt}$ as instrumental variables in a two-stage least squares estimation (2SLS). In the first stage, we regress changes of total regio-sector exports on changes in the weighted trade costs IVs:

$$\Delta x_{ikt} = \alpha \Delta \tilde{b}^{*}_{ikt} + \upsilon \Delta \tilde{b}_{ikt} + Z_{ikt} \varphi + \Upsilon_{ik} + \Upsilon_{it} + c_{ikt}, \tag{3.14}$$

where Υ_{ik} and Υ_{it} are region-sector and region-time fixed effects, respectively, and we include the same control variables as in Equation (3.10), subsumed in Z_{ikt}.

Based on the aforementioned estimation, we predict the growth of region-sector exports $\Delta \check{x}_{ikt}$, which we use in the second stage:

$$\Delta q_{ikt} = \gamma \Delta \check{x}_{ikt} + Z_{ikt} \omega + \Xi_{ik} + \Xi_{it} + d_{ikt}, \tag{3.15}$$

where Z_{ikt} again subsumes the same control variables as in Equation (3.10), Ξ_{ik} are region-sector fixed effects, and Ξ_{it} are sector-time fixed effects.

3.2.3 Export and import competition: IV approach

Additionally, we include the effect of import competition for the Turkish labor market in our estimation. In this regard we adjust our estimation strategy. Instead of Equation (14), we estimate the change of log imports to Turkish region i and sector k at time t as:

$$\Delta m_{ikt} = \varpi \Delta \tilde{d}^{*}_{ikt} + \varrho \Delta \tilde{d}_{ikt} + Z_{ikt}\xi + I_{ik} + I_{it} + e_{ikt}, \tag{3.16}$$

where I_{ik} and I_{it} are the respective region-sector and region-time fixed effects. $\tilde{d}^{*}_{ikt}$ and $\Delta\tilde{d}_{ikt}$ are the IVs for the direct and indirect import competition, analogously to Equations (3.12) and (3.13):

$$\tilde{d}_{ikt} = \sum_{n \in \Omega - TUR} \zeta_{nik0} \check{b}_{nikt}, \tag{3.17}$$

where ζ_{nik0} is the share of country n in all imports of Turkish region i in sector k at time 0 ($t = 0$ corresponds to 2007) and $\check{b}_{nikt}$ are the above estimated exogenous sectoral trade costs of Turkey's imports from country n at time t.

The IV for the indirect import competition is given by

$$\tilde{d}^{*}_{ikt} = \sum_{j \in \Omega_{-TUR}} \sum_{n \in \Omega_{-TUR}} \zeta_{nik0} \kappa_{njk0} \check{b}_{njkt}, \tag{3.18}$$

where κ_{njk0} is defined as the share of importing country j in country n's total exports (except for Turkey) in sector k at time 0 ($t = 0$ corresponds to 2007).

The reason for why we can use $\tilde{d}_{ikt}$ and $\tilde{d}^{*}_{ikt}$ as instruments is that although bilateral trade costs have a symmetric component i.e., $\check{b}_{inkt}$ and $\check{b}_{nikt}$ are positively correlated (e.g., geographical distance, cultural distance, historical common factors are responsible for the latter), they are not perfectly correlated.

Once the import competing instrumental variables have been derived, the second-stage estimation equation can be re-written to include Turkish regional imports:

$$\Delta q_{ikt} = \vartheta \Delta \check{m}_{ikt} + \varsigma \Delta \check{x}_{ikt} + Z_{ikt}\epsilon + O_{ik} + O_{it} + g_{ikt}, \tag{3.19}$$

where $\Delta\check{m}_{ikt}$ is the predicted import growth based on Equation (3.16) in region i, sector k, and year t. In both stages we include the same control variables as in Equation (3.10), subsumed in Z_{ikt}, as well as region-sector and region-time fixed effects.

All four instrumental variables are derived from a theory-consistent structural gravity equation based on a commonly used trade model. Because bilateral trade costs are estimated based on the structural gravity equation, they have a clear direct impact on bilateral imports and exports. Intuitively, any trade friction will change the relative price of exported or imported goods and lead to economic adjustments. Moreover, the estimated trade costs are orthogonal to labor market outcomes in the import and export markets, as in the estimation import-sector-year and exporter-sector-year fixed effects control for these. This implies that the weighted bilateral trade costs are correlated with trade flows but not directly with labor market outcomes and thus they are valid IVs.

3.3 Data

We source regional trade data for Turkish regions from the Turkish Statistical Institute (TURKSTAT). TURKSTAT provides values of bilateral trade at the NACE Rev. 2 four-digit sectoral level for 81 cities in Turkey that constitute the 26 NUTS 2 regions in Turkey. We aggregate these four-digit data to the two-digit sectoral level for each city so as to match them with labor-market data. Note that we can observe the precise value of sector-city level bilateral trade without needing to impute trade at the regional level as is done in Autor et al. (2013). We aggregate the 81 cities to the corresponding 26 NUTS 2 regions. From this we obtain trade data for 40 NACE Rev. 2 two-digit sectors (including agricultural products, manufactures, and services) and 26 NUTS 2 regions in Turkey. A detailed description of the sector coverage is provided in Table 3.7 in the Appendix.

Moreover, we use trade data from the United Nations Comtrade Database at the International Standard Industrial Classification (ISIC) Rev. 3 four-digit level. We convert these data to the ISIC Rev. 4 level, which is equivalent to NACE Rev. 2 using concordance tables of the United Nations. We then aggregate these 4-digit NACE Rev. 2 data to the two-digit level.

Based on the procedure described in Section 3.2.2, we estimate exogenous trade costs, b_{jnkt}, using Comtrade data. Given these we construct our instrumental variables as described in Equations (3.12) and (3.13).

Regarding labor-market outcomes, we use data at the NACE Rev. 2 two-digit sectoral level from the Household Labor Force Survey (HLFS) conducted by the TURKSTAT. HLFS provides information on the structure of the labor force in the country. This includes information on economic activity, occupation, status in employment, and hours of work per person. The sampling frame is constructed by selecting households where at least one person is registered according to the "Address Based Register System", which is based on clusters each containing around 100 addresses.

HLFS data permit calculating hourly wages and salaries based on monthly data as the ratio of wages and salaries divided by the average hours worked per person which are as well provided in the survey. The HLFS also reports employment status and industry of employment which allow us to calculate the sectoral distribution of employment and wages as well as the regional distribution. Our sample covers the period between 2007 and 2017, in which the survey results are comparable. We restrict the sample to individuals aged above 15 (up to 65) in the labor force and drop observations for individuals who report to be employed but do not report their earnings. We also drop region-sector pairs in a year unless there are more than 35 labor-market observations for them in the survey data.

Specifically, we define the following six variables based on HLFS data. *Log employment* uses the number of people aged between 15 to 65, who are employed among the workforce in logs. *Log real wage* is the log of the (deflated) hourly wage per employee which is defined as the ratio of (monthly) wages and salaries divided by (monthly) hours worked. For deflation, we use the yearly consumer price index (CPI) for Turkey as a whole with 2003 as the base year. *Log hours of work* is the log of the actual hours of work spent working in the job per person. *Ratio of high educated to low educated employees* is the ratio of employees holding at least a degree from a two-year technical high school to the remaining (low educated) employees. *Ratio of young employees to elder employees* is the ratio of young employees (aged between 15 to 25) to other employees (aged between 25 and 65). *Ratio of female employees to male employees* is the ratio of female employees to male employees. All of the above variables as used in the analysis represent averages per sector, region, and year.

Table 3.1 provides the descriptive statistics for all variables used.

Table 3.1: Descriptive statistics

Description	Variable	Mean	Std. Dev.	Min.	Max.	Nb. of obs.
Weighted sum of export cost between Turkey and the ROW	$\tilde{b}_{ikt}$	0.007	0.005	-0.011	0.030	7,607
Change in weighted sum of export cost between Turkey and the ROW	$\Delta\tilde{b}_{ikt}$	0.000	0.003	-0.030	0.030	6,912
Weighted sum of export cost between all countries except Turkey	$\tilde{b}^*_{ikt}$	0.393	0.256	-0.162	1.590	7,623
Change in weighted sum of export cost between all countries except Turkey	$\Delta\tilde{b}^*_{ikt}$	-0.006	0.074	-0.827	0.649	6,930
Weighted sum of import cost between Turkey and the ROW	$\tilde{d}_{ikt}$	0.005	0.006	-0.033	0.032	7,607
Change in weighted sum of import cost between Turkey and the ROW	$\Delta\tilde{d}_{ikt}$	0.000	0.004	-0.033	0.034	6,912
Weighted sum of import cost between all countries except Turkey	$\tilde{d}^*_{ikt}$	0.366	0.252	-0.409	1.380	7,623
Change in weighted sum of import cost between all countries except Turkey	$\Delta\tilde{d}^*_{ikt}$	-0.000	0.069	-0.586	0.408	6,930
Log exports (1'000 USD)	x_{ikt}	15.144	3.688	4.605	23.846	8,495
Change in log exports (1'000 USD)	Δx_{ikt}	0.108	1.061	-9.050	9.441	8,122
Log employment	l_{ikt}	9.771	1.028	7.310	13.272	7,482
Change in log employment	Δl_{ikt}	0.034	0.212	-1.040	1.247	6,851
Log real wage	w_{ikt}	0.973	0.483	-0.682	3.234	7,481
Change in log real wage	Δw_{ikt}	0.037	0.169	-1.404	1.538	6,849
Log hours of work	h_{ikt}	3.856	0.178	2.724	4.395	6,894
Change in log hours of work	Δh_{ikt}	-0.010	0.070	-0.538	0.556	6,303
Ratio of highly to lowly educated employees	$skilled_{ikt}$	0.594	1.725	0.000	124.736	10,050
Ratio of female employees to male employees	$female_{ikt}$	0.895	3.560	0.000	133.178	13,002
Ratio of young employees to elder employees	$youth_{ikt}$	0.434	0.588	0.001	13.580	14,707

Notes: All variables are region-sector-year specific. ROW is Rest of the World. Data coverage: 26 NUTS 2 regions (i), NACE Rev. 2 sectors (k), and 11 years between 2007-2017 (t).

As explained in Section 3.2.3 the IVs related to import and export trade costs are correlated, but not perfectly and hence can be used together to estimate a causal relationship between labor market and trade (imports and exports, respectively) outcomes. Table 3.2 shows the correlation of the four IVs. The direct IVs for imports and exports are much more strongly correlated that the indirect ones. The correlation between the direct and indirect IVs for export and respective import competition is even lower.

Table 3.2: Correlation matrix of IVs

	$\Delta\tilde{b}_{ikt}$	$\Delta\tilde{d}_{ikt}$	$\Delta\tilde{b}^{*}_{ikt}$	$\Delta\tilde{d}^{*}_{ikt}$
$\Delta\tilde{b}_{ikt}$	1.0000			
$\Delta\tilde{d}_{ikt}$	0.5513	1.0000		
$\Delta\tilde{b}^{*}_{ikt}$	0.2790	0.1734	1.0000	
$\Delta\tilde{d}^{*}_{ikt}$	0.1023	0.1784	0.2809	1.0000

3.4 Empirical analysis

In this section, we present results regarding the impact of export and import competition on Turkish local labor markets. We do so by structuring this section into subsections, one pertaining to export competition and one pertaining to the joint effect of export and import competition. Throughout the analysis, except for demonstration purposes at the beginning of each section, we treat trade variables – exports and imports at the local labor-market level – as endogenous, using the instruments introduced previously.

3.4.1 Export competition

Before turning to the IV regressions, we present results, where we treat (log) total exports of Turkish labor-market region i in sector k and year t, x_{ikt}, as exogenous in Table 3.3. In particular, we present findings where we focus on first differences as in Equation (3.10).

Table 3.3: OLS: Labor market effects of exports

Dependent variable:	Δl_{ikt}		Δw_{ikt}		Δh_{ikt}	
	(1)	(2)	(3)	(4)	(5)	(6)
Δx_{ikt}	0.012	0.012	0.009	0.010	-0.005	-0.004
	[0.009]	[0.009]	[0.007]	[0.007]	[0.003]	[0.003]
female_{ikt}	-0.000	0.002	-0.005^{**}	-0.004^{***}	-0.001	-0.001^{**}
	[0.003]	[0.002]	[0.002]	[0.002]	[0.001]	[0.000]
skilled_{ikt}	-0.008	-0.005	0.049*	0.042*	0.006	0.008
	[0.035]	[0.028]	[0.028]	[0.063]	[0.012]	[0.010]
youth_{ikt}	0.072	0.103***	-0.061	-0.044	-0.006	0.010
	[0.072]	[0.038]	[0.046]	[0.030]	[0.021]	[0.014]
Region fixed effects	NO	YES	NO	YES	NO	YES
Sector fixed effects	NO	YES	NO	YES	NO	YES
Time fixed effects	NO	YES	NO	YES	NO	YES
Region-time fixed effects	YES	NO	YES	NO	YES	NO
Region-sector fixed effects	YES	NO	YES	NO	YES	NO
No. of observations	1,508	1,508	1,507	1,507	1,341	1,341
R^2	0.322	0.063	0.366	0.119	0.415	0.129

Notes: OLS estimation. ***significant at the 1% level, **significant at the 5% level, *significant at the 10% level. Standard errors in parenthesis.

This table suggests that there is no clear-cut effect of exports on regional labor markets. The sign of the coefficient on Δx_{ikt}, after controlling for the ratio of female, skilled, and young workers in the region as well as numerous fixed effects as indicated in the lower part of the table, is never significantly different from zero. However, the parameters in that table are likely to be biased due to the joint determination of labor-market outcomes such as employment and exports in a local labor market, sector, and year.[8]

In what follows, we treat exports as endogenous and estimate versions of Equation (3.15), employing

[8] An exogenous increase in employment in a region-sector would increase output and hence exports, while an exogenous increase of exports in a region-sector would increase employment. Both variables affect each other so that a simultaneity bias results in estimation. The sign of the bias is not clear a-priori. If the effect of greater employment on exports and the effect of greater exports on employment are both positive and relatively big, we would expect a downward bias of the parameter of exports on employment, see Wooldridge (2009).

the IV approach described in Section 3.2.2. In the associated two-step approach, we estimate a first stage with region-sector-year exports as the dependent variable and the weighted-trade-cost instruments introduced above; see Equation (3.14). In the second stage, we use various labor-market outcomes as the dependent variable.

Table 3.4 summarizes the results for the first-stage regressions in the upper part. According to the table, both instruments, $\Delta\tilde{b}_{ikt}$ and $\Delta\tilde{b}^*_{ikt}$, are statistically relevant in the fixed-effects configurations. The coefficients in the regressions have the expected sign, i.e., $\Delta\tilde{b}_{ikt}$ raises Turkish exports (direct effect), which is exactly what is expected if trade frictions decline (b_{inkt} increases.), and $\Delta\tilde{b}^*_{ikt}$ reduces Turkish exports (indirect effect), i.e., less trade frictions between third countries and Turkish export markets crowd out Turkish exports.

While the point estimate of the direct effect seems rather high, note that lowering trade frictions, i.e., increasing $\Delta\tilde{b}_{ikt}$, by one standard deviation leads to an additional export growth between 0.15 and 0.17 percentage points. Considering that Δx_{ikt} has a mean of 0.108 and a standard deviation of 1.061 this corresponds to roughly 15% of the standard deviation of the outcome variable. Hence, the estimates are in a plausible range. On the other hand, increasing $\Delta\tilde{b}^*_{ikt}$ by one standard deviation reduces Turkish exports between 0.07 and 0.09 percentage points. Thus, both the direct and indirect effects of increased trade costs have quantitatively significant effects on Turkish regional export openness.

Table 3.4: Two-stage least squares: Effects of export competition on labor-market outcomes

	First stage					
Dependent variable: Δx_{ikt}	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\tilde{b}^*_{ikt}$	-0.934^{**}	-1.169^{***}	-0.953^{**}	-1.178^{***}	-0.934^{**}	-1.169^{***}
	[0.440]	[0.338]	[0.440]	[0.338]	[0.440]	[0.338]
$\Delta\tilde{b}_{ikt}$	48.834^{***}	55.472^{***}	49.070^{***}	55.671^{***}	48.834^{***}	55.472^{***}
	[10.824]	[8.762]	[10.825]	[8.765]	[10.824]	[8.762]
female_{ikt}	0.006	0.002	0.006	0.002	0.006	0.002
	[0.007]	[0.005]	[0.007]	[0.005]	[0.007]	[0.005]
skilled_{ikt}	-0.300^{**}	-0.224^{**}	-0.300^{**}	-0.224^{**}	-0.300^{**}	-0.224^{**}
	[0.137]	[0.101]	[0.137]	[0.101]	[0.137]	[0.101]
youth_{ikt}	-0.065	-0.015	-0.058	-0.014	-0.065	-0.015
	[0.149]	[0.092]	[0.149]	[0.092]	[0.149]	[0.092]
F-test	10.210	20.540	10.320	20.680	10.210	20.540
p-value	0.000	0.000	0.000	0.000	0.000	0.000
	Second stage					
Dependent variable:	Δl_{ikt}		Δw_{ikt}		Δh_{ikt}	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\check{x}_{ikt}$	0.175^{*}	0.132^{*}	0.082	0.050	0.049	0.036
	[0.103]	[0.073]	[0.077]	[0.054]	[0.034]	[0.024]
female_{ikt}	-0.002	0.001	-0.005^{**}	-0.004^{***}	-0.001	-0.001^{*}
	[0.003]	[0.002]	[0.002]	[0.002]	[0.001]	[0.000]
skilled_{ikt}	0.047	0.028	0.151^{***}	0.098^{***}	0.035	0.023
	[0.071]	[0.050]	[0.053]	[0.037]	[0.023]	[0.017]
youth_{ikt}	0.142^{**}	0.124^{***}	-0.043	-0.029	0.005	0.013
	[0.069]	[0.043]	[0.052]	[0.032]	[0.023]	[0.014]
Region fixed effects	NO	YES	NO	YES	NO	YES
Sector fixed effects	NO	YES	NO	YES	NO	YES
Time fixed effects	NO	YES	NO	YES	NO	YES
Region-time fixed effects	YES	NO	YES	NO	YES	NO
Region-sector fixed effects	YES	NO	YES	NO	YES	NO
No. of observations	1,291	1,291	1,290	1,290	1,291	1,291

Notes: Two-stage least squares estimation. F-test refers to the joint significance of the two instrumental variables in the first stage. ***significant at the 1% level, **significant at the 5% level, *significant at the 10% level. Standard errors in parenthesis.

The second-stage results for changes in region-sector employment, real wages, and average hours worked in logs based on Equation (3.15) and corresponding to the just-mentioned first-stage results are presented in the lower part of Table 3.4. The two specifications in columns (1) and (2) suggest that raising exports from a Turkish region i in sector k increases employment there. According to our preferred specification in column (1), a one-standard-deviation increase in export growth leads to an increase in the growth of employment by 0.19 percentage points (with a coefficient of 0.18) which corresponds to almost one standard deviation in the outcome variable (Δl_{ikt}).

While the change in region-sector employment is interesting in itself, we have data which enable us to analyze further margins of labor-market outcomes beyond employment.[9] Using the same IV approach, we focus on year-to-year changes in log real (deflated) hourly wages and log weekly hours worked, Δw_{ikt} and Δh_{ikt}, as alternative outcomes to employment in the second stage of the IV regressions, see columns (3) - (6). The corresponding results suggest that neither real wages nor hours worked are affected by an increase in the growth of Turkish exports. Hence, the main margin at which firms adjust labor in the short run appears to be employment. Although Turkey has a reputation of a flexible labor market, wage rigidities and restrictions on the hours of work can be the reason for this finding.

In Appendix 3.6.2 we investigate the possible heterogeneity of the effects of export competition in terms of skill-, female-, and youth-intensive regions and sectors. Earlier work by Biscourp and Kramarz (2007), Accetturo et al. (2013), and Dix-Carneiro (2014) pointed to skill-related labor-market effects of exporting. Moreover, the work by Başlevent and Onaran (2004) and Keller and Utar (2016) suggested gender-related employment effects of trade. Dauth et al. (2017) found different effects for older and younger workers. Intuitively, firms that are more export-oriented could hire workers based on the aforementioned characteristics, or individuals could self-select into firms that are more export-oriented. Both would imply that effects might differ significantly for skill-, female-, and youth-intensive regions and sectors. Splitting the sample along these dimensions and estimating the (causual) effect of increased exports on employment points to statistically significant effects only for sectors and regions which relatively intensively employ male workers.

3.4.2 Export and import competition

Most of the related literature – as well as the public debate – on the labor-market effects of trade focuses on developed countries and on import competition, see Autor et al. (2013, 2016). An interesting and relevant question here is, whether the focus on export competition with a transition

[9] As stated by Equation (3.9) total sectoral income is log linear in total employment, average hours worked and wages.

country such as Turkey is appropriate and justified or whether the import-competition effects are similar to the ones observed in developed countries. We address this very question in this subsection by including import growth as an (endogenous) explanatory variable of labor-market outcomes. For this purpose, we use the slightly adapted IV approach as described by Equations (3.17) and (3.18) above.[10] Again we first present the estimation results treating imports and exports as exogenous in Table 3.5. Exports have marginally positive effects on employment and real wages, but a negative impact on hours worked. In contrast, increased import growth has a significant positive effect on employment.

Table 3.5: OLS: Labor market effects of exports and imports

Dependent variable:	Δl_{ikt}		Δw_{ikt}		Δh_{ikt}	
	(1)	(2)	(3)	(4)	(5)	(6)
Δx_{ikt}	0.028	0.029*	0.027*	0.029**	-0.007	−0.010*
	[0.020]	[0.017]	[0.016]	[0.013]	[0.006]	[0.006]
Δm_{ikt}	0.036**	0.022	0.000	0.000	-0.005	0.002
	[0.017]	[0.014]	[0.014]	[0.011]	[0.006]	[0.005]
female$_{ikt}$	-0.000	0.002	−0.005**	−0.004***	-0.001	−0.001**
	[0.003]	[0.002]	[0.002]	[0.002]	[0.001]	[0.000]
skilled$_{ikt}$	-0.023	-0.011	0.114**	0.079**	0.022	0.015
	[0.060]	[0.046]	[0.048]	[0.036]	[0.020]	[0.015]
youth$_{ikt}$	0.113**	0.134***	-0.053	-0.033	-0.005	0.013
	[0.064]	[0.042]	[0.051]	[0.032]	[0.021]	[0.013]
Region fixed effects	NO	YES	NO	YES	NO	YES
Sector fixed effects	NO	YES	NO	YES	NO	YES
Time fixed effects	NO	YES	NO	YES	NO	YES
Region-time fixed effects	YES	NO	YES	NO	YES	NO
Region-sector fixed effects	YES	NO	YES	NO	YES	NO
No. of observations	1,273	1,273	1,272	1,272	1,273	1,273
R^2	0.389	0.087	0.386	0.136	0.428	0.133

Notes: OLS estimation. ***significant at the 1 percent%, **significant at the 5% level, *significant at the 10% level. Standard errors in parenthesis.

[10] We exclude 25 outliers in the estimation based on the bacon procedure by Weber (2010).

Note that imports and exports are treated as exogenous in these estimations. In Table 3.6 we present two-stage least squares regression results which consider them jointly endogenous.

As we now define two instruments for export and import competition each, we need to define counterparts to the export trade-cost IVs $\Delta\tilde{b}^*_{ikt}$ and $\Delta\tilde{b}_{ikt}$. We derived the import competition IVs, $\Delta\tilde{d}^*_{ikt}$ and $\Delta\tilde{d}_{ikt}$, in Section 3.2.3, i.e., they are given by Equations (3.17) and (3.18). In the relevant regressions in columns (1), (3), and (5) in Table 3.6, the direct IV, $\Delta\tilde{b}_{ikt}$, is statistically significant in the first stage, while the indirect IV, $\Delta\tilde{b}^*_{ikt}$, is not. The parameters on both IVs have the expected sign though. For import competition, the parameter on $\Delta\tilde{d}^*_{ikt}$ is statistically significant, while the one on $\Delta\tilde{d}_{ikt}$ is not. However, we need to acknowledge that the $\Delta\tilde{b}^*_{ikt}$ and $\Delta\tilde{d}^*_{ikt}$ on the one hand and $\Delta\tilde{b}_{ikt}$ and $\Delta\tilde{d}_{ikt}$ on the other hand are relatively highly correlated.

In the second stage, higher export growth of a Turkish region i in sector k significantly raises employment by 0.80 percentage points (with a coefficient of 0.59) and based on our preferred fixed-effects specification (with region-year and region-sector fixed effects) has also a positive impact of 0.16 percentage points (with a coefficient of 0.15) on the average hours worked. Increased import competition in Turkish region-sectors does not exert a significant effect on employment, but average hours worked decline in response to it. Moreover, import competition has a negative and marginally significant impact on wages which amounts to -0.25 percentage points (with a coefficient of - 0.22).

Table 3.6: Two-stage least squares: Effects of export and import competition on labor-market outcomes

			First stage			
Dependent variable: Δx_{ikt}	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\tilde{b}^*_{ikt}$	-0.051	-0.306	-0.071	-0.314	-0.051	-0.306
	[0.393]	[0.302]	[0.393]	[0.302]	[0.393]	[0.302]
$\Delta\tilde{d}^*_{ikt}$	-0.068	-0.392	-0.083	-0.399	-0.068	-0.392
	[0.397]	[0.318]	[0.396]	[0.317]	[0.397]	[0.318]
$\Delta\tilde{b}_{ikt}$	20.041*	21.227**	20.479*	21.518**	20.041*	21.227**
	[10.539]	[8.451]	[10.540]	[8.457]	[10.539]	[8.451]
$\Delta\tilde{d}_{ikt}$	9.797	16.307	9.469	16.130	9.797	16.307
	[8.566]	[6.854]	[8.566]	[6.857]	[8.566]	[6.854]
F-test	2.270	5.050	2.270	5.090	2.270	5.050
p-value	0.060	0.001	0.060	0.001	0.060	0.001
			First stage			
Dependent variable: Δm_{ikt}	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\tilde{b}^*_{ikt}$	-0.051	0.149	-0.054	0.149	-0.051	0.149
	[0.448]	[0.369]	[0.448]	[0.369]	[0.448]	[0.369]
$\Delta\tilde{d}^*_{ikt}$	1.326***	0.949**	1.323***	0.948**	1.326***	0.949**
	[0.451]	[0.388]	[0.452]	[0.388]	[0.451]	[0.388]
$\Delta\tilde{b}_{ikt}$	-5.662	6.414	-5.575	6.423	-5.662	6.414
	[12.000]	[10.323]	[12.013]	[10.334]	[12.000]	[10.323]
$\Delta\tilde{d}_{ikt}$	-4.873	-7.922	-4.938	-7.928	-4.873	-7.922
	[9.753]	[8.373]	[9.763]	[8.379]	[9.753]	[8.373]
F-test	2.580	2.300	2.550	2.300	2.580	2.300
p-value	0.036	0.057	0.038	0.057	0.036	0.057
			Second stage			
Dependent variable:	Δl_{ikt}		Δw_{ikt}		Δh_{ikt}	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\check{x}_{ikt}$	0.590***	0.359**	-0.039	0.068	0.147**	0.061
	[0.221]	[0.158]	[0.147]	[0.118]	[0.074]	[0.047]
$\Delta\check{m}_{ikt}$	0.091	0.179	-0.228^{*}	-0.224	-0.123^{**}	0.034
	[0.182]	[0.192]	[0.121]	[0.143]	[0.061]	[0.057]
Controls	YES	YES	YES	YES	YES	YES
Region fixed effects	NO	YES	NO	YES	NO	YES
Sector fixed effects	NO	YES	NO	YES	NO	YES
Time fixed effects	NO	YES	NO	YES	NO	YES
Region-time fixed effects	YES	NO	YES	NO	YES	NO
Region-sector fixed effects	YES	NO	YES	NO	YES	NO
No. of observations	1,273	1,273	1,272	1,272	1,273	1,273
R^2	0.169	0.028	0.239	0.041	0.176	0.054

Notes: Two-stage least squares estimation. F-test refers to the joint significance of the instrumental variables in the first stage. ***significant at the 1% level, **significant at the 5% level, *significant at the 10% level. Standard errors in parenthesis.

Using two endogenous variables in the two-stage least squares estimation indicates that the – quantitatively and statistically – dominant channel through which trade shocks impact local labor-market outcomes is export exposure. Simultaneously increasing imports and exports of a Turkish region-sector affects employment in a statistically significant positive way, while the net-effect on hours worked is close to zero. Negative wage effects appear exclusively driven by import-competing trade shocks and are not counteracted by export shocks.

In Appendix 3.6.3 we present results for regressions which exclusively focus on import competition, i.e., ignoring export competition. In contrast to the estimation above, we find that increased import competition has no significant effect on any of the labor market outcomes in that analysis.

3.5 Conclusion

This paper assesses the causal effects of a change in trade openness on local labor markets in a transition country, Turkey. In developed economies most – though not all – of the trade-related labor-market effects emerge through the import-competition channel and are related to trade with lower-cost/lower-income economies. In a transition economy such as Turkey, it seems that the import competing channel is much more limited and most of the labor-market effects are driven by increased export exposure. Competition effects from third countries on Turkish export markets have a cushioning effect on the country's labor-market outcomes in accordance with theoretical expectations.

Economic analyses as the one conducted in this paper are potentially important complements to the existing literature which is largely focused on developed economies and import competition. Trade shocks can potentially lead to much greater adjustments in developing countries as these countries' resilience is much lower and labor markets are much more dynamic than in the developed part of the world. Thus, economic and policy concerns related to openness may even be more pertinent in such economies than in developed countries, where they recently received much public attention.

3.6 Appendix

3.6.1 Data description

This appendix describes the data sources and data construction we use in the paper. The 175 countries included in our dataset are: Albania, Algeria, Andorra, Angola, Antigua and Barbuda, Aruba, United Arab Emirates, Argentina, Armenia, Australia, Austria, Azerbaijan, Bangladesh, Bahrain, Bahamas, Belarus, Belize, Benin, Bermuda, Bhutan, Bolivia, Botswana, Brazil, Bosnia and Herzegovina, Brundi, Brunei Darussalam, Burkina Faso, Bulgaria, Cambodia, Cameroon, Canada, Cape Verde, Central African Republic, Chile, China, Congo, Colombia, Costa Rica, Crotia, Czech Republic, Djibouti, Dominica, Dominican Republic, Denmark, Ecuador, Egypt, Estonia, Ethiopia, Faroe Islands, Finland, Fiji, France, French Polynesia, Gambia, Georgia, Germany, Ghana, Greece, Greenland, Guatemala, Guinea, Guyana, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kiribati, Korea, Kuwait, Kyrgyzstan, Lao People's Democratic Republic, Latvia, Lebanon, Lithuania, Luxembourg, Macao, Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mayotte, Mexico, Moldova, Mongolia, Mozambique, Montserrat, Morocco, Myanmar, Namibia, Nepal, Netherlands, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Russia, Rwanda, El Salvador, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Slovakia, Slovenia, Solomon Islands, South Africa, Spain, Sri Lanka, Sudan, Suriname, Syrian Arab Republic, Sweden, Switzerland, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Kingdom, United Republic of Tanzania, United States, Uruguay, Vietnam.

In Turkey, we distinguish 26 NUTS 2 regions and 40 Nace Rev.2 2-digit sectors. The analysis generally covers annual data for the years 2007-2017.

Table 3.7: Classification of economic activities

Sector	NACE Rev. 2
Agriculture	01
Forestry and logging	02
Fishing and aquaculture	03
Mining of coal and lignite	05
Extraction of crude petroleum and natural gas	06
Mining of metal ores	07
Other mining and quarrying	08
Manufacture of food products	10
Manufacture of beverages	11
Manufacture of tobacco products	12
Manufacture of textiles	13
Manufacture of wearing apparel	14
Manufacture of leather and related products	15
Manufacture of wood and of products of wood and cork, except furniture	16
Manufacture of paper and paper products	17
Printing and reproduction of recorded media	18
Manufacture of coke and refined petroleum products	19
Manufacture of chemicals and chemical products	20
Manufacture of basic pharmaceutical products	21
Manufacture of rubber and plastic products	22
Manufacture of other non-metallic mineral products	23
Manufacture of basic metals	24
Manufacture of fabricated metal products, except machinery and equipment	25
Manufacture of computer, electronic and optical product	26
Manufacture of electrical equipment	27
Manufacture of machineryand equipment n.e.c.	28
Manufacture of motor vehicles, trailers and semi-trailers	29
Manufacture of other transport equipment	30
Manufacture of furniture	31
Other manufacturing	32
Electricity, gas, steam and air conditioning supply	35
Sewerage	37
Waste collection, treatment and disposal activities	38
Publishing activities	58
Architectural and engineering activities	71
Other professional, scientific and technical activities	74
Creative, arts and entertainment activities	90
Libraries, archives, museums and other cultural activities	91
Other personal service activities	96

Table 3.8: Classification and NUTS 3 coverage of NUTS 2 Regions

NUTS 2 codes	NUTS 2 Regions	NUTS 3 Regions (provinces)
TR10	İstanbul	İstanbul
TR21	Tekirdağ	Tekirdağ, Edirne, Kırklareli
TR22	Balıkesir	Balıkesir, Çanakkale
TR31	İzmir	İzmir
TR32	Aydın	Aydın, Denizli, Muğla
TR33	Manisa	Manisa, Afyonkarahisar, Kütahya, Uşak
TR41	Bursa	Bursa, Eskişehir, Bilecik
TR42	Kocaeli	Kocaeli, Sakarya, Düzce, Bolu, Yalova
TR51	Ankara	Ankara
TR52	Konya	Konya, Karaman
TR61	Antalya	Antalya, Isparta, Burdur
TR62	Adana	Adana, Mersin
TR63	Hatay	Hatay, Kahramanmaraş, Osmaniye
TR71	Kırıkkale	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir
TR72	Kayseri	Kayseri, Sivas, Yozgat
TR81	Zonguldak	Zonguldak, Karabük, Bartın
TR82	Kastamonu	Kastamonu, Çankırı, Sinop
TR83	Samsun	Samsun, Tokat, Çorum, Amasya
TR90	Trabzon	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane
TRA1	Erzurum	Erzurum, Erzincan, Bayburt
TRA2	Ağrı	Ağrı, Kars, Iğdır, Ardahan
TRB1	Malatya	Malatya, Elazığ, Bingol, Tunceli
TRB2	Van	Van, Muş, Bitlis, Hakkari
TRC1	Gaziantep	Gaziantep, Adıyaman, Kilis
TRC2	Şanlıurfa	Şanlıurfa, Diyarbakır
TRC3	Mardin	Mardin, Batman, Şırnak, Siirt

Notes: This table shows the aggregation of all (NUTS 3-level) provinces to the corresponding NUTS 2 regions. There are 81 (NUTS 3-level) provinces and 26 (NUTS 2-level) regions in total.

3.6.2 Export competition: Heterogeneous effects

We investigate different dimensions of the heterogeneity of employment responses to export changes. In particular, we split the data in the sector-region dimension in terms of skill-, female-, and young-worker-intensity in employment to investigate skill-, gender-, and age-related dimensions of this heterogeneity. Specifically, we define the respective cutoffs in terms of the median ratio of skilled workers, of female workers, and young workers across sector-region pairs.[11] We present the results exclusively for the preferred second-stage regression as given by Equations (3.14) and (3.15) for the sake of brevity.

The results in Table 3.9 suggest that the adjustments of employment in response to export competition mainly happen in sectors which use men intensively in production.

Table 3.9: Two-stage least squares: Employment effects of export competition

	Second stage					
Dependent variable: Δl_{ikt}	High skill-intensive	Low skill-intensive	Female-intensive	Male-intensive	Youth-intensive	Elder-intensive
$\Delta\hat{x}_{ikt}$	0.218	-0.226	-0.447	0.339*	0.303	0.254
	[0.140]	[0.302]	[0.804]	[0.199]	[0.748]	[0.163]
female_{ikt}	0.042	0.003	0.002	0.669	-0.001	-0.010
	[0.093]	[0.004]	[0.006]	[0.548]	[0.008]	[0.009]
skilled_{ikt}	0.035	0.271	-0.119	0.854*	0.076	0.159
	[0.087]	[1.179]	[0.155]	[0.464]	[0.165]	[0.145]
youth_{ikt}	0.189	0.131	0.007	0.196	0.088	0.395
	[0.130]	[0.129]	[0.198]	[0.142]	[0.130]	[0.359]
Region-time fixed effects	YES	YES	YES	YES	YES	YES
Region-sector fixed effects	YES	YES	YES	YES	YES	YES
No. of observations	615	676	651	640	667	624
R^2	0.398	0.565	0.220	0.450	0.447	0.425

Notes: Two-stage least squares estimation. Sample was split at the median into high- vs. low-skill-intensive, female- vs male-intensive, and young- vs. elder-intensive region-sector-years. F-test refers to joint significance of the first-stage instrumental variables. ***significant at the 1% level, **significant at the 5% level, *significant at the 10% level. Standard errors in parenthesis.

3.6.3 Import competition

OLS approach

Before turning to IV regressions for import competition, let us again present results based on ordinary-least-squares regressions in Table 3.10, which is organized in a similar way as Table 3.3. As can be seen from the parameter on the (log-differenced) import variable of interest, Δm_{ikt}, the results do not point to any significant effect of import competition on region-sector labor-markets outcomes, when assuming exogeneity of the import variable.

[11] The interquartile ranges (IQR) for the female, youth, and high-skill variables in the year 2017 are 0.560, 0.309, and 0.692, respectively. These correspond to 0.141, 0.539, and 0.395 times the standard deviation of the respective variables, which indicates sufficient variation to identify heterogeneous effects.

Table 3.10: OLS: Labor-market effects of import competition

Dependent variable:	Δl_{ikt}		Δw_{ikt}		Δh_{ikt}	
	(1)	(2)	(3)	(4)	(5)	(6)
Δm_{ikt}	0.011	0.010	-0.002	-0.001	-0.002	0.000
	[0.012]	[0.009]	[0.010]	[0.007]	[0.004]	[0.003]
female_{ikt}	-0.000	0.002	-0.005^{**}	-0.005^{***}	-0.001	-0.001^{*}
	[0.003]	[0.002]	[0.002]	[0.001]	[0.001]	[0.000]
skilled_{ikt}	-0.000	-0.003	0.017	0.014	-0.002	0.000
	[0.028]	[0.025]	[0.023]	[0.020]	[0.010]	[0.008]
youth_{ikt}	0.135	0.121^{***}	-0.040	-0.031	-0.008	0.008
	[0.062]	[0.041]	[0.050]	[0.032]	[0.020]	[0.014]
Region fixed effects	NO	YES	NO	YES	NO	YES
Sector fixed effects	NO	YES	NO	YES	NO	YES
Time fixed effects	NO	YES	NO	YES	NO	YES
Region-time fixed effects	YES	NO	YES	NO	YES	NO
Region-sector fixed effects	YES	NO	YES	NO	YES	NO
No. of observations	1,367	1,367	1,366	1,366	1,367	1,367
R^2	0.370	0.082	0.360	0.122	0.432	0.130

Notes: OLS estimation. ***significant at the 1% level, **significant at the 5% level, *significant at the 10% level. Standard errors in parenthesis.

IV approach

Table 3.11 summarizes the corresponding estimation results when considering imports as endogenous. In the first-stage regressions the coefficient of the direct IV is positive and statistically significant when using separate region-, sector-, and time-fixed effects. Using the alternative fixed effect specifications in columns (1), (3), and (5) turns the coefficients insignificant and even reverse their signs. In none of the specifications the indirect IV is statistically significant.[12] In contrast to Autor et al. (2016), the change in trade frictions might be too small to cause significant and

[12] Intuitively, in a static world (without output adjustments) an import-competing trade shock in a country j can (one-to-one) divert previous exports between country n and region i towards country j. But as firms in country n can adjust their output the effect on Turkish imports from country n should be very limited.

consistent changes in imports over the covered time span.[13] This is also reflected in the second-stage estimation results in the lower part of Table 3.11. An increase in Turkish import growth only displays a negative effect on changes in employment, real wages, and average hours worked in columns (1), (3) and (5), respectively. It is not statistically significant in any of the specifications (columns) and only has a negative sign in the specification for which both IVs are statistically insignificant. Thus, import competition does not appear to be a major channel through which openness affects Turkish labor markets. In comparison to the China shock on the United States, Turkey was not affected by a major import competition shock during the period of investigation, and in such "normal" times, a country such as Turkey appears to mainly respond to changes in openness through export competition.

[13] The Chinese trade shock might have been a unique trade-policy experience which was not only a one-time event, but also focused on the United States in its effect.

Table 3.11: Two-stage least squares: Effects of import competition on labor-market outcomes

	First stage					
Dependent variable: Δm_{ikt}	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\tilde{d}_{ikt}$	0.175	-0.088	0.170	-0.090	0.175	-0.088
	[0.461]	[0.412]	[0.462]	[0.412]	[0.461]	[0.412]
$\Delta\tilde{d}^{*}_{ikt}$	-16.388	19.932*	-16.320	19.968*	-16.388	19.932*
	[11.564]	[10.643]	[11.573]	[10.651]	[11.564]	[10.643]
female$_{ikt}$	-0.000	-0.004	-0.000	-0.005	-0.000	-0.004
	[0.007]	[0.006]	[0.007]	[0.006]	[0.007]	[0.006]
skilled$_{ikt}$	-0.048	-0.118	-0.048	-0.099	-0.048	-0.118
	[0.141]	[0.122]	[0.141]	[0.123]	[0.141]	[0.122]
youth$_{ikt}$	0.220	0.168	0.224	0.207*	0.220	0.168
	[0.153]	[0.112]	[0.153]	[0.112]	[0.153]	[0.112]
F-test	1.040	1.930	1.040	1.930	1.040	1.930
p-value	0.353	0.146	0.355	0.145	0.353	0.146
	Second stage					
Dependent variable:	Δl_{ikt}		Δw_{ikt}		Δh_{ikt}	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\check{m}_{ikt}$	-0.637	0.478	-0.156	0.073	-0.191	0.095
	[0.544]	[0.302]	[0.252]	[0.151]	[0.162]	[0.079]
female$_{ikt}$	-0.001	0.003	-0.005^{*}	-0.004^{**}	-0.001	-0.001
	[0.005]	[0.004]	[0.003]	[0.002]	[0.002]	[0.001]
skilled$_{ikt}$	-0.036	0.055	0.118**	0.095**	0.026	0.014
	[0.114]	[0.081]	[0.053]	[0.040]	[0.033]	[0.021]
youth$_{ikt}$	0.266	0.038	-0.012	-0.042	0.041	0.004
	[0.166]	[0.086]	[0.077]	[0.043]	[0.049]	[0.022]
Region fixed effects	NO	YES	NO	YES	NO	YES
Sector fixed effects	NO	YES	NO	YES	NO	YES
Time fixed effects	NO	YES	NO	YES	NO	YES
Region-time fixed effects	YES	NO	YES	NO	YES	NO
Region-sector fixed effects	YES	NO	YES	NO	YES	NO
No. of observations	1,289	1,289	1,288	1,288	1,289	1,289
R^2	0.057	0.011	0.291	0.088	0.126	0.028

Notes: Two-stage least squares estimation. instrumental variables in the first stage. ***significant at the 1% level, **significant at the 5% level, *significant at the 10% level. Standard errors in parenthesis.

Heterogeneous effects

In Table 3.12 we investigate whether there is some heterogeneity about the employment effects in terms of skilled- versus unskilled-intensive and female- versus male-intensive region-sector tuples. For this analysis, we again split the data akin to the previous subsection. However, it turns out that in none of the respective sub-samples we find a statistically significant effect of import competition on the respective subsets of the Turkish labor market.

Table 3.12: Two-stage least squares: Employment effects of import competition

		Second stage				
Dependent variable: Δl_{ikt}	High skill-intensive	Low skill-intensive	Female-intensive	Male-intensive	Youth-intensive	Elder-intensive
$\Delta\hat{m}_{ikt}$	0.808	0.009	0.163	1.942	-0.680	-0.485
	[0.719]	[0.185]	[0.194]	[2.537]	[1.476]	[0.348]
female_{ikt}	0.159	0.001	0.003	0.102	-0.003	-0.013
	[0.184]	[0.003]	[0.004]	[0.892]	[0.007]	[0.010]
skilled_{ikt}	0.026	0.107	-0.056	0.363	-0.121	0.011
	[0.114]	[1.194]	[0.075]	[0.536]	[0.007]	[0.133]
youth_{ikt}	0.024	0.192	-0.114	0.140	0.318	0.187
	[0.234]	[0.101]	[0.129]	[0.302]	[0.503]	[0.394]
Region-time fixed effects	YES	YES	YES	YES	YES	YES
Region-sector fixed effects	YES	YES	YES	YES	YES	YES
No. of observations	614	675	651	638	666	623
R^2	0.276	0.570	0.525	0.126	0.245	0.325

Notes: Two-stage least squares estimation. Sample was split at the median into high- vs. low-skill-intensive, female- vs male-intensive, and young- vs. elder-intensive region-sector-years. ***significant at the 1% level, **significant at the 5% level, *significant at the 10% level. Standard errors in parenthesis.

Chapter 4

MNE and Exporter Wage Premium: France

Staying at the intersection point between trade and labor economics literature, the relationship between firms' international activities and wage inequality has been the center of attention for a long time. Wage inequality may be the outcome of two alternative mechanisms at work: specialization forces and comparative advantage on the one hand, whereby workers in some (firms and) sectors win while others lose in labor markets with some frictions; and premia paid to workers of firms which gain from globalization relative to others even within sectors.

In this study, we explore the heterogeneity in wage premia among MNEs and exporters relying on French firm-level data covering years between 2007 and 2012. With an interest in the three firm-status-related wage premia (relative to non-exporting domestic firms) we classify firms as: exporting domestic firms (E), non-exporting MNE firms (M), exporting MNEs (ME), and the remainder reference category (non-exporting domestic firms). As France is a well-developed country with many MNEs and exporting firms, we believe that it is very suitable for our analysis. Building on the ideas of Wooldridge (1995) in treating self-selection in the context of a selection-on-observables framework, we formulate a panel-data endogenous-treatment-effects model with the aforementioned three status (in comparison to non-exporting domestic firms) to estimate the effect of (switching the status of) global-market participation on the average wages paid by French firms.

A significant body of literature has focused on confirming the existence of wage premia and justifying it with theoretical explanations. On the one hand, recent studies on global-market-participation-related wage premia indeed found considerable wage premia for exporters and MNEs; see Eaton et al. (2011)). Egger et al. (2013), Baumgarten (2013), Klein et al. (2013), Ayumu et al. (2015), Helpman et al. (2017) and Schröder (2018) Feliciano and Lipsey (2006), Lipsey (2004), Conyon et al. (2002), Girma et al. (2001),Chen et al. (2011), Sjöholm and Lipsey (2006), Saglam and Sayek (2011), while Becker et al. (2013), Eckel and Egger (2009) find that MNEs pay lower wages thanks to their stronger bargaining power with trade unions. Also, Egger and Kreickemeier (2013) find that wage premium is fully explained by firm characteristics; while Heyman et al. (2007) find that foreign wage premium is significantly reduced if we control for employee characteristics. Also, Schank et al. (2010) point out, self selection into exporting- and MNE-status is an issue and needs to be properly controlled for. Almeida (2007) finds that foreign procurement of domestic firms have little effect on average wages in the acquired firms. Girma and Görg (2007) find significant differences in the post-acquisition wage effect depending on the nationality of the foreign acquirer and the skill level of the workers.

So far, the empirical research on wage premia has rather looked at MNEs and exporters as a whole without classifying them as MNE-only and exporting-only firms except for a few studies like Ayumu et al. (2015) and Schröder (2018). We believe that it is of crucial importance to abstract the two from each other in order to be able to assess each state's to contribution to wage inequality in the right direction. Because exporters are generally associated with higher productivity we expect them to pay higher wages. Having said this, MNEs are most likely to be more productive than an average firm and also likely to export (see Aitken et al. (1997)). However, concerning wages, for MNEs there are two confounding factors. On the one hand, likewise exporters, MNEs are expected to be more productive and hence associated with higher wages as well (see Aitken et al. (1996), Dunne et al. (2009), Lipsey and Sjöholm (2004)). On the other hand, the main attraction point for low-cost seeking MNEs is self-explanatory – low costs – and regarding this aspect, government policies in the host country play a crucial role (see Amiti and Javorcik (2008), Cheng and Kwan (2000), Head and Ries (1996)). Therefore, if government policies are so strict that MNEs cannot achieve low production costs due to local enforcements like trade unions, MNEs might choose to invest in another location. As MNEs are more flexible in terms of location and investment opportunities than that of non-MNEs, they can simply make use of it to improve their bargaining power. Therefore, regarding MNEs the wage premia question is more puzzling than it seems. Ultimately, this is an empirical issue about which one of the productivity and the bargaining effects will dominate.

This paper contributes to the mentioned literature in two ways: (i) it formulates a four-treatment design where selection into exporting-only, multinational-firm-activity-only, and exporting-and-multinational-activity against the contrast of non-exporting domestic firms can generate a specific wage premium each; (ii) it casts this design in the context of a panel-data model with multiple endogenous treatments which is inspired by the approach of Wooldridge (1995) which had been designed for sample-selection problems with panel data. Using data on French firms, we find that it is primarily exporting – both by domestic firms and MNEs – which generates wage premia. MNE-only firms tend to undercut wages below the ones in domestic non-exporting firms in the data at hand.

The empirical analysis is largely in line with the theoretical predictions. We find that being an exporter, either an MNE or non-MNE contributes to wage premia significantly, after controlling for firm chracteristics such as firm size and age. This confirms the findings of most studies in trade literature. On the other hand, our findings suggest that non-exporting MNEs are associated with lower wages. As already mentioned, this can be explained by the stronger power of low-cost seeking MNEs in terms of wage bargaining with local units such as trade unions (see Eckel and Egger (2009)).

The paper is organized as follows. The subsequent section describes the data. Section 4.2 outlines the econometric framework and presents the empirical findings. Finally, Section 4.3 concludes.

4.1 Data description

4.1.1 Sample statistics

We use French firm-level data from Bureau van Dijk's Orbis database as it provides a very detailed balance sheet information as well as a classification of MNEs and exporting firms. We drop the observations with missing values, and then we are left with 662,029 firm-year observations for the period between 2007 and 2012, in total. Out of these observations, 7,761 firms are MNEs and 126,647 firms are exporters. Among those MNEs, 79% of the firms are exporters; and among exporters almost 5% are MNEs. Figure 4.1 shows the composition of the sample in terms of MNEs and exporters in detail.

Table 4.1: Composition of the sample

	Exporter	Non-exporter	Total
MNE	6,163	1,598	7,761
Non-MNE	120,484	533,784	654,268
Total	126,647	535,382	662,029

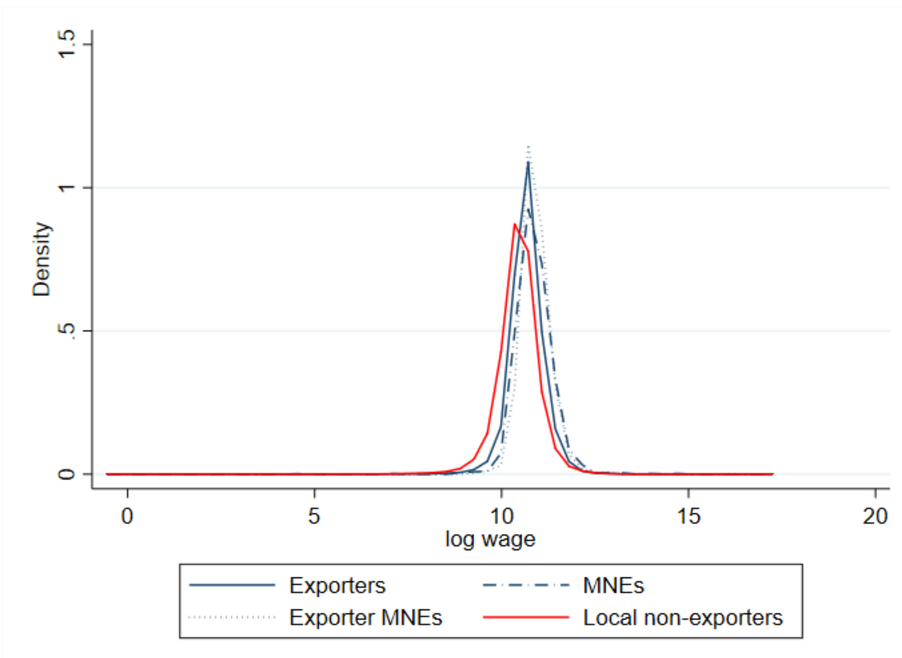
Table 4.2 summarizes average yearly wages by firm types between 2007-2012. As Melitz (2003), and Melitz and Ottaviano (2008) would predict exporters or MNEs that engage in exporting pay higher wages.

Table 4.2: Average (yearly) wages by firm-type

	Exporter	Non-exporter	Total
MNE	70,335	77,604	71,832
Non-MNE	48,876	40,268	41,854
Total	49,921	40,380	42,205

Figure 4.1 shows the kernel density of lof wage in the sample for the four categories: Exporter-only firms, MNE-only firms, exporting MNEs, and local firms which only serve in domestic markets. The figure supports the descriptive evidence from Table 4.2, that exporters and MNEs on average pay higher wages than locals. However, together with Table 4.2, Figure 4.1 underlines the importance of differentiating MNEs and exporters while exploring the implications on wage premia.

Figure 4.1: Kernel density function



Notes: The figure shows the kernel density of log wage distribution in the sample by firm types, i.e. Exporters, MNEs, and local firms. Exporters include exporting non-MNEs. MNEs include foreign-owned or domestic MNEs which do not export. Exporter MNEs are MNEs involved in exports. Local non-exporters include domestic firms which do not engage in export activities. The Kernel is Epanechnikov and the Kernel width is the default one by Stata.

4.1.2 Classification of firms

We classify firms as exporters which report positive export revenues for the corresponding year. MNEs are either domestic firms under foreign ownership or domestic firms reporting foreign investments (operating in other countries as well as France). As Orbis contains detailed information at the firm level, we can clearly identify exporting firms and MNEs. As already mentioned, we single out MNEs and exporters. Overall, we have four categories of firms (of which three – Exporters-only, MNEs-only, Exporting MNEs) are of interest):

1. *Exporters-only*: Firms which are not MNEs (domestically owned) and participate in international markets.

2. *MNEs-only*: Firms either domestically owned and report outward FDI or domestically operating firms under foreign ownership.

3. *Exporting MNEs*: Firms that are classified as MNEs and engage in export activities.

4. *Local non-exporting firms*: Firms domestically owned and do not report positive export revenues.

4.1.3 Variable descriptions

Wage Yearly wages are calculated by dividing the value of wage bill of the firm by the number of employees. Wage bills are reported in USD and are provided from Orbis database.

Productivity Productivity is estimated using a Levinsohn and Petrin (2003) procedure which estimates production function using intermediate inputs to control for unobservable productivity shocks.

Sectoral margin We calculate sectoral margin by simply dividing total sectoral (NACE Rev. 2, 2 digits) profits before tax by total sectoral sales.

Tangible fixed assets Tangible fixed assets refer to assets that have a physical value such as building or machinery. We obtain the value of tangible fixed assets from Orbis database.

Intangible fixed assets Intangible assets are operational assets like patents, copyrights, trademarks, that do not include physical substance. We obtain the value of intangible fixed assets from Orbis database.

Firm age We compute firm age by taking the difference between the foundation year of the firm and the current year of the analysis.

Combining the aforementioned data we construct a panel containing information of almost 94,575 firms (per year) for the years 2006–2012. Table 4.3 summarizes the descriptive statistics for variables used in the analysis.

Table 4.3: Descriptive statistics

	Mean	Std. dev.	Min.	Max.	No. obs.
wage (USD)	42,205	78,312	0.585	30.4 mil.	662,029
productivity	699.620	9422.856	0.729	2.5 mil.	662,029
sectoral margin	0.071	0.045	0.000	2.491	662,029
intangible fixed assets (USD)	446,104	22.7 mil.	1	10,800 mil.	662,029
tangible fixed assets (USD)	1.1 mil.	91.7 mil	1	4,280 mil.	662,029
firm age	14	13	1	220	662,029

4.2 Econometric strategy

We build on the self-selection approach for panel data by Wooldridge (1995) and modify it to a setting with four mutually exclusive endogenous treatments as regressors of interest in a regression with log firm-level average wages per worker as the dependent variable. With an interest in the three firm-status-related wage premia (relative to non-exporting domestic firms) we classify firms as: exporting domestic firms (E), non-exporting MNE firms (M), exporting MNEs (ME), and the remainder reference category (non-exporting domestic firms). It is important to note that M and ME firms may be owned domestically or abroad, as in Table 4.1.

Let us denote log wages as of firm i in year t by y_{it}. Moreover, denote the three indicator variables of firm status $v \in \{E, M, ME\}$ by s_{it}^v. Finally, denote the explanatory variables determining (the net profitability of) treatment v by Z_{it}^v and the explanatory variables of outcome apart from the treatment indicators by X_{it}. We will consider selection equations of the form

$$\ell_{it}^v = Z_{it}^v \beta_t^v + \varepsilon_{it}^v, \tag{4.1}$$

where ℓ_{it}^v is a latent variable, net profitability of selecting treatment s_{it}^v,[1] and an outcome equation of the form

[1] What we postulate is that $P(\ell_{it}^v > 0) = P(s_{it}^v = 1 | Z_{it}^v)$.

$$y_{it} = \left(\sum_{v \in \{E,M,ME\}} \alpha^v s^v_{it} \right) + X_{it}\gamma + u_{it}, \tag{4.2}$$

where ε^v_{it} and u_{it} denote first- and second-stage residuals, β^v_t time-specific first-stage parameters, α^v are the average treatment effects of interest, and γ are parameters on second-stage control variables.

By mutual exclusivity of the three treatment indicators and their endogeneity, the symmetric variance-covariance matrix of the residuals $\zeta_{it} = (\varepsilon^E_{it}, \varepsilon^M_{it}, \varepsilon^{ME}_{it}, u_{it})'$ for any time period t reads

$$E(\zeta_{it}\zeta'_{it}) \quad = \quad \begin{bmatrix} 1 & \rho_{\varepsilon^E_{it},\varepsilon^M_{it}} & \rho_{\varepsilon^E_{it},\varepsilon^{ME}_{it}} \\ \rho_{\varepsilon^E_{it},u_{it}} & & \\ \rho_{\varepsilon^M_{it},\varepsilon^E_{it}} & 1 & \rho_{\varepsilon^M_{it},\varepsilon^{ME}_{it}} \\ \rho_{\varepsilon^M_{it},u_{it}} & & \\ \rho_{\varepsilon^{ME}_{it},\varepsilon^E_{it}} & \rho_{\varepsilon^{ME}_{it},\varepsilon^M_{it}} & 1 \\ \rho_{\varepsilon^M_{it},u_{it}} & & \\ \rho_{u_{it},\varepsilon^E_{it}} & \rho_{u_{it},\varepsilon^M_{it}} & \rho_{u_{it},\varepsilon^M_{it}} \\ 1 & & \end{bmatrix}. \tag{4.3}$$

We follow Wooldridge (1995) and estimate a probit model for each time period separately. Denoting the inverse-Mill's ratio for endogenous treatment v and observation $\{it\}$ by λ^v_{it}, what will be estimated as the outcome equation is

$$y_{it} = \left(\sum_{v \in \{E,M,ME\}} \alpha^v s^v_{it} + \rho^v_t \lambda^v_{it} \right) + X_{it}\gamma + \left(\sum_{h=1}^{T} X_{ih}\pi_h \right) + \varepsilon^y_{it}, \tag{4.4}$$

where expression $\left(\sum_{h=1}^{T} X_{ih}\pi_h\right)$ represents the Mundlak-Chamberlain-Wooldridge-type control function of the individual effects.

4.2.1 Probit estimates

Tables 4.4 presents the results regarding probit regressions (see Equation (4.2)) for being exporter-only firms. Each column of a table gives the estimation results for a different year.Firm age and capital have a significant positive impact on export status in all years, while sectoral margin and intangible fixed assets have negative significant effects for all years.

Table 4.4: Probit results: Exporters-only

Dependent variable: E	2007	2008	2009	2010	2011	2012
log Productivity	0.034***	0.016***	0.047***	0.031***	0.049***	0.027***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)
log Sectoral profit margin	−0.238***	−0.065***	−0.207***	−0.138***	−0.197***	−0.075***
	(0.009)	(0.011)	(0.011)	(0.010)	(0.010)	(0.011)
log Intangible assets	−0.020***	−0.026***	−0.026***	−0.030***	−0.029***	−0.030***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
log Tangible assets	0.118***	0.115***	0.108***	0.100***	0.109***	0.111***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
log Firm age	0.232***	0.241***	0.233***	0.243***	0.236***	0.252***
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Nb. of obs.	116,244	109,831	106,858	122,970	118,523	87,603
Pseudo R^2	0.076	0.070	0.070	0.065	0.069	0.069

Notes: Standard errors are block bootstrapped with firm blocks. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively.

Tsble 4.5 shows results for MNEs-only. Firm age, intangible fixed assets and capital have a significant positive impact on export status in all years.

Table 4.5: Probit results: MNE-only

Dependent variable: M	2007	2008	2009	2010	2011	2012
log Productivity	0.111***	0.118***	0.134***	0.110***	0.131***	0.102***
	(0.020)	(0.019)	(0.020)	(0.022)	(0.019)	(0.021)
log Sectoral profit margin	0.056	0.056	0.022	0.035	0.058	0.086**
	(0.048)	(0.045)	(0.047)	(0.042)	(0.048)	(0.056)
log Intangible assets	0.058***	0.058***	0.075***	0.072***	0.059***	0.047***
	(0.010)	(0.011)	(0.012)	(0.011)	(0.012)	(0.014)
log Tangible assets	0.182***	0.200***	0.175***	0.166***	0.139***	0.155***
	(0.010)	(0.013)	(0.012)	(0.012)	(0.012)	(0.015)
log Firm age	0.162***	0.172***	0.243***	0.267***	0.214***	0.214***
	(0.027)	(0.030)	(0.032)	(0.032)	(0.030)	(0.030)
Nb. of obs.	116,244	109,831	106,858	122,970	118,523	87,603
Pseudo R^2	0.207	0.232	0.231	0.220	0.157	0.157

Notes: Standard errors are block bootstrapped with firm blocks. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively.

Table 4.6 shows results regarding exporting MNEs. All variables including firm age, sectoral margin, intangible fixed assets and capital have a significant positive impact on export status in all years.

Table 4.6: Probit results: Exporting MNEs

Dependent variable: ME	2007	2008	2009	2010	2011	2012
log Productivity	0.022*	0.005	0.042***	0.039***	0.034**	0.037**
	(0.016)	(0.016)	(0.017)	(0.015)	(0.016)	(0.015)
log Sectoral profit margin	0.075***	0.174***	0.113***	0.111***	0.090***	0.113***
	(0.022)	(0.027)	(0.031)	(0.023)	(0.031)	(0.031)
log Intangible assets	0.072***	0.073***	0.082***	0.077***	0.062***	0.074***
	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.008)
log Tangible assets	0.211***	0.221***	0.215***	0.199***	0.216**	0.217***
	(0.006)	(0.007)	(0.008)	(0.007)	(0.007)	(0.009)
log Firm age	0.282***	0.264***	0.311***	0.332***	0.309***	0.306***
	(0.015)	(0.018)	(0.019)	(0.016)	(0.022)	(0.019)
Nb. of obs.	116,244	109,831	106,858	122,970	118,523	87,603
Pseudo R^2	0.241	0.252	0.261	0.247	0.241	0.243

Notes: Standard errors are block bootstrapped with firm blocks. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively.

As the standard theory on exporting and MNE status predicts, see Helpman et al. (2004), productivity has a positive impact on both exporting-status and MNE-status. In all years, but 2008, productivity has as well a statistically significant positive effect on the exporting-MNE-status.

4.2.2 Wage premium regression estimates

Table 4.7 presents the regression results regarding Equation (4.4).

Table 4.7: Outcome regression results

Dependent variable: y_{it} (log Wage)	(1)	(2)
Exporter-only	0.132^{***}	0.929^{***}
	(0.013)	(0.007)
MNE-only	-0.485^{***}	-0.283^{***}
	(0.066)	(0.061)
Exporter-MNE	0.250^{***}	0.275^{***}
	(0.038)	(0.025)
log Productivity	0.547^{***}	0.190^{***}
	(0.002)	(0.001)
Time fixed effects	NO	YES
Mundlak-Chamberlain-Wooldridge terms	NO	YES
Nb. of obs.	662,029	662,029
F-stat.	15016.850	3592.530
R^2	0.854	0.152

Notes: Model (1) is a standard (firm-)fixed effects model which includes inverse Mill's ratios, and Model (2) is the proposed endogenous-multiple-treatment model. Model (2) parameterizes the firm-fixed effects by Mundlak-Chamberlain-Wooldridge terms for log Productivity, and a constant is included as well. Standard errors are block bootstrapped with firm blocks. The F-test refers to the joint significance of the three inverse Mill's ratios in Model (1) and (2). ***, **, * indicate statistical significance at 1%, 5%, and 10%.

While workers of exporting-only firms and exporting-MNEs enjoy a significant wage premium, employees of MNE-only firms face a negative effect. Our results indicate that the wage premium of MNEs is based less on the MNE-status and much more on the exporting-status of the firm. MNE-only firms are essentially domestically operating firms, quite often sales outlets of foreign headquarters or foreign subsidiaries. It appears that such entities are set up primarily to jump the costs of delivering goods directly from abroad, which appears to introduce a competitive element in wage setting.

The average premia estimated conditional on log firm productivity are relatively large, according to Table 4.7. The results suggest that non-MNE exporters pay premia over comparable non-exporters of $100\exp(0.929) - 100 \approx 153\%$ for their average worker. These results are largely in line with what the theory predicts regarding exporter wage premia (see Bernard et al. (1995), Eaton et al. (2011)). MNE exporters pay a smaller premium of $100\exp(0.275) - 100 \approx 32\%$, and non-exporting MNEs pay an average wage which is $100\exp(-0.283) - 100 \approx 33\%$ lower than that of comparable non-exporting domestic firms. These premia for exporters are larger than the ones reported in Egger et al. (2013) for France. However, the latter paper did not distinguish between the four treatment status considered here, and it relied on cross-sectional rather than fixed-effects panel-regression results.

4.3 Conclusion

This paper contributes to the understanding on how firms' international activity impacts wages. Being able to distinguish exporter and MNE status allows us to identify each state's contribution to wage inequality separately. MNE-only firms are essentially domestically operating firms, quite often sales outlets of foreign headquarters or foreign subsidiaries. It appears that such entities are set up primarily to jump the costs of delivering goods directly from abroad, which appears to introduce a competitive element in wage setting.

Relying on detailed French firm level data, this paper provides empirical evidence for wage premia of exporter-only firms and exporting MNEs after controlling for firm chracteristics. Firms operating in foreign markets pay higher wages than their counterparts, whereas being an MNE is associated with a decline in wage premia in case the firm is an exporter. On the other hand employees working in non-exporting MNEs face negative wage premia.

Moreover, for the interpretation of the premia it is important to note that exporters or exporter-MNEs do not hold the composition of the work force constant so that they include worker-sorting effects. Hence, the meaning of these premia is that firms which are comparable in firm characteristics but have a different status pay different average wages to their work force, but a given worker might not obtain the respective premium when switching firms.

4.4 Appendix

Table 4.8: Probit descriptive statistics

	Probit						Linear					
EXP-only	2007	2008	2009	2010	2011	2012	2007	2008	2009	2010	2011	2012
10%	0.084	0.082	0.069	0.072	0.073	0.084	-1.377	-1.395	-1.484	-1.460	-1.456	-1.376
25%	0.126	0.118	0.100	0.103	0.104	0.119	-1.148	-1.185	-1.284	-1.267	-1.257	-1.182
50%	0.196	0.183	0.153	0.155	0.157	0.176	-0.858	-0.905	-1.023	-1.014	-1.006	-0.931
75%	0.287	0.266	0.230	0.228	0.232	0.254	-0.562	-0.624	-0.740	-0.746	-0.733	-0.660
90%	0.382	0.353	0.312	0.305	0.313	0.337	-0.301	-0.377	-0.490	-0.511	-0.489	-0.421
MNE-only												
10%	0.000	0.000	0.000	0.000	0.000	0.000	-3.722	-3.834	-3.854	-3.796	-3.572	-3.624
25%	0.000	0.000	0.000	0.000	0.000	0.000	-3.483	-3.580	-3.592	-3.535	-3.354	-3.400
50%	0.001	0.001	0.001	0.000	0.001	0.001	-3.203	-3.282	-3.283	-3.227	-3.103	-3.141
75%	0.002	0.002	0.002	0.002	0.002	0.002	-2.872	-2.928	-2.926	-2.878	-2.818	-2.839
90%	0.006	0.005	0.005	0.006	0.006	0.006	-2.528	-2.552	-2.554	-2.513	-2.518	-2.531
MNE&EXP												
10%	0.000	0.000	0.000	0.000	0.000	0.000	-3.500	-3.538	-3.612	-3.507	-3.490	-3.464
25%	0.001	0.001	0.001	0.001	0.001	0.001	-3.182	-3.223	-3.288	-3.193	-3.171	-3.142
50%	0.003	0.002	0.002	0.002	0.003	0.003	-2.799	-2.849	-2.908	-2.823	-2.800	-2.773
75%	0.009	0.008	0.007	0.008	0.009	0.010	-2.367	-2.423	-2.474	-2.403	-2.385	-2.352
90%	0.0269	0.024	0.021	0.024	0.025	0.027	-1.943	-1.982	-2.032	-1.973	-1.953	-1.919

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